

TAXONOMY OF THE FAMILY LOXOGRAMMACEAE CHING EX PIC.-SER. IN INDIA

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A B S T R A C T

The family Loxogrammaceae Ching ex Pic.-Ser. is represented by singular genus *Loxogramme* (Bl.) Presl. in India. Study and scrutiny of the herbarium specimens collected from all over India, and the specimens deposited at the Forest Research Institute, Dehra Dun (DD) and the National Botanical Research Institute, Lucknow (NBRI) together with the photographs of type and authentic specimens, microfiches, protologues etc. established the occurrence of 20 species against 2 species recognised by Beddome (1883, 1892) from the Indian region. It has also been observed that morphologically two populations may be remarkably segregated as larger fronds with monolete spores and smaller fronds with trilete spores. Three new taxa viz. *L. avalanchia* Dixit et Das, *L. mussooriana* Dixit et Das and *L. manipuriensis* Das et Dixit have been described in addition to several new records of species reported by various workers from time to time.

Key to the species, illustrations of diagnostic characters, current nomenclature, description, specimens examined, distribution etc. have been provided for facilitating easy identification.

Key words: Loxogrammaceae in India.

INTRODUCTION

The genus *Loxogramme* (Bl.) Presl. was included by the earlier workers in the family Polypodiaceae, however, Ching (1940) segregated it into the family Loxogrammaceae, but provided description in English. Later, Pichi-Sermoli (1974) validated the taxon by providing Latin transcription. Two genera i.e. *Loxogramme* with 35 species and monotypic *Anarthropteris* were included in the family Loxogrammaceae. Only the genus *Loxogramme* has been reported from the Indian region so far.

Ching (l.c.) considers the Loxogrammaceae allied to families Antrophyaceae and Vittariaceae but recent cytological studies do not support the hypothesis. Nayar (1955) supports an affinity of the genus with *Syngramma* J. Smith but such an opinion is hardly tenable and Nayar (1970) himself changed his views by changing *Loxogramme* as allied to

Polypodieae in order of Gleicheniales and rejected the affinities between Polypodiaceae and Grammitaceae. He suggested the affinities with Thelypteridaceae in the order of Cyatheaales.

The Loxogrammaceae shares some important characters with the Grammitaceae and Polypodiaceae and it seems that Grammitaceae and Polypodiaceae have been evolved from the Loxogrammaceae.

REVIEW OF THE WORK DONE IN INDIA

Beddome (1883), (1892) recognised occurrence of three species of *Loxogramme* from British India, Ceylon and the Malay Peninsula, of which only two species viz. *L. lanceolata* (Sw.) Presl. and *L. involuta* (D. Don) Presl. were reported by Mehra and Bir (1964) from Darjeeling and Sikkim Himalayan regions in India. Later, several workers added more number of species viz. Tagawa (1966) in Hara's

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Flora of Eastern Himalayas added two more species; namely *L. grammitoides* (Bak.) C. Chr. and *L. salicifolia* Makino, Dixit *et al.* (1976) added *L. ramote-frondigera* (Hayata) C. Chr. from Maneybhanjan in Darjeeling. Tagawa (1971) added *L. duclouxii* Christ and *L. chinensis* Ching from Darjeeling Himalayas.

Recently two more species have been added, by Singh and Panigrahi (1985) viz. *L. lankokiensis* (Rossenst.) C. Chr. from Arunachal Pradesh and the other *L. porcata* Price (1990) from Sikkim Himalayas, Nepal and Bhutan. Sledge (1960) concluded that the specimens from South India and Ceylon identified as *L. lanceolata* by Beddome (*l.c.*) represents *L. parallela* (Copel). Further he also referred Commerson and Bojer's specimens from Mauritius and Reunion (Bourbon) referred by Hook. and Grev. (1827), which represent the true *L. lanceolata* (Sw.) Presl. which are available in Kew collections. These remarks of Sledge (*l.c.*) led the authors to examine all the specimens housed at herbarium (CAL) and the regional herbaria of the Botanical Survey of India, Eastern Circle, Shillong; Sikkim Himalayan Circle, Gangtok; Arunachal Field Station, Itanagar; Southern Circle, Coimbatore; Northern Circle, Dehra Dun and Forest Research Institute, Dehra Dun. The scrutiny of the specimens of various Circles of B.S.I. together with the specimens housed at Central National Herbarium, Howrah (CAL) and type/authentic photographs of different species obtained from the various herbaria of the world proved fruitful. The authors segregated the two sets of specimens, one with larger fronds and the other with smaller fronds. After segregation of smaller and larger fronds the authors found that majority of the specimens of smaller fronds belonged to *L. lanceolata* and *L. chinensis*. Type photograph and protologue revealed that *L. lanceolata* is one of the species with smaller fronds. One most important observation made during this study was that all large fronds possessed monolete spores whereas all smaller fronds possessed trilete spores. *L. lanceolata* belongs to monolete group of spores. Thus it has been observed that all the specimens available at CAL have been erroneously identified as *L. lanceolata*. After critical studies and scrutiny

of earlier identified material of *L. lanceolata* and herbarium specimens from South India, the authors have established a new species namely *L. avalanchia* Dixit and Das and four new records for India from North East India namely *L. linearis* Copel., *L. subecostata* (Hook.) C. Chr., *L. assimillis* Ching, *L. elevata* Ching. (*cf.* Dixit and Das, 1993, 1994).

Majority of the ferns with larger fronds from South India are identified as *L. involuta*. Price (1984) made a new combination as *Loxogramme cuspidata* (Zenker) Price from South India. The specimens of *L. cuspidata* were wrongly identified as *L. involuta* in Indian herbaria. The critical examination of *L. involuta* specimens together with literature and type photograph from Kew herbarium revealed that *L. involuta* (D. Don) Presl., is a mixture of species. Price made a new species of *Loxogramme* from Sikkim Himalaya as *L. porcata* Price. Later a number of new taxa and new records of species have been segregated from *L. involuta* complex, namely *L. carinata* Price, *L. wallichiana* (Hook.) Price, *L. mussooriana* Dixit & Das, *L. ensiformis* Ching and *L. manipuriana* Das & Dixit (*cf.* Price, 1990; Dixit & Das 1993A, 1993B, 1993C, 1994A, and 1994B).

The present communication deals with the taxonomic study of 20 species providing key to the species, current nomenclature, description, specimens examined, ecology and illustrations of habit and other diagnostic characters to facilitate easy identification.

MATERIAL & METHODS

The present study is based on the critical study of voucher specimens housed at the Central National Herbarium, Howrah (CAL) and various Regional circles of Botanical Survey of India, the Forest Research Institute, Dehra Dun, microfiches and herbarium specimens of Wallich in CAL and Cibachrome photographs of type and authentic specimens of number of species obtained from the Royal Botanic Garden (Kew).

LOXOGRAMMACEAE

Loxogrammaceae Ching, Sunyantsenia 5: 233. 1940 (*nom. nud.*); Ching ex Pic.-Serm. in Webbia 29(1): 11. 1974; Ching in Acta Phytotax. Sin. 16(3): 1974.

Terrestrial, epiphytic or lithophytic ferns; rhizomes long-creeping or if short bearing masses of roots and scales, narrow lanceolate to lanceolate-oblong, entire, basifixed; cells of basal portion of the scales form long and hair like dorsal protrusions. Stipe short or long, fronds never articulated to rhizomes. Fronds simple, entire, uniform or dimorphic, almost always linear-lanceolate, oblanceolate, thick, somewhat fleshy and flaccid, glabrous, apex usually acuminate or acute, base gradually narrowed to stout stipes. Costa prominent, raised or flat. Veins immersed, forked and anastomosing freely with or without included

veinlets. Sori sub-orbiculate, linear, elongate in a single row on each side. Costa sometimes confluent near the margin, oblique, parallel or sub-parallel to costa, superficial. Spores monolete or trilete. Cytology: X 35, 36, 37.

LOXOGRAMME (Bl.) Presl.

Loxogramme Bl. (Fl. Jav. II. 73. 1828. as section) Presl., Tent. Pterid. 215. t. 9.f.8, 1836.

Genus characters are same as mentioned in the family characters. Species 45 in the world and 20 in India.

KEY TO THE SPECIES

1a. Fronds smaller 1 24 cm × 0.2 2.6 cm:

2a. Fronds dimorphic, vegetative
fronds 1.7 2.0 × 1.0 1.2 cm;
fertile fronds 3.0 - 3.5 × 3.5 - 5.0 mm

... 11. *L. lankokiensis*

2b. Fronds not dimorphic:

3a. Fronds 3 20 cm long:

4a. Fronds lanceolate:

5a. Fronds 3 7 × 3 5 mm

... 9. *L. grammitoides*

5b. Fronds 15 20 cm × 3 11 mm:

6a. Fronds 3 7 mm broad,
margins entire, sori near
the midrib mostly parallel and
confluent

... 15. *L. parallela*

6b. Fronds 9 11 mm broad,
margins distinctly wavy,
sori away from the midrib
reaching near the margins
and distant

... 19. *L. subecostata*

4b. Fronds oblanceolate:

7a. Fronds 5 14 cm × 6 7 mm,
sori confined into upper one
third part of frond and reaching
near the margins

... 4. *L. chinensis*

7b. Fronds 12 14 cm × 10 15 mm,
sori starting just above the
middle of frond and never
reaching margins

... 2. *L. avalanchia*

3b. Fronds 20 24 cm:

- 8a. Fronds linear-lanceolate, 8-10 mm broad, stipe 3-6 mm long ... 12. *L. linearis*
- 8b. Frond lanceolate, 15-20 mm broad, sessile :
- 9a. Fronds 18-20 mm broad, midrib not raised, texture thin, greenish, scales linear lanceolate, reddish brown ... 1. *L. assimilis*
- 9b. Fronds 15-18 mm broad, midrib raised on both the surfaces, texture thick, brownish, scales broadly ovate, pale brown ... 7. *L. elevata*
- 1b. Fronds larger 25-90 cm × 1-6 cm:
- 10a. Stipes long:
- 11a. Stipes purplish black at the base, lamina with long acuminate apex ... 17. *L. remote-frondigera*
- 12a. Stipes 3-4 cm long, lamina 32-40 cm long ... 5. *L. cuspidata*
- 12b. Stipes 5-6 cm long, lamina 47-55 cm long ... 6. *L. duclouxii*
- 11b. Stipe not coloured, lamina acute to acuminate at apex ... 18. *L. salicifolia*
- 10b. Stipes very short or absent:
- 13a. Lamina 25-54 cm long:
- 14a. Lamina lanceolate to linear-lanceolate:
- 15a. Lamina thick, costa raised, scales ovate to linear-lanceolate:
- 16a. Scales long, linear lanceolate, costa very thick, not coloured on drying ... 13. *L. manipuriensis*
- 16b. Scales short, ovate lanceolate, costa not thick, coloured on drying:
- 17a. Leaf margin not cartilaginous but involute ... 10. *L. involuta*
- 17b. Leaf margins cartilaginous, not involute ... 16. *L. porcata*
- 15b. Lamina thin, costa not raised scales broadly ovate-lanceolate ... 14. *L. mussooriana*
- 13b. Lamina 34-90 cm long ... 3. *L. carianata*
- 14b. Lamina oblanceolate:
- 18a. Fronds 25-45 cm long, scales narrowly ovate lanceolate ... 20. *L. wallichiana*
- 18b. Fronds 20-25 cm long, scales broadly ovate-lanceolate ... 8. *L. ensiformis*

1. *Loxogramme assimilis* Ching, in Bull. Deptt. Biol. College Sci. Yatsen Univ. 326. 1932.

Rhizome creeping, densely covered with linear-lanceolate finely pointed, reddish-brown, clathrate scales $3-4 \times 0.4-0.6$ mm.

Fronds simple, lamina linear-lanceolate, $8-30 \times 1.5-2.5$ cm, stipes sub-sessile, acuminate at apex, gradually tapering towards decurrent base; midrib not raised on either sides; texture thin, greenish on drying, margins entire. Sori oblong-linear, in a parallel, oblique line between the margin and the midrib. Spores trilete, $50-60 \mu\text{m}$, verrucoid. (Fig.-I (1-4).

Specimens examined: Wailong, 1750 m, 09.04.1985. Ghosh 5599 (CAL), Manipur, the very hills 2800 m, 19.3.1984, Ghosh 1580 (CAL); Nagaland, Kohima, 1750 m, 12-04-1985, Ghosh 59633 (CAL). Meghalaya, Swer Peak, 17.04.1969. Rao 47436 (CAL); Bengal Bhutan border; Sinchula, 1524-1829 m, 2.3.1934. K. Biswas 1972 (CAL).

Distrib.: INDIA: Manipur, Nagaland, Meghalaya, Bengal, Bhutan border; CHINA.

2. *Loxogramme avalanchia* R.D. Dixit et Silpi Das *sp. nov.* in Bull. Bot. Surv. India 35(1-4): 133. 1993.

Rhizome creeping, scales clathrate, pale brown, ovate-lanceolate, $3-5 \times 0.5-1.0$ mm, smooth along margins. Fronds simple, decurrent up to base, membranaceous, pale-green, $12-14$ cm long and $1.0-1.5$ cm broad, oblanceolate, acute at apex, attenuate at base, margins slightly wavy; midrib raised on the lower surface, pinkish in colour, distinct on upper surface, veins reticulate, areoles with or without included veinlets. Sori usually starting above the middle of lamina, divergent, confined in the middle between midrib and margin. Sori $6-8$ mm long, $2.5-3.0$ mm broad, distant, $2-4$ mm apart, never contiguous; spores yellow, trilete $50-80 \mu\text{m}$ in diameter, verrucoid. Fig. II. (1-4).

Holotypus: SOUTH INDIA-Nilgiri Hills: Avalanchia, Nov. 1883, *s.n.* Accession No. 59932 (MH).

Paratypus: MADRAS -Nilgiri Naduvattam, 2000 m, 25-7-1960, Subramanyam 10582 (MH. dupl. CAL).

The present new species of *Loxogramma* Presl. can easily be distinguished from all other species by the presence of fronds decurrent, up to the base, oblanceolate; sori obliquely divergent, never contiguous, away from midrib and margins, more or less in the middle part of lamina, $2-4$ mm apart, spores always trilete.

Etymology: The species is named after the place of collection *Avalanchia* in Nilgiri hills of South-India.

3. *Loxogramme carinata* Price in Amer. Fern. Journ. 80(1): 4. f.1.90. 1990. Dixit & Das in Indian Fern J. 11: 27-30, 29. figs. 3-4. 1994.

Rhizome thick, creeping, clothed with mass of thick roots and thick scales. Scales fragile, clathrate, dark-brown to black, broadly ovate-lanceolate, apex bristle like, usually broken, $6-10 \times 0.7-1.0$ mm. Fronds $5-10$ mm apart, lamina typically elliptic $34-90 \times 3.5-11.5$ cm, gradually decurrent up to base, long acuminate at apex, tan to chestnut or reddish-brown on drying, margins revolute, surfaces slightly wrinkled. Costa abaxially narrowly and distinctly carinate upto 1 mm, slightly raised on adaxial side, veins visible, reticulate also with included simple or bipinnate veinlets. Sori oblique starting from the base to apical region except acumen, 5 cm long, $4-6$ mm apart, overlapping. Spores monolet, verrucoid $100-106 \times 50-60 \mu\text{m}$. Fig. III (1-4).

Photographs examined: Isotype: E. Malayasia, Sabah, Mt. Kabalu, ulu ulu Langonani, Sungai Momut, 1220 m, 4-0-1961. Chow corner & Staintan 1228 (K).

Specimens examined: SIKKIM Nov. 1850, *s.l.* 24274 (CAL); K. Biswas 9357 (CAL) two specimens; Darjeeling 21-5-1972. R.K. Ghosh 50219 (CAL).

Distrib.: MALAYASIA, INDIA (Darjeeling & Sikkim Himalaya).

The present species can be easily distinguished from all other Indian species by typical elliptic fronds, carinate costa drying tan-chestnut to reddish brown fronds. Sori throughout the frond, except basal and acumen regions.

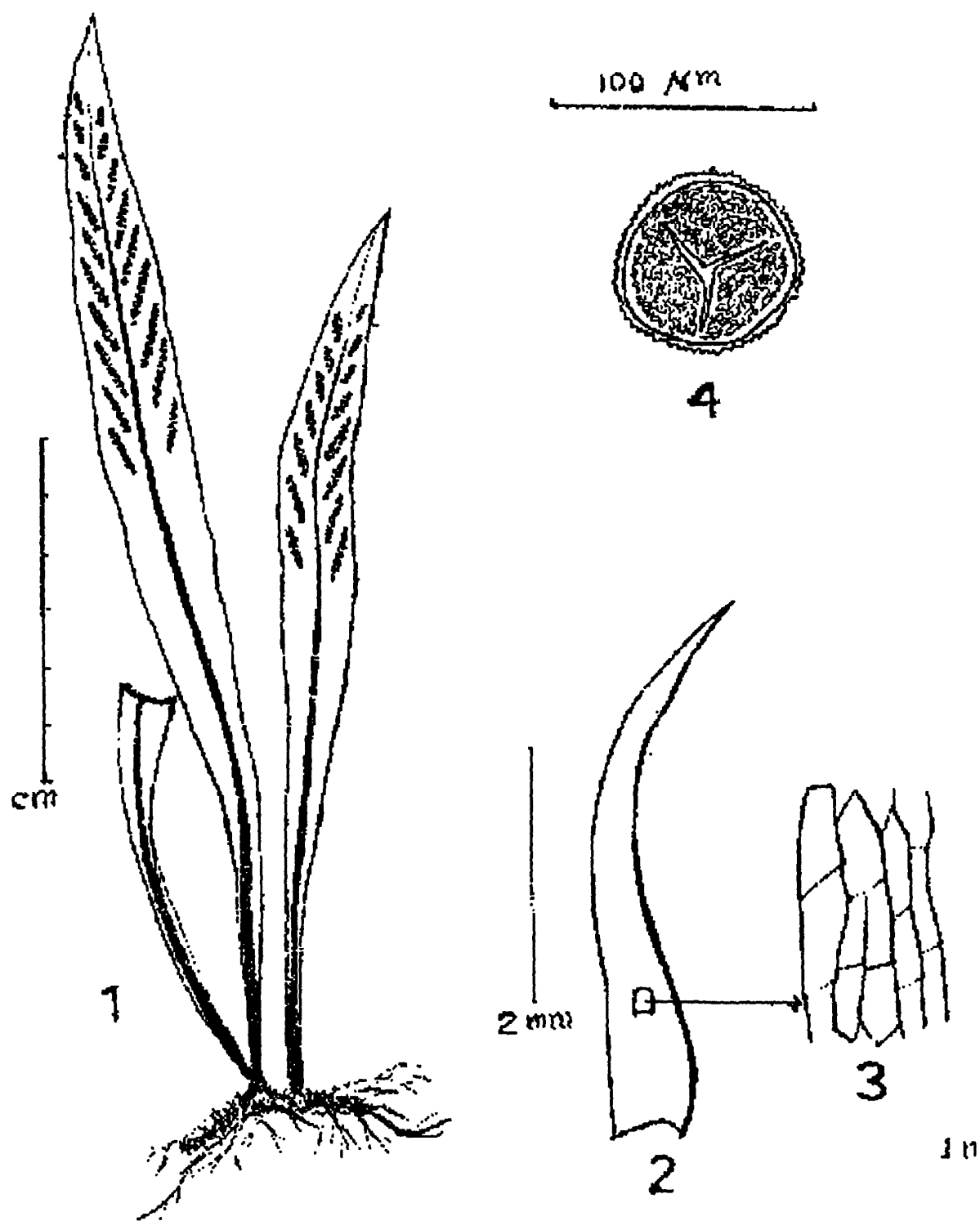


Fig. I (1-4): 1. *Loxogramme assimilis* Ching : 1. habit; 2. rhizome scale; 3. cells of rhizome scales; 4. proximal part of spores.

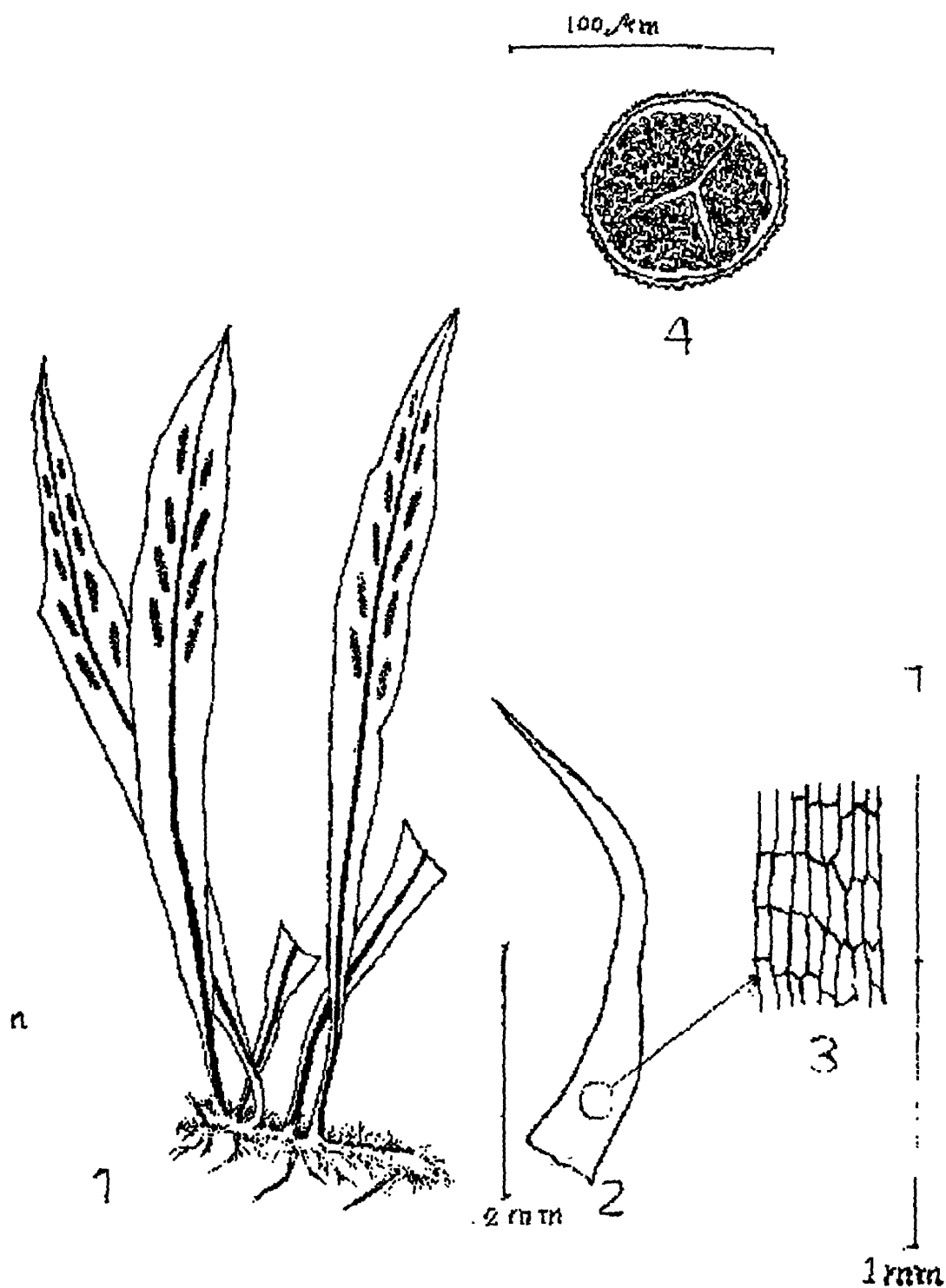


Fig. II (1-4) : *Loxogramme avalanchia* R. D. Dixit & Silpi Das : 1. habit ; 2. rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

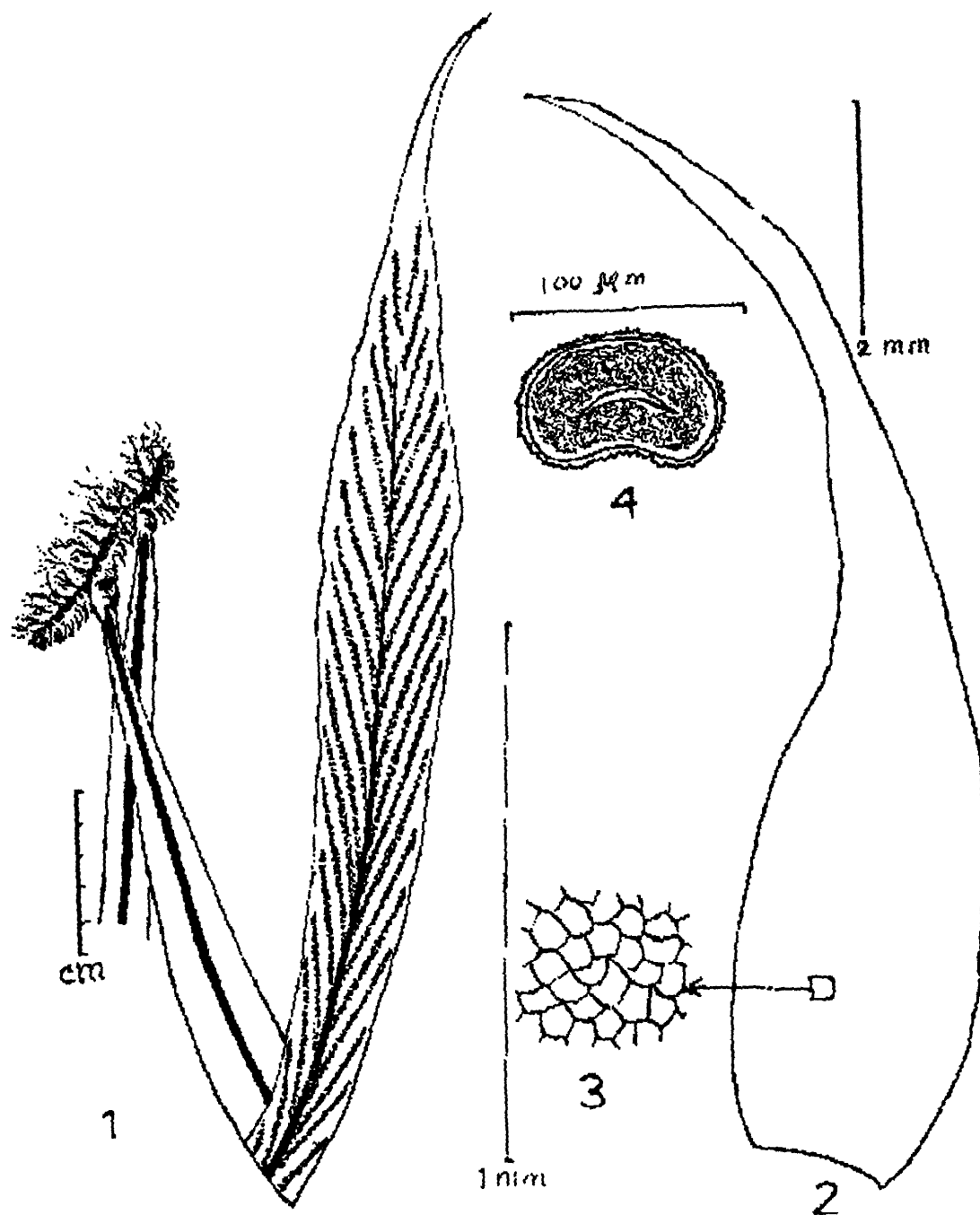


Fig.III (1-4): 3 *Loxogramme carinata* Price: 1. habit ; 2, rhizome scales;
3. cells of rhizome scales; 4. proximal part of spores.

4. *Loxogramme chinensis* Ching, Sinensia 1: 13. 1929; Dixit in Census of Indian Pteridophytes 33. 1984.

Rhizomes wide-creeping, 2-3 mm thick; scales dark-brown, dense, broad at base, gradually attenuate into a long subulate apex, distinctly clathrate, $8.5-10 \times 1-1.6$ mm. Stipes very short; fronds pale-green, glabrous, somewhat dimorphic, $5-14 \times 0.5-0.7$ cm. Sterile fronds shorter and broader; upper one third portion of lamina broadest, slowly narrowed downwards to the short stiped base, apex acute to blunt, margins entire, midrib raised above, texture coriaceous but flaccid. Sori oblique to subparallel, more often tending to confluent, not costal but well extending to the margins, 3-8 mm long, confined to the upper one-third portion of the lamina. Spores trilete $60-70 \mu\text{m}$. fig. IV (1-4).

Photograph examined: Yeo Mar Shn 120 U.N. of Lin. Yan, N.W. Kwangsi, near the border of Kweichow. 1463 m., R.C. Ching, 7146 (CAL).

Specimens examined: ARUNACHAL PRADESH, NEFA, 2300 m., 3.9.1964, Joseph 40323 (CAL).

Distrib.: INDIA (Eastern Himalayas, Meghalaya) CHINA; BHUTAN, MYANMAR; THAILAND.

5. *Loxogramme cuspidata* (Zenk.) Price in Amer. Fern Journ. 74(2): 61. 1984. *Gramitis cuspidata* Zenk., Plantae 1: t. 2. 1935. *Loxogramme involuta sensu auct.* Bedd., Handb. Fern Brit. India 393. 1883; Dixit, Cens. Indian Pterid. 33. 1984 (*pro-parte*). Dixit and Silpi Das in Bull. Bot. Surv. India 35 (1-4): 131. 1993.

Rhizome thick, long-creeping, clothed with clathrate, dark brown, dense adpressed, ovate-lanceolate scales $4.5-5.0 \times 1.5-1.8$ mm and bunch of roots. Stipes 3-4 cm long, base blackened at least abaxially. Fronds large, simple; lamina pale green, papyraceous, $32-40 \text{ cm} \times 2-3 \text{ cm}$, broadest above the middle, apex cuspidate, margins plane, midrib slightly raised on the lower side. Sori always start above the middle part of the lamina, oblique, $2.5-3.0$ long, 2 mm thick, 3-5 mm apart, very close to midrib and 4-5 mm away from the margins. Spores monolet, $118-120 \times 58-60 \mu\text{m}$, pale yellow Fig. V (1-4).

Photograph examined: (Obtained from Royal

Botanic Gardens, Kew). South India: Nilgiri, Schmidt s.n., Accession No. RBG, Kew 246 determined by M.G. Price as probable Isotype in 1985 (CAL).

Specimens examined: (All the specimens housed at CAL). South India, 1858, *Beddome* 46; Herb. *Wight* 3170; V. Narayanswami Party s.n.; Tamil Nadu - Nilgiri, Ootacamund, 15.8.1878, G. King 2430; Kodaikanal, 21.4.1883, *Levinge* 24309; Nilgiri, 5. 1883, *Gamble* 11480; Santaveri bababoodu 123 m, 19-10-1908, *Meebold* 7885; Devicolam Trau, 12. 1910, *Meebold* s.n. Nilgiri Glenmargeen forest; Pykora, 17.10.1981. *Vajravelu* 77711 (MH. dupl. CAL).

Distrib.: INDIA: Tamil Nadu, endemic.

Loxogramme cuspidata (Zenk.) Price can be easily distinguished from all other species of *Loxogramme* Presl. by presence of long-creeping rhizome, pale-green membranaceous fronds, plane margins and blackened stipe bases at least abaxially.

6. *Loxogramme duclouxii* Christ, Bull. Acad. Geogr. Bot. 17: 140. 1907; Masam. Tr. 81: 341. 1941.

Rhizome long-creeping; scales membranaceous, fuscous-brown, ovate-oblong or ovate-lanceolate, acuminate. Stipes thick, coriaceous, 5-8 cm long, purplish black or blackish brown, shining, narrowly winged upwards. Fronds narrowly oblanceolate, 45-55 cm long, 2.5-3.0 cm wide, acuminate, gradually attenuated towards the stipes; costa beneath prominent. Sori confined to the upper part of the lamina, very oblique, nearer the costa, away from the margin. Spores monolet, $100-110 \times 45-55 \mu\text{m}$. Fig. VI (1-4).

Type photograph examined: G. Bonati, Plantes Duyunnan (Chine Pharmacian de 1st Classe, Lure (Hie-Soone) 12. Oct. 1909. D. Christ 24100 (Herbarium of Fan Institute of Biology) TYPUS.

Specimens examined: INDIA: Sikkim 16 March, 1984, 1900 m (4 sheets).

Distrib.: INDIA: Sikkim, Assam; BHUTAN, CHINA, JAPAN.

7. *Loxogramme elevata* Ching in Bull. Fan. Mem. Inst. of Biol. News. Surv. 5: 298. 1949.

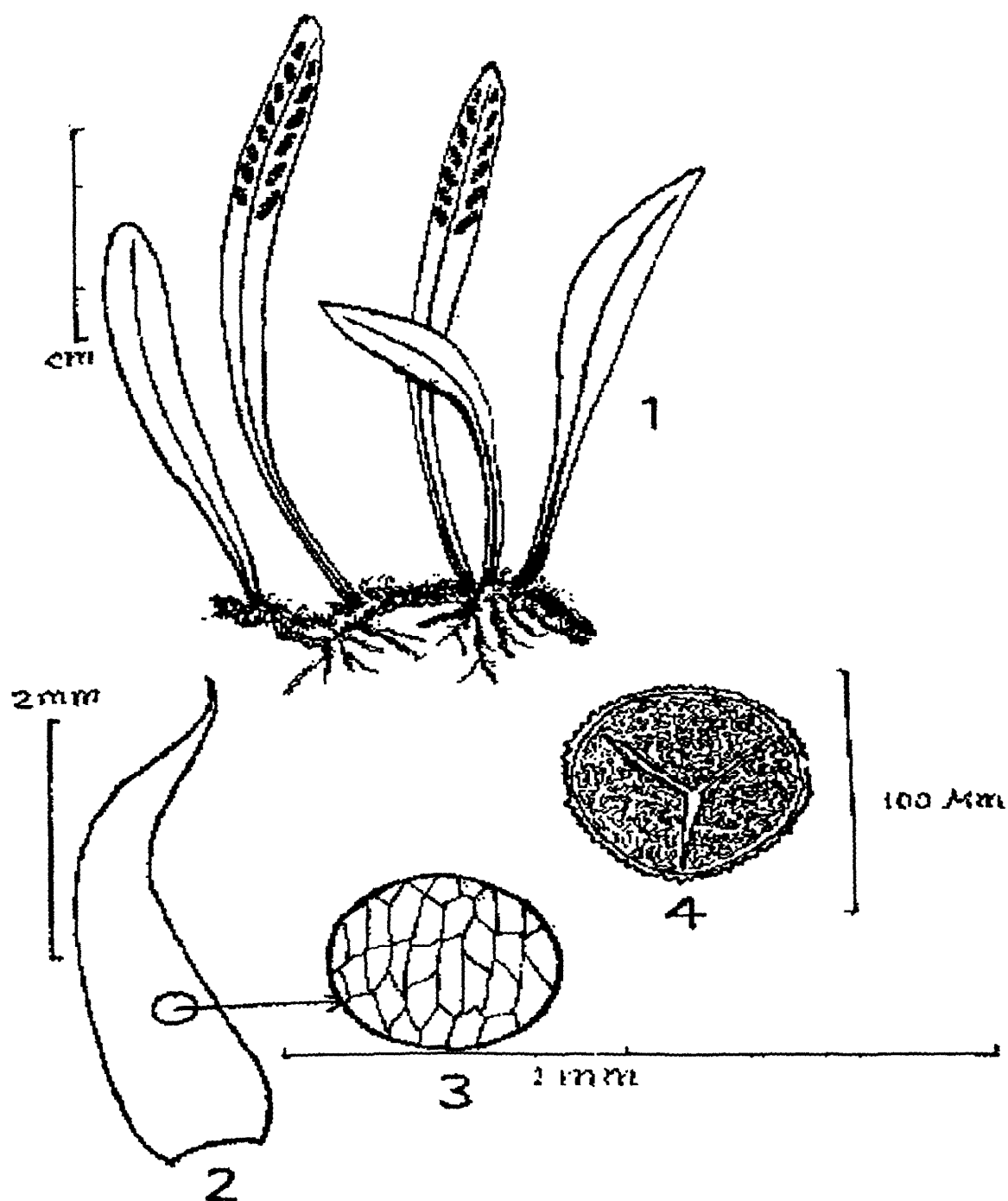


Fig.IV (1-4): *Loxogramme Chinensis* Ching: 1. habit ; 2, rhizome scales;
3. cells of rhizome scales; 4. proximal part of spores.

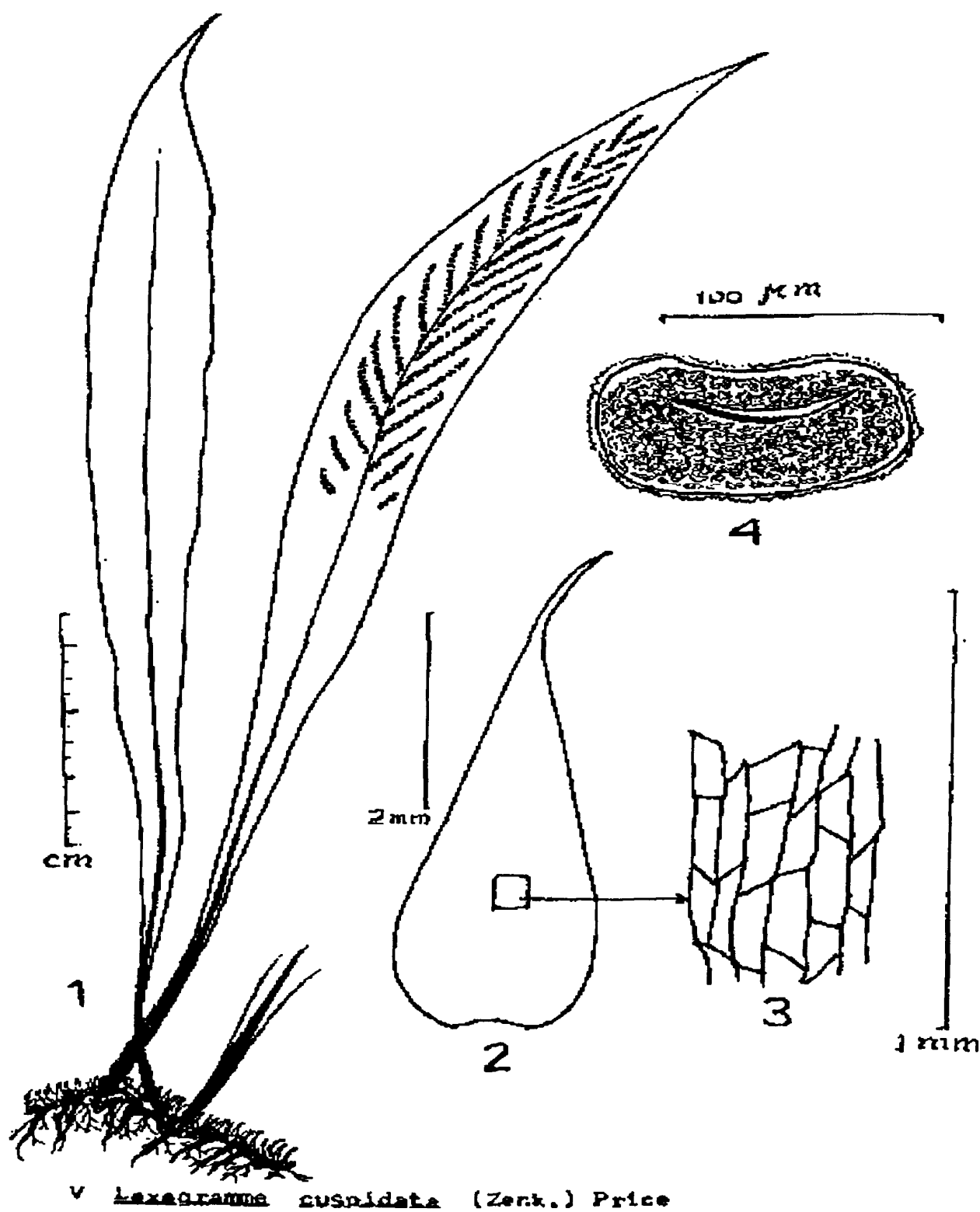
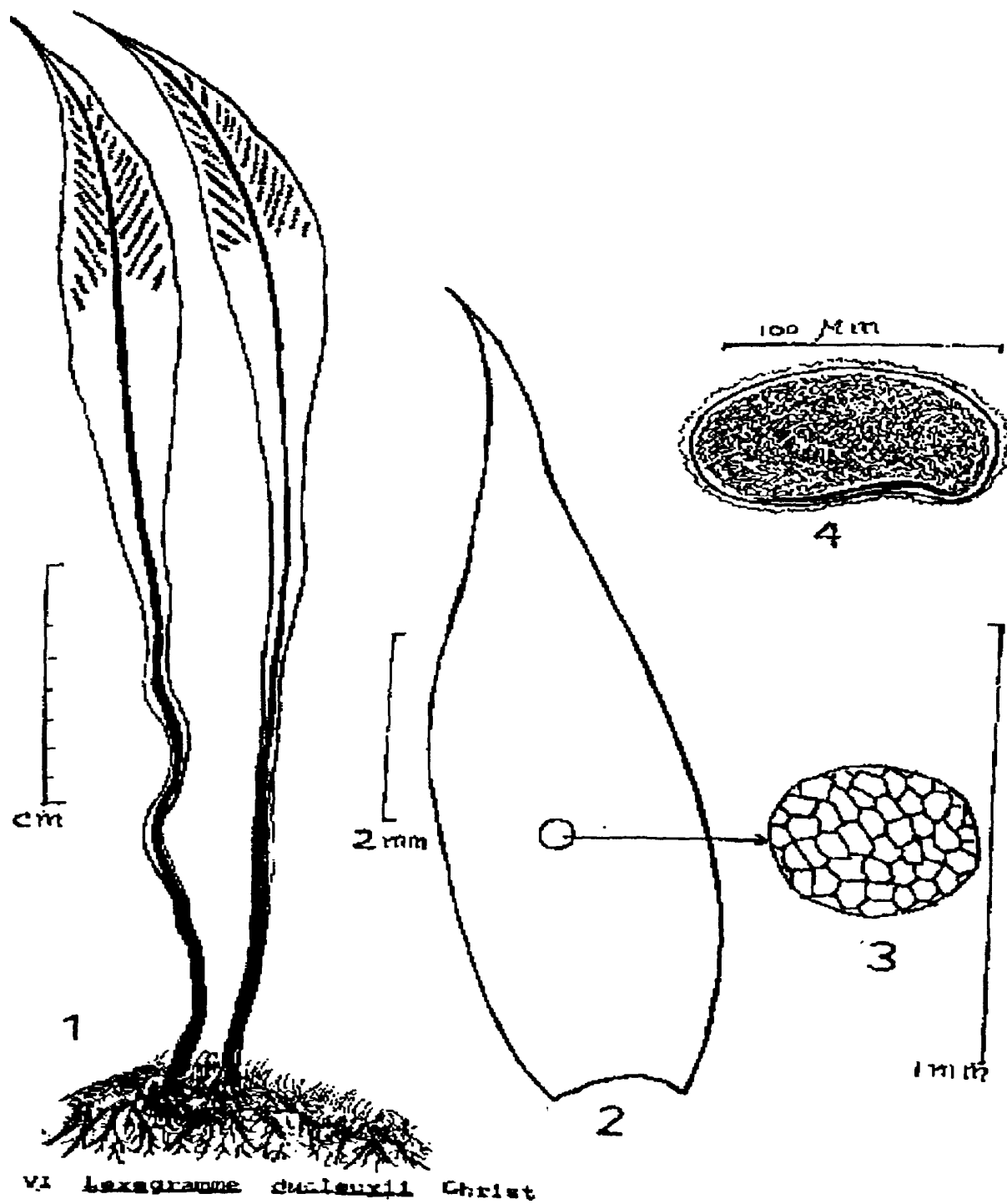


Fig.V (1-4): *Loxogramme cuspidata* (Zenk.) Price: 1. habit; 2, rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.



VI *Laxogramme duclouxii* Christ

Fig. 1. Habit.

Fig.VI (1-4): *Laxogramme duclouxii* Christ: 1. habit; 2, rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

Rhizomes creeping; scales clathrate, dull brown, ovate-lanceolate, acuminate, entire, with elongate clear luminae $2.5 - 3 \times 0.6 - 1$ mm. Fronds $20 - 25 \times 1.5 - 1.8$ cm linear-lanceolate, apex short-acuminate, from the lower one third way down, gradually narrowed towards the base, stipes short, strong; midrib prominently raised on both the sides; margins entire, slightly revolute, texture coriaceous on drying obscure green, both sides glabrous. Sori linear, $1 - 1.5$ cm long, thick, oblique confined to the upper one third part of frond. Spores trilete, $70 - 80 \mu\text{m}$. Fig. VII (1-4).

Photograph examined: China, Szechuan, Mt. Fmel (Umel) 700 m, 15.12.64 R.C. Ching & K.H. Shing 1517.

Specimens examined: (All specimens housed in CAL) Sikkim, China 1415 m, 4.3.1983, Chakraborty, 2652, (2 specimens); Darjeeling 16.5.1971, Ghosh 994; Darjeeling, Karseong, 19.5.75, Dixit 5305; Darjeeling s.l. 5051; Darjeeling s.l. 52766.

Distrib.: INDIA: West Bengal, Darjeeling, CHINA.

8. *Loxogramme ensiformis* Ching, Icon. Fil. sin. 191, 1937.

Rhizome short, erect, densely scaly; scales light-brown, broadly ovate, short, acuminate, entire, 5 mm long, consisting of numerous, small, roundish brown luminae. Fronds caespitose, stipes short, thick, 2 cm long, compressed; lamina oblanceolate, long acuminate $20 - 25$ cm long, $3 - 3.5$ cm broad at the upper two-third part, gradually attenuate along a long narrowly winged stipe; texture chartaceous, greenish, naked, midrib distinct on both sides, slightly keeled below and raised above. Sori oblique, thick brown, raised about 5 mm apart, confined to the upper half of leaf, extending from near the costa to one third way from the margin. Spores monolet $115 - 120 \times 60 - 65 \mu\text{m}$. Fig. VIII (1-4).

Photograph examined: TYPUS. Sichun Tianquan, Szechuan, 1550 m, 6.9.1963, K.C. Kuan et al. 3268 (CAL).

Specimens examined: Darjeeling, 16.6.1960, 1000 -

1700 m, Hara & Party 298 (CAL) Darjeeling, 21-5-1972, 1254 m, R.K. Ghosh 50213 (CAL 2 sheets).

Distrib.: INDIA: Darjeeling and Sikkim; CHINA, JAPAN.

9. *Loxogramme grammitoides* (Bak.) C. Chr., Ind. Fl. Suppl. 2:21; 1917. *Gymnogramme grammitoides* Bak., Journ. Bot. 27. 178. 1889; Dixit in Census of Indian Pterid. 35, 1984.

Rhizomes slender, wide-creeping, densely covered with fusco-brown, thin, lanceolate, acuminate, clathrate scales, $1.5 - 2 \times 0.3 - 0.5$ mm. Fronds dimorphic, vegetative fronds morphologically shorter and broader up to 1.2 cm. Fertile fronds much longer and narrow up to 5 mm broad. Lamina small, spatulate or oblanceolate, stipes very short; fertile fronds $3.5 - 4$ cm $\times$ $4 - 5$ mm acute, sterile fronds obtuse, gradually narrowed to base, margins entire, texture sub-coriaceous, greenish-brown, midrib raised above, only slightly keeled or not, visible beneath; veins not visible, forming two rows of elongated areolae on each side of midrib. Sori linear, parallel to costa or somewhat oblique to costa, confined to upper part, away from margins, spores trilete, $40 - 45 \mu\text{m}$. Fig. IX (1-4).

Specimens examined: Arunachal Pradesh, NEFA, Lohit Dist. 13.1.1970, Joseph 48934 (ASSAM), Three sheets; West Bengal; Darjeeling, 1.7.1960. H Hara 2164 (CAL).

Distrib.: INDIA-West Bengal (Darjeeling), Sikkim, Arunachal Pradesh.

10. *Loxogramme involuta* (D.Don) Presl, Tent. Pterid. 215. 1836; Bedd., Handb. Ferns Brit. India 393, 1883 (*Descript*) *pro parte excl.* t. 228), *Grammitis lanceolata* D. Don, Fl. Nepal 14, 1825, Dixit, Census of Indian Pterid. 33, 1984.

Rhizome thick, creeping, clothed with bunch of thick roots and dark-brown to black, clathrate, ovate-lanceolate $5 - 6.6 \times 0.8 - 1$ mm, scales. Fronds $2 - 8$ mm apart; lamina elliptic-lanceolate to lanceolate, $20 - 35$ cm $\times$ $2.0 - 3.5$ cm, thick in texture, broadest in the middle, apex acuminate, margins involute at maturity, brown on drying, midrib raised on the lower surface brownish-violet in colour. Sori start

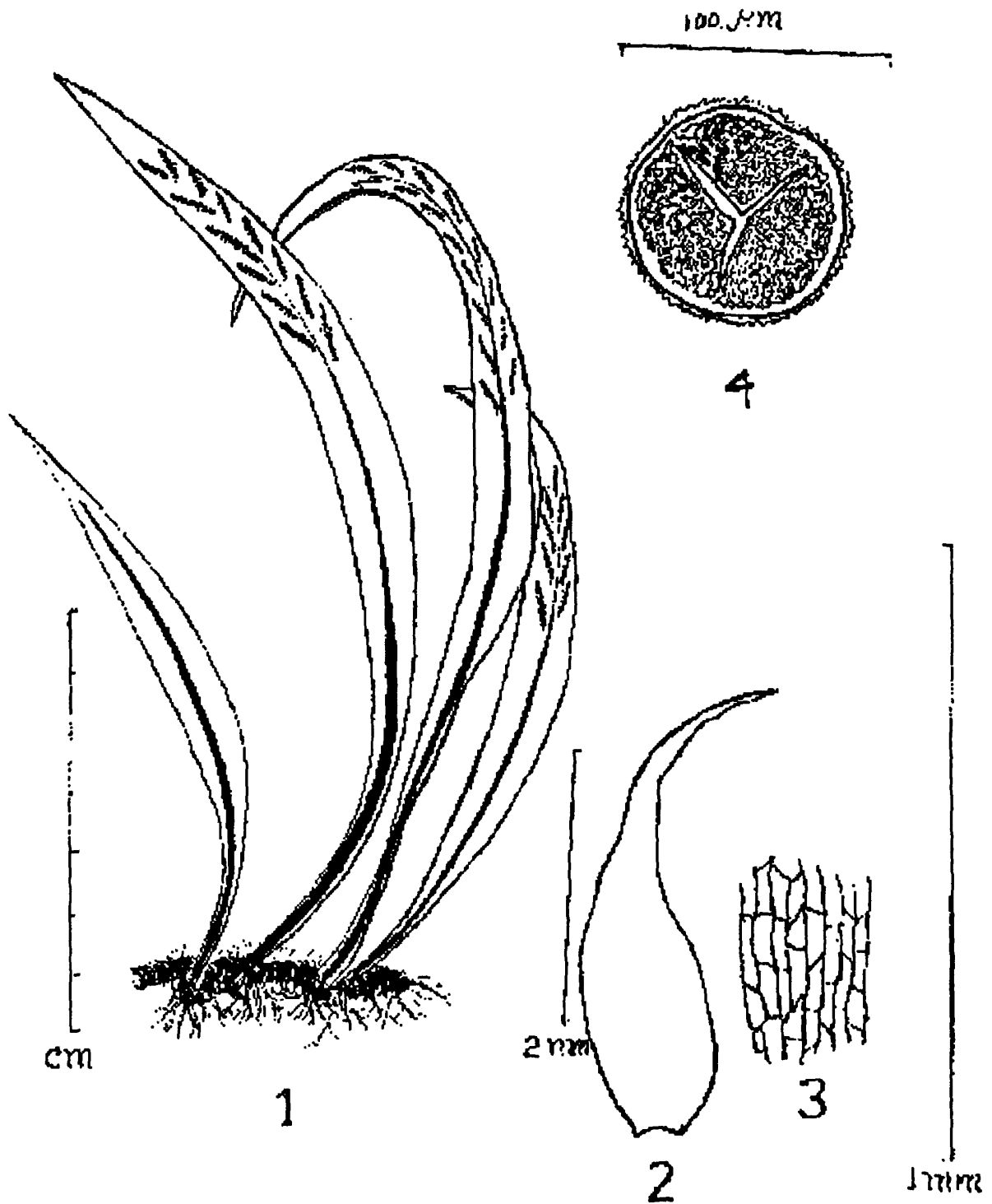


Fig. VII (1-4): *Loxogramme elevata* Ching : 1. habit ; 2. rhizome scales;
3. cells of rhizome scales; 4. proximal part of spores.

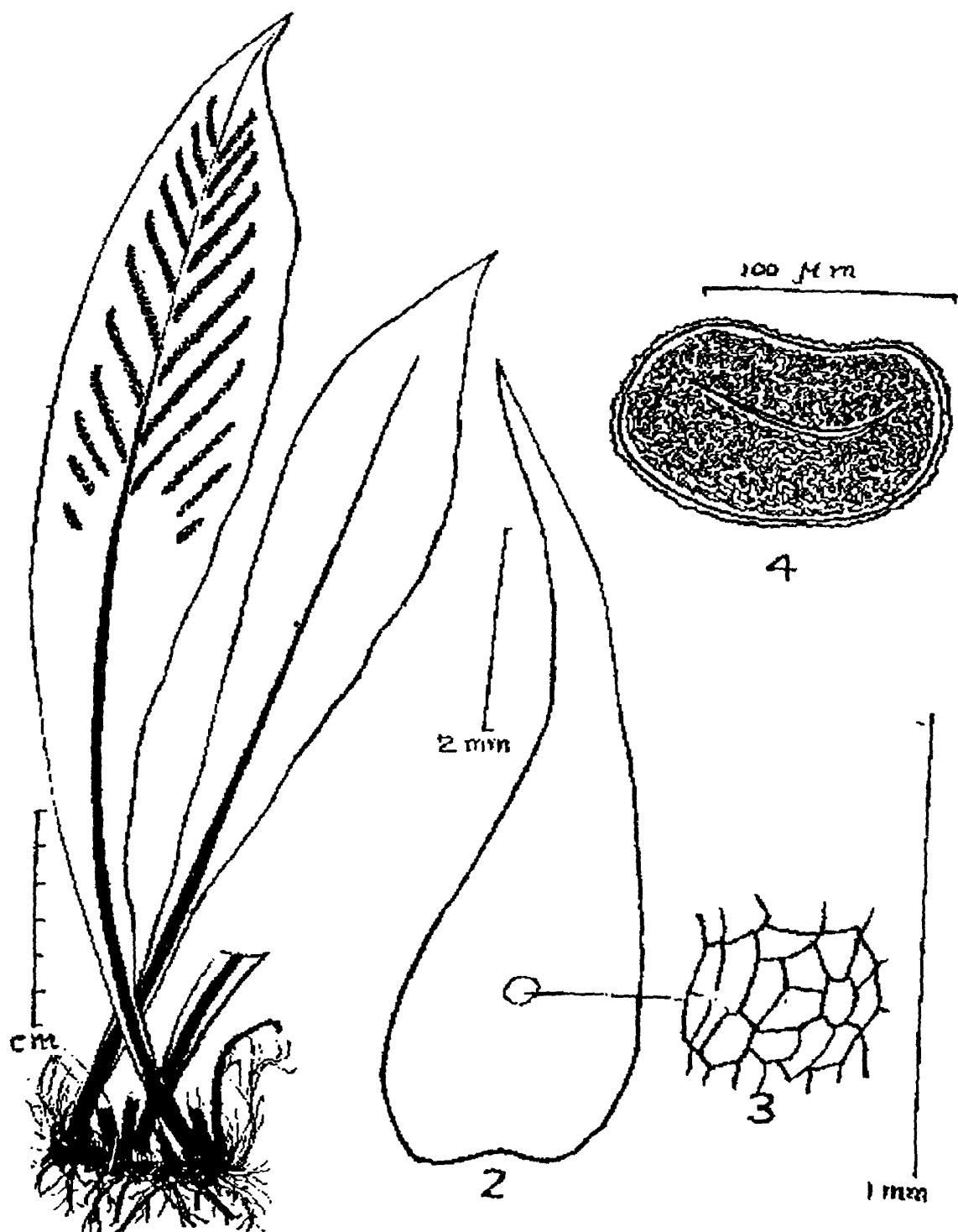


Fig. VIII (1-4): *Loxogramme ensiformis* Ching: 1. habit; 2. rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

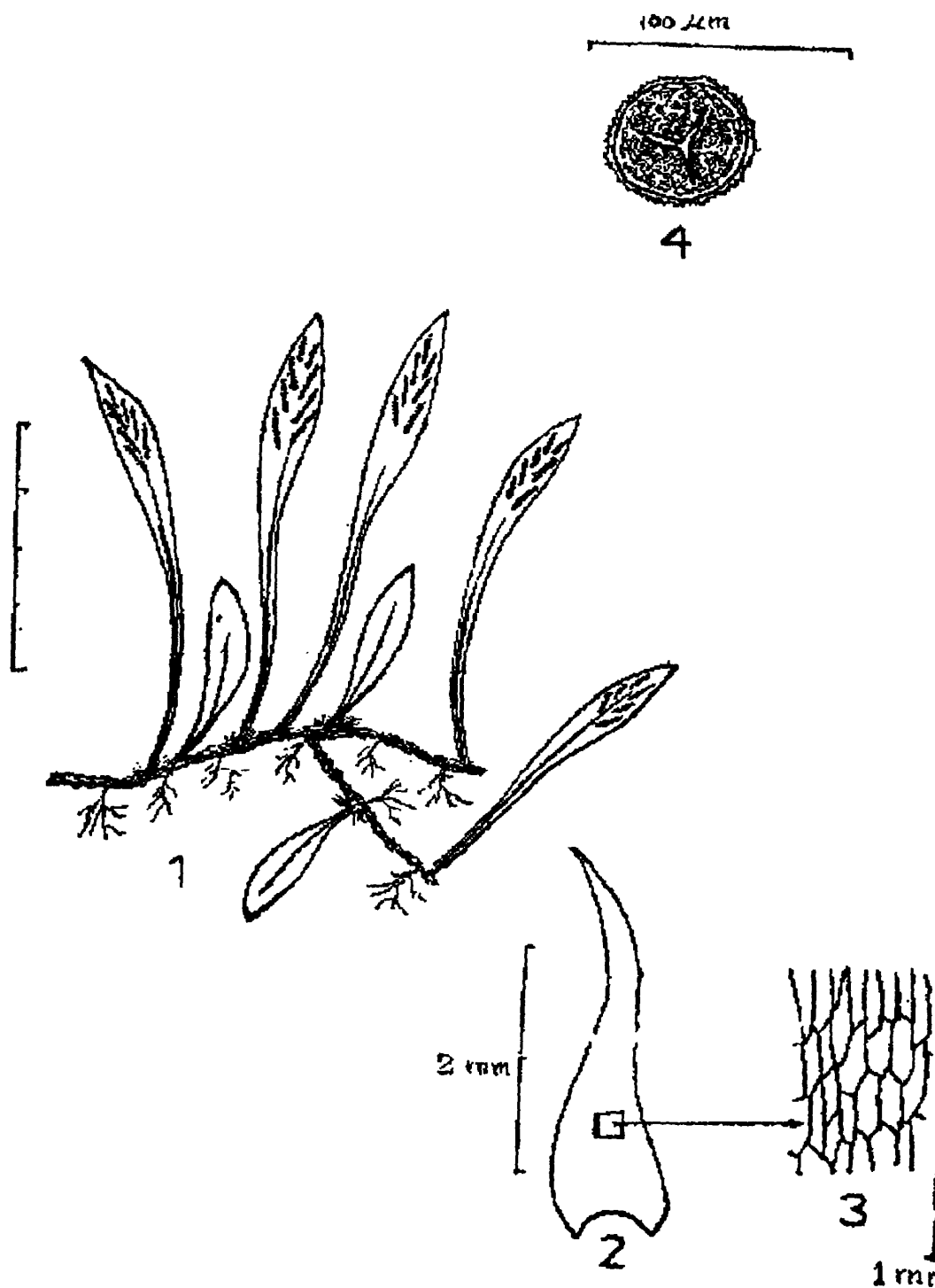


Fig. IX (1-4): *Loxogramme grammitoides* Bak. C. Chr.: 1. habit ; 2, rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

from the lower half of lamina, oblique, 4-4.5 cm long 2-3 mm apart, very close to midrib and margins. Spores monoletate $75-80 \times 45-50 \mu\text{m}$., verrucoid. Fig. X (1-4).

Photograph examined : ~~NEPAL~~, E. Nepal, Wall. Cat. 1820 (CAL).

Specimens examined: INDIA: Manipur 2000 m, 18-09-1984, Ghosh 16546 (CAL); Meghalaya, 28-06-1956, Deka 2622 (ASSAM: CAL); Sikkim: Gangtok 19-05-1961, Mazumdar 87 (CAL); Darjeeling, Jalpaiguri, 12-5-1976, Sikdar 4610 (CAL); Kalimpong 1800 m, 07-06-1983, Ghosh 57669 (CAL); Naga Hills 01-03-1882, H. Collet 71 (CAL).

Distrib. : INDIA : Meghalaya, West Bengal, Sikkim, Manipur, Nagaland, ~~NEPAL~~, MALAYA.

11. *Loxogramme lankokiensis* (Rosenst.) C.Chr., Ind. Fil. Suppl. III: 125, 1934. Tagawa and Iwatuki in Acta Phytotax. Geo. Bot. 24 (1-2): 60. 1969. *Polypodium lankokinesis* Rosenst., Mad. Rijxs. Herb. Leiden, No. 31:5.1917; *Type*: Tonkin (Mt. Bavi), La kok, 12 June, 1888. *Loxogramme microphyllum* C.Chr. in Danak. Bot. Arkiv. 6(3): 48. t.3, 6.1929.

Rhizomes wide-creeping 0.5 mm across, paleaceous; roots covered with brown simple, elongated, persistent root hairs; scales 1.5-2 mm 0.4-0.5 mm, lanceolate, entire or slightly toothed at base. Fronds dimorphic, lamina coriaceous, dull green on drying and bearing brown, scattered, 2 celled trichomes on the lower surface. Sterile fronds up to 20 mm long, 10-13 mm wide, sessile, obovate to round, entire, obtuse. Fertile ones 14-30 mm long, 3-7 mm wide, sessile, oblanceolate, obtuse. Sori up to 3 mm long, oblique. Spores trilete $40-50 \mu\text{m}$; Fig. XI (1-4).

Distrib. : INDIA: Arunachal Pradesh, THAILAND & VIETNAM.

Specimens examined: INDIA: Arunachal Pradesh, Tirap District, Miao (Zoological Park) 400 m, 26.9.1960; Singh 78167 (ASSAM); Subansiri Dist., Yazoli 350 m, 17.4.1985 S.R. Ghosh 59668 (CAL)

12. *Loxogramme linearis* Copel. in Philip. Journ. Sc. C. (Bot.) 11(1): 45. 1916.

Rhizomes creeping, 2 mm thick, clothed with clathrate scales; scales dark-brown, lanceolate, $3-4 \times 0.5-0.9 \text{ mm}$, acute to acuminate. Fronds 25-30 cm long. Stipes tufted 3-5 mm apart, 3-6 cm long; lamina 25-30 cm $\times$ 8-10 mm, glabrous, coriaceous in texture, costa raised on the upper surface, margins entire; veins hidden. Sori oblique, linear 10-12 mm long, confluent near acumen, nearer to the margins, spores trilete, $50-60 \mu\text{m}$ in diameter, verrucoid. Fig. XII (1-4).

Ecology : Epiphytic on tree trunk and branches covered with moist mossy cover; fronds hanging downwards, rare.

Photograph examined: *Type*: Formosa: Faurie 959.(CAL).

Specimens examined: Meghalaya: Khasi Hills: lower ranges, Nov. 1833. s.l.s.n. (Acc.No. 24258, Plants numbered I & II, CAL); Acc.No. 24257 (CAL: 4 specimens); Arunachal Pradesh, Tirap: Rale, 26-08-1958, Panigrahi 16831 (Assam, CAL-4 specimens). South India, Wight 3169 (CAL-21243-two specimens); Kerala, Travancore; Davidolum. 5700 ft., 3-5-1883, Lavinge s.n. (CAL-24255) two plants.

Distrib. : INDIA: Meghalaya, Arunachal Pradesh, S. India; CHINA, SRI LANKA, PHILIPPINES, FORMOSA.

13. *Loxogramme manipurensis* Das & Dixit sp. nov.

Fronds lanceolatae, obscure brunneae, rhizomatis squamae longae lanceolatae, marginibus non involutis sed fragilibus, costa crassa, valida, utrinque prominens, in sicco non colorata, lamina viridula in sicco, crassa, coriacea, sori lineares obliqui, 2-4 mm distantes, hand confluentes. Sporae monoletae.

Rhizome thick, creeping, clothed with bunch of thick roots and dullbrown clathrate long lanceolate $9.5 \text{ to } 10.0 \times 0.8-0.9 \text{ mm}$ scales. Fronds 2-8 mm apart; lamina lanceolate, $35-45 \times 2.8-3.5 \text{ cm}$, apex acute, margins not involute but fragile; midrib raised on both surfaces, thick, terete, stout, not coloured on drying; lamina greenish on drying, thick, coriaceous. Sori linear, oblique nearer to midrib

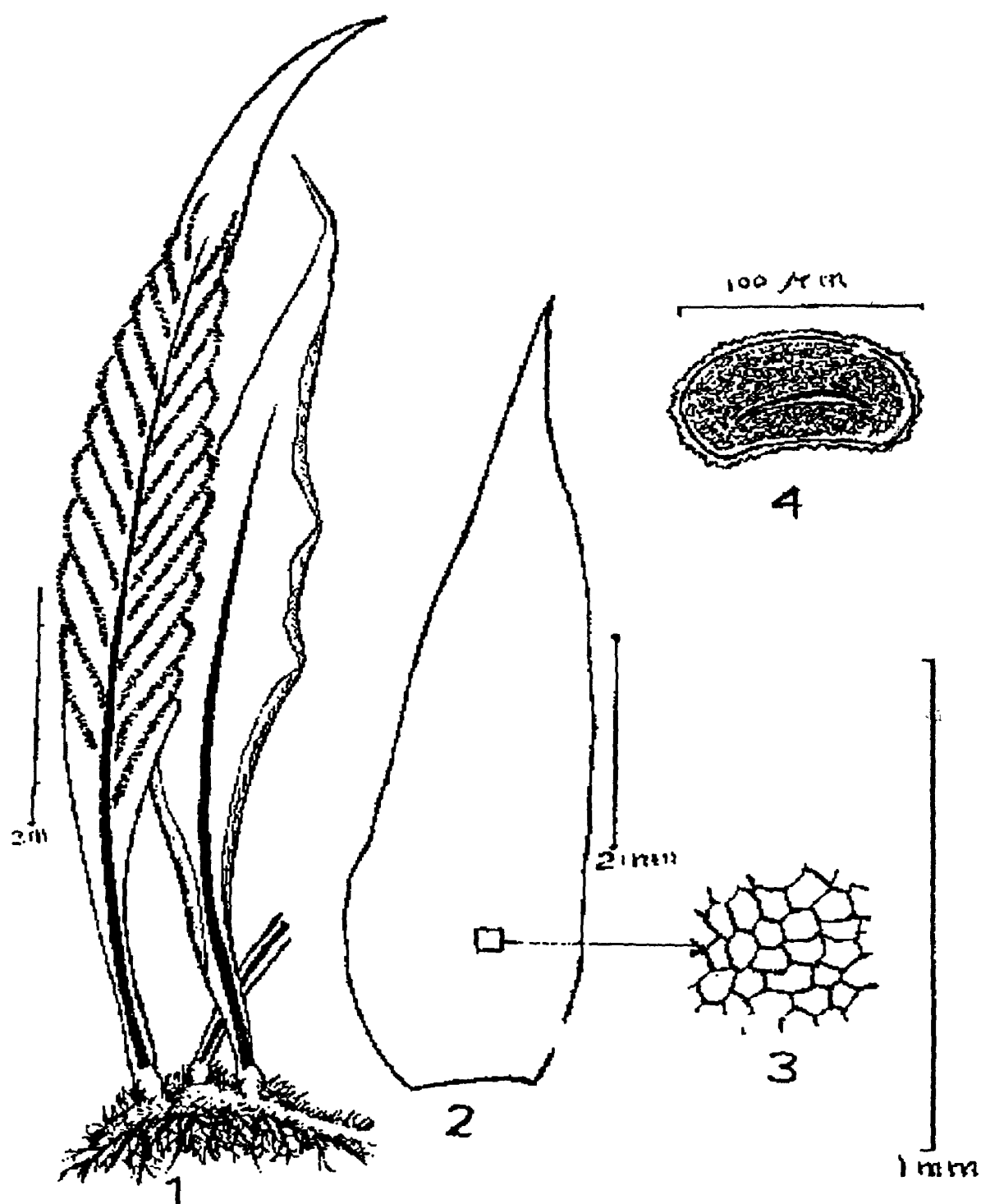


Fig.X (1-4): *Loxogramme involuta* (D. Don) Presl: 1. habit ; 2. rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

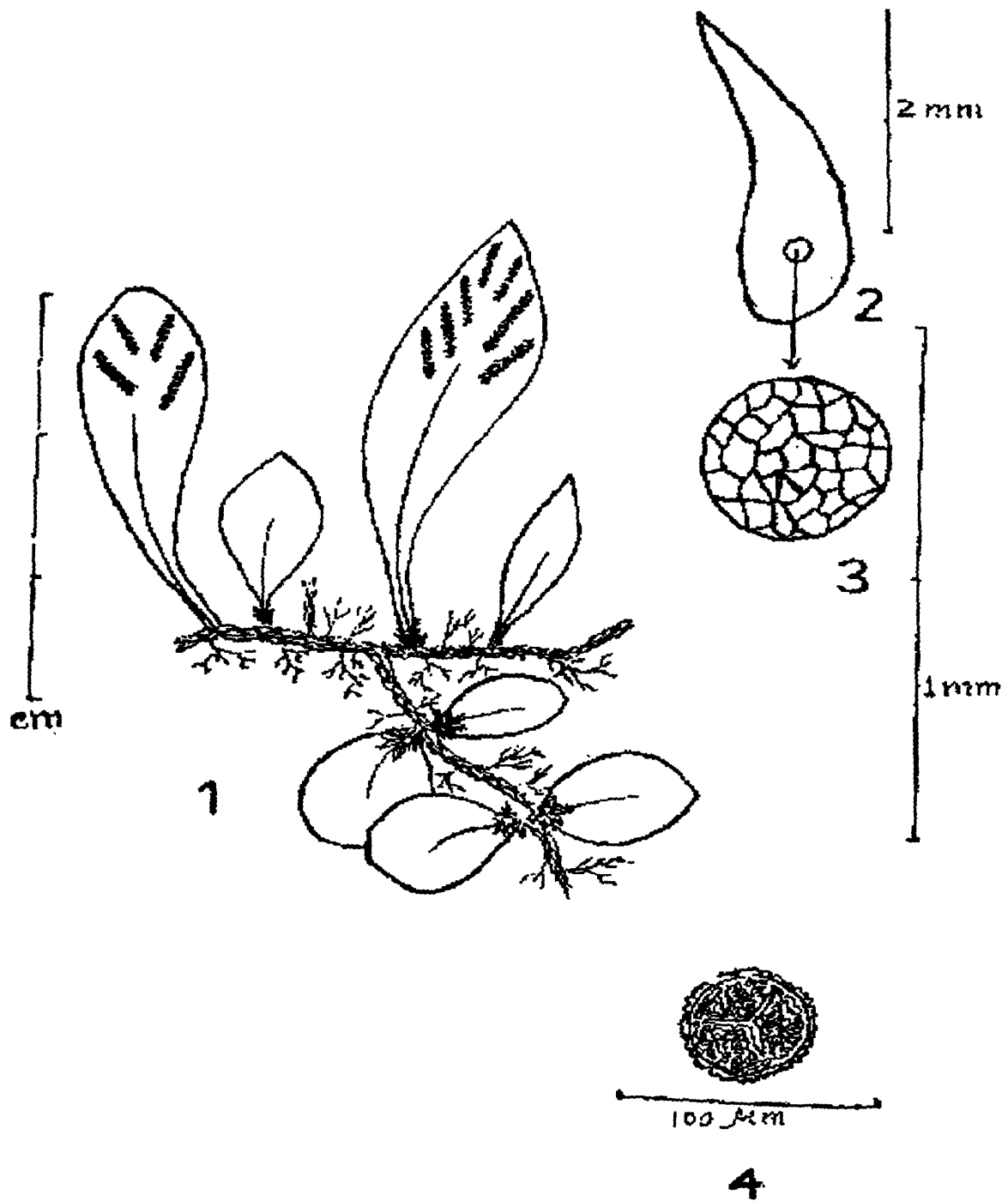


Fig.XI (1-4): *Laxogramme lankokiensis* (Resenst.) C. Chr.: 1. habit ; 2, rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

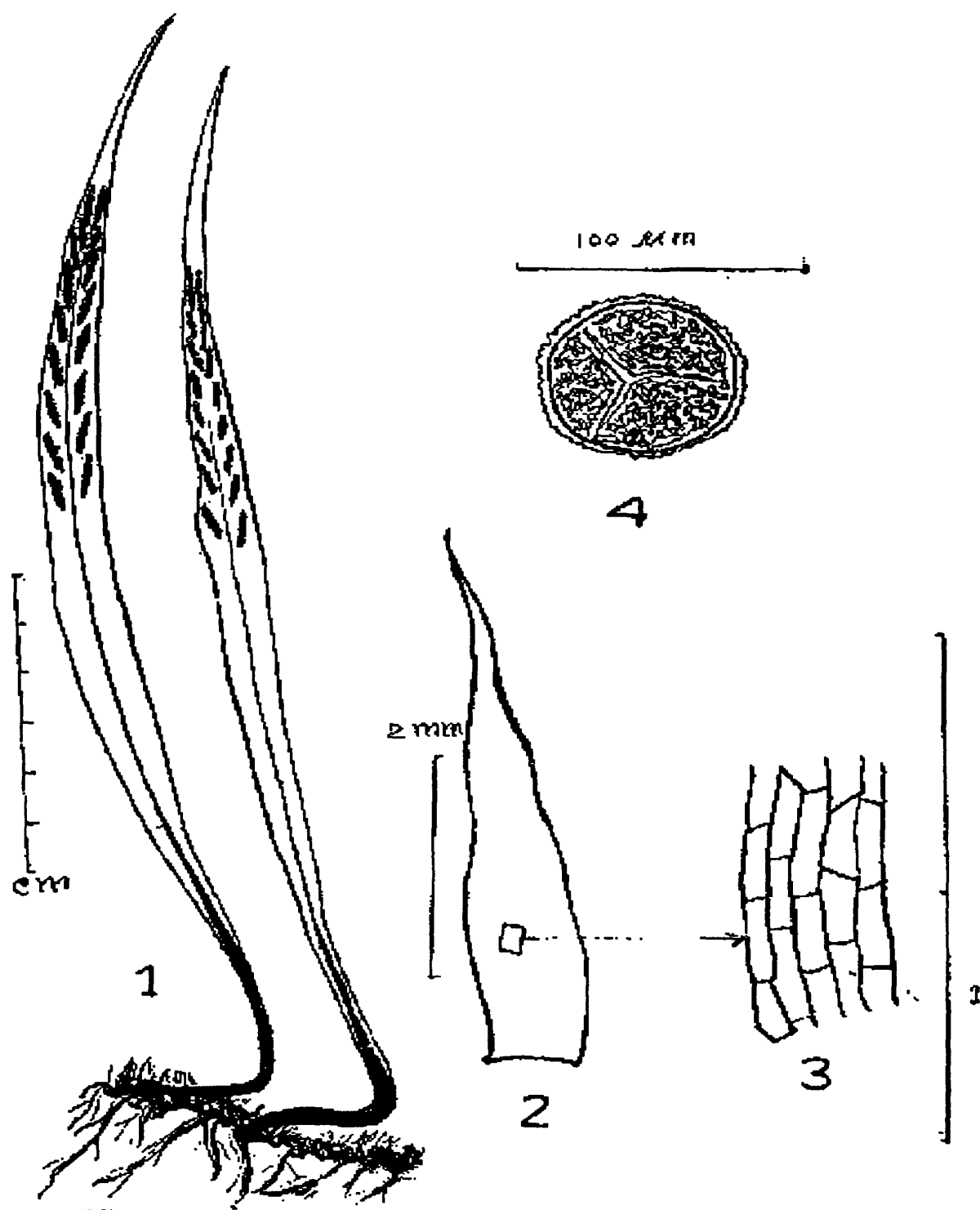


Fig.XII (1-4): *Loxogramme linearis* Copel: 1. habit ; 2. rhizome scales;
3. cells of rhizome scales; 4. proximal part of spores.

than margin, 4.5 - 5 cm long, 2 mm thick, 2 - 4 mm apart, never confluent, spores $100 - 110 \times 75 - 80 \mu\text{m}$, monolete, verrucoid, Fig. XIII (1-4).

Specimens examined: INDIA: NORTH-EAST-HIMALAYAS, MANIPUR, Tamenlong 1050 m, 19-03-1985, B.Ghosh 59271 (CAL, 5 sheets).

Distrib. : INDIA: Manipur (Endemic).

Loxogramme manipurensis Das & Dixit is similar to *L. involuta* D. Don in size and distribution of sori, but can be easily distinguished from *Loxogramme involuta* D. Don by the presence of long lanceolate scales and thick, stout and colourless costa.

Type : INDIA: Manipur Tamenlong, 1050 m, 19-3-1985 B. Ghosh 59271 (CAL).

Etymology: The species is named after the place of collection of type specimens i.e. Manipur in North-East India.

14. *Loxogramme mussooriana* R.D. Dixit et Silpi Das in Indian Fern J. 11: 62.f. 1 - 3. 1994.

Rhizomes short-creeping; scales clathrate-broadly, ovate-lanceolate, shining-rufous-brown in colour $7 - 8 \times 0.5 - 0.6 \text{ mm}$. Fronds densely tufted, sessile; lamina elliptic-lanceolate, broadest above the middle, acute at apex, gradually long decurrent up to base, pale shining-brown on drying, glabrous, thin but firm in texture, margins entire never wrinkled or involute, costa not raised on both the surfaces but distinct from the base up to the $3/4$ th of fronds, violet in colour. Sori present throughout the fronds leaving only basal region oblique $3 - 5 \text{ cm}$ long, 2 mm apart, starting near the costa upto wall within the margins, paraphyses dense, present among sori, dark-brown, $6 - 8$ celled, apical cell conical; spores monolete, $90 - 105 \times 50 - 60 \mu\text{m}$ verrucoid. Fig. XIV (1-4).

Specimens examined: India: North-West Himalayas, Mussoorie, 1829 m, 20-08-1898, P.N. Mackinon s.n. (CAL-24277); Garhwal, 1800 m; 23-09-1958; M.A. Rau (BSD, Dupl, CAL) Chotal Ghot. 488 m, 21-06-1959; M.A. Rau 10376 (BSD. Dupl. CAL) Phote, 1500 m, 24-09-1958. M.A. Rau 6495 (BSD, dupl. CAL).

Type : INDIA-North-West Himalaya, Mussoorie, 1829 m, Aug., 1898, P.N. Mackinon s.n. (CAL-9238).

Isotype: Ibid. (CAL-9239).

Etymology : The species is named after the place of collection of type specimens i.e. Mussoorie in Dehra Dun Dist. of Uttar Pradesh.

Distrib. : INDIA: North-West Himalayas-Endemic.

15. *Loxogramme parallela* Copel. in Parkins. Fragm. Fl. Phillip. 3. 182. 1905; Sledge, in Bull. Brit. Mus. (N.H.) Bot. 2: 141. 1960. *L. lanceolata* sensu Bedd., Handb. Ferns Brit. India 392. 1883 (non C. Presl); van Alderwerelt van Rossenburgh in Malayan Islands 64. 1908; Dixit in Census Indian Pterid. 34. 1984.

Rhizomes short-creeping, the scales reddish brown, lanceolate, acuminate, $6 - 7 \times 0.7 - 0.8 \text{ mm}$. Fronds linear, $15 - 20 \text{ cm}$ long, $3 - 7 \text{ mm}$ broad, sessile erect, acuminate, entire, narrowed gradually to the base, texture coriaceous; costa distinct beneath, veins immersed. Sori oblong, near the midrib mostly parallel and confluent. Spores trilete, $60 - 70 \mu\text{m}$. and monolete $90 - 100 \times 50 - 60 \mu\text{m}$. Fig. XV (1-4).

Photograph examined : Type photograph examined from "The Genus Loxogramme" by Copeland in the Philippine Journal of Science, C. Botany, Vol. XI (1): 1916.

Specimen examined: INDIA: Arunachal Pradesh; NEFA 2789 m, 4th April, 1957. Panigrahi 8386 (CAL) (3 sheets); Manipur, 1524 m, Dec. 1907, Meebold 5306 (CAL).

Distrib. : INDIA: (Eastern India and Eastern Himalayas); SRI LANKA, CHINA, JAPAN, FIJI, SAMOA, AFRICA, MALAYAN ISLANDS.

16. *Loxogramme porcata* Price in Amer. Fern. J. 80(1) 4. 1990.

Rhizomes short-creeping, phyllopodice, approximate to 3 mm apart. Scales ovate to linear-lanceolate, $5 - 10 \times 0.5 - 1.2 \text{ mm}$, dark greenish-brown. Lamina narrowly elliptic to oblanceolate, apex gradually acuminate, evenly narrowed to base, $10.5 - 61 \times 0.8 - 6 \text{ cm}$, coriaceous, light olive-brown

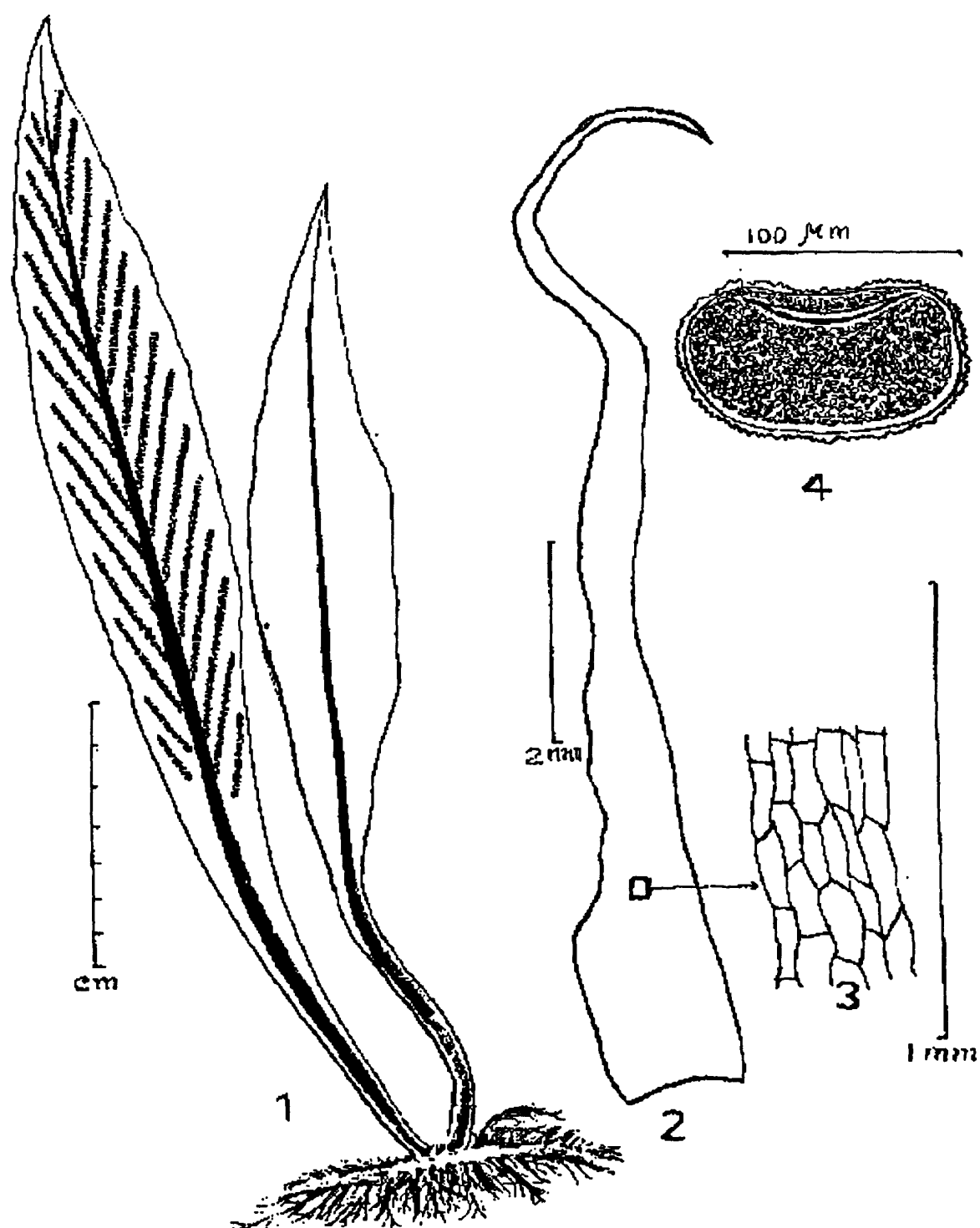


Fig. XIII (1-4) : *Loxogramme manipuriensis* Das & Dixit : 1. habit ; 2. rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

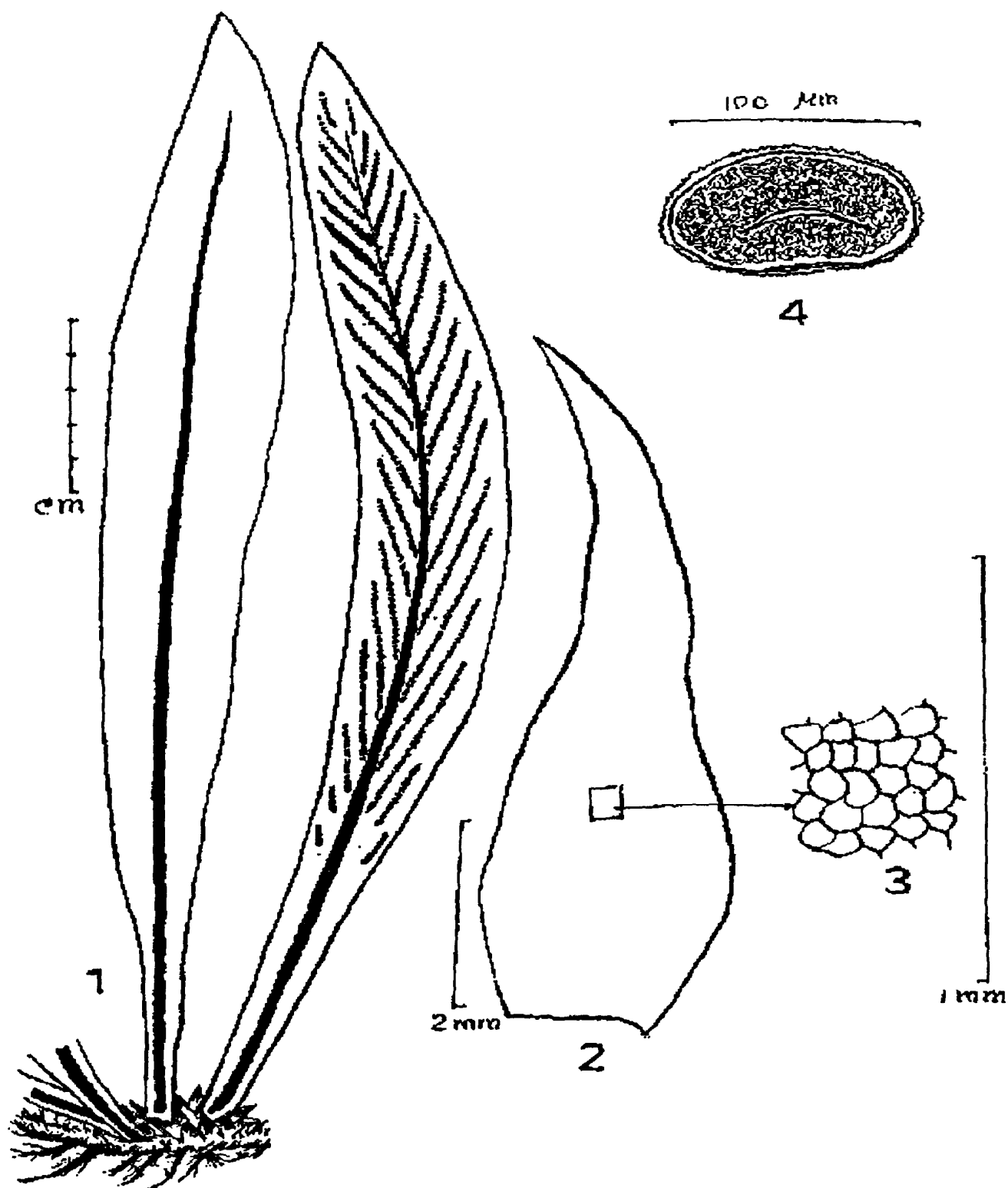


Fig. XIV : *Loxogramme mussoriana* R. D. Dixit & Silpi Das : 1. habit ; 2, rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

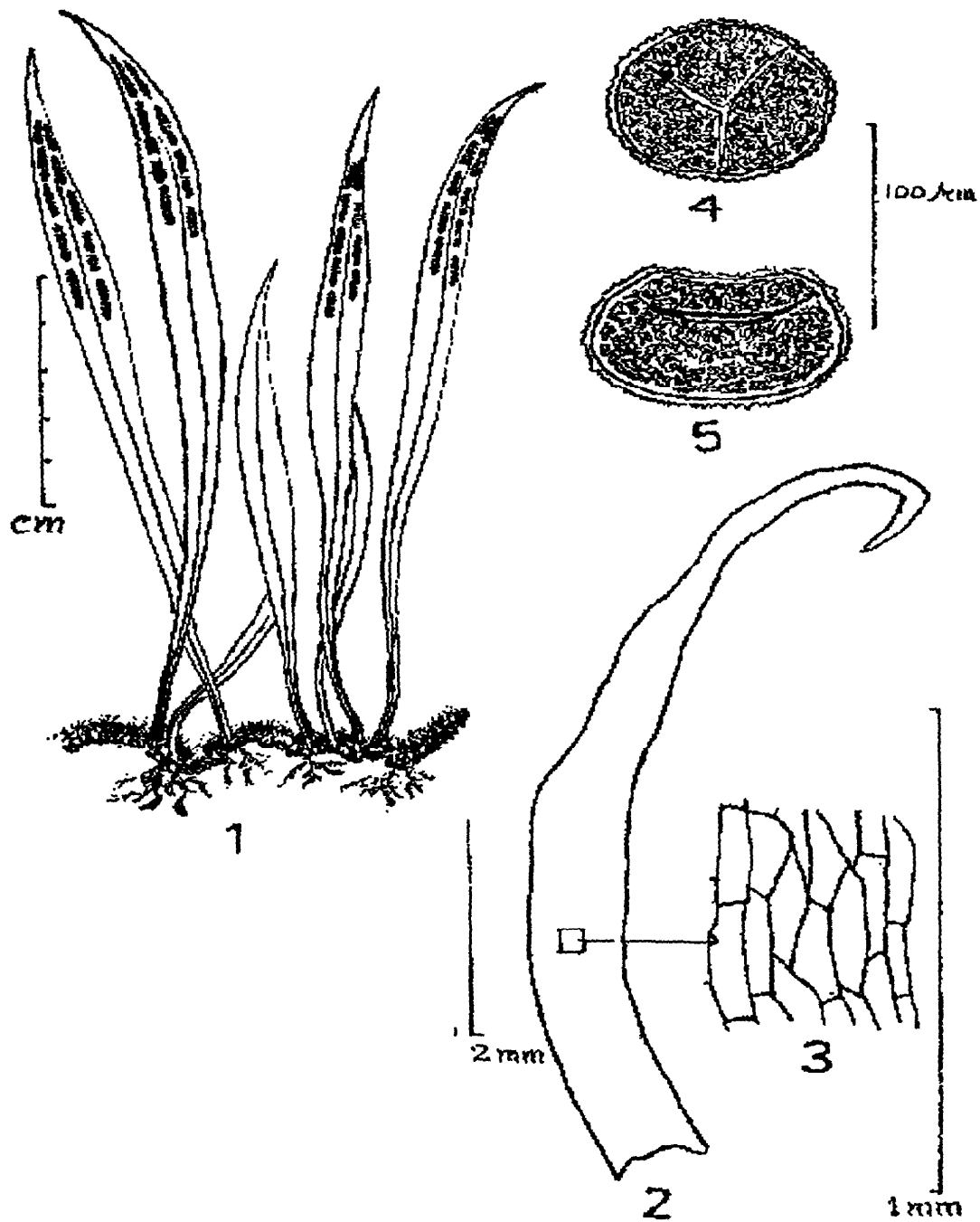


Fig. XV (1-4): *Loxogramme parallela* Copel. : 1. habit ; 2, rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

to deep-brown, surface slightly to deeply wrinkled abaxially, smooth adaxially, margins cartilaginous, costa adaxially prominent. Sori 6 mm long, 2 - 5 mm apart; spores monolet 100 - 105 × 50 - 60 μ m, paraphyses 10 celled long, apical cell small, clavate. Fig. XVI (1-4).

Photograph examined: Holotype *L. porcata* Price examined from "Four new Asian *Loxogramme*" by M.G. Price in *American Fern Journal*, Vol. 80(1) 4 - 8, 1990.

Specimens examined: Arunachal Pradesh, Subansiri Dist. 17-4-85. S.R. Ghosh 59682 (2 sheets); Meghalaya, Shillong Peak, 17-6-56, G. Panigrahi 2772; 18-08-1960, Patnaik 12817 (CAL).

Distrib. : India: Himachal Pradesh, Uttar Pradesh, West Bengal, Assam, Sikkim, Manipur, Meghalaya, Mizoram, Bhutan; CHINA, NEPAL.

17. *Loxogramme remote-frondigera* (Hayata) C.Chr., Index Fil. Suppl. II.22. 1917; Tagawa, Acta Phytot. Geobot. 13: 124. 1949. *Polypodium remote-frondigerum* Hayata in Icon Pl. Form. 5 : 323. f. 135 A. B. 1915.

Rhizomes long-creeping, clothed with clathrate, fuscous brown, ovate-oblong scales. Scales 2 - 3 × 0.5 - 1.0 mm acute to acuminate at apex. Fronds linear-lanceolate; stipes firm, 1.5 - 7.0 cm long, purplish black, shining, more or less compressed; lamina, coriaceous, linear-lanceolate, broadest towards the middle, 30 - 45 cm long, 10 - 12 mm rarely upto 15 mm broad, attenuated at both ends, long acuminate at apex, midrib distinct, thick and flat. Sori linear, 2.0 - 2.3 cm long, oblique to the midrib, with the anterior end of each overlapping the posterior end of the one next above and often confluent at this region when mature, extending from the midrib to very close to the margins of the lamina. Spores monolet, 100 - 105 × 75 - 80 μ m in diam., verrucoid. Fig. XVII (1-4).

Photograph examined : Flora of Taiwan Herbarium, National Taiwan University, Taiwan, China. Loo. Taoyuan Cu. Col. C.M. Kue. 1512-1972. 2583.

Specimens examined : INDIA: West Bengal: Darjeeling; Maney-bhanjang, Dixit 52881, 52881A,

52881B, R.K. Ghosh 991 (CAL); Sanchal Reserve Forest, Dixit 50259 (CAL); CHINA: Hupeh, Henry 5452 (CAL) FORMOSA: Details written in Japanese, collected on 13-03-1940, det. K. Iwastusuki (TY).

Distribution: INDIA: West Bengal. JAPAN, CHINA.

18. *Loxogramme salicifolia* (Makino) Makino, Bot. Mag. Tokyo 19: 138, 1905; Nakakai, Bot. Mag. Tokyo 43: 11, 1929. C. Chr., Contr. U.S. Nat. Herb. 26: 324., 1931; H. ITO, Journ. Jap. Bot. 11: 94. 1935; Ogata, Ic. Fil. Jap. 7: Pl. 321. 1936; Ching, Icon. Fil. Sin. 4: Pl. 190. 1937. *Gymnogramma salicifolia* Makino, Phan. Pter. Jap. Ic. II.1. t. 34., 1899. *Loxogramme makinini* (C. Chr.) C. Chr., Ind. fil. suppl. II. 22. 1917.

Rhizomes slender, scales densely placed at the base of stipes, long ovate, acuminate, entire, membranaceous 7 - 8 × 1.2 - 1.3 mm. Leaves loosely placed on rhizome, linear-lanceolate, 30 - 45 × 2.5 - 3.5 cm including stipe. Stipe 3.5 - 4 cm long, acuminate, greenish on drying, gradually attenuated towards the stipe, texture thick, coriaceous, midrib raised on lower surface, upper half of lamina broadest. Sori oblique, more nearer to midrib than margin, 3 - 3.5 cm long. Sori present half of lamina, spores monolet, 120 - 125 × 70 - 75 μ m. Fig. XVIII (1-4).

Photograph examined : Fujian Province, Chongan country wuyi Mt. P.S. Chin 2242. 2300 (Type, PE).

Specimens examined : Sikkim, Yoksum; Bakhim Road, 1700 m, 18-03-1994. S.R. Ghosh 57887 (CAL); 2 sheets, Kalimpong, Love, Western side of forest Bunglow 2335 m, 6.4.84. S.R. Ghosh 58590-(2 sheets); Darjeeling, 1829 m, 8.5.1975, Dixit 5288 (CAL).

Distrib. : INDIA: West Bengal, Sikkim. CHINA, JAPAN.

19. *Loxogramme subecostata* (Hook.) C. Chr. in Gard. Bull. Strait. Settl. 4: (11 & 12). 405, 1929; Piggott, Ferns of Malaysia in colour 125 t. 366. 1988. *Polypodium subescotatum* Hook., Sp. Fl. 5: 59. t. 283 A. 1863. *Loxogramme brooksii* Copel. in Philip. Journ. Sci. 96: 232. 1910.

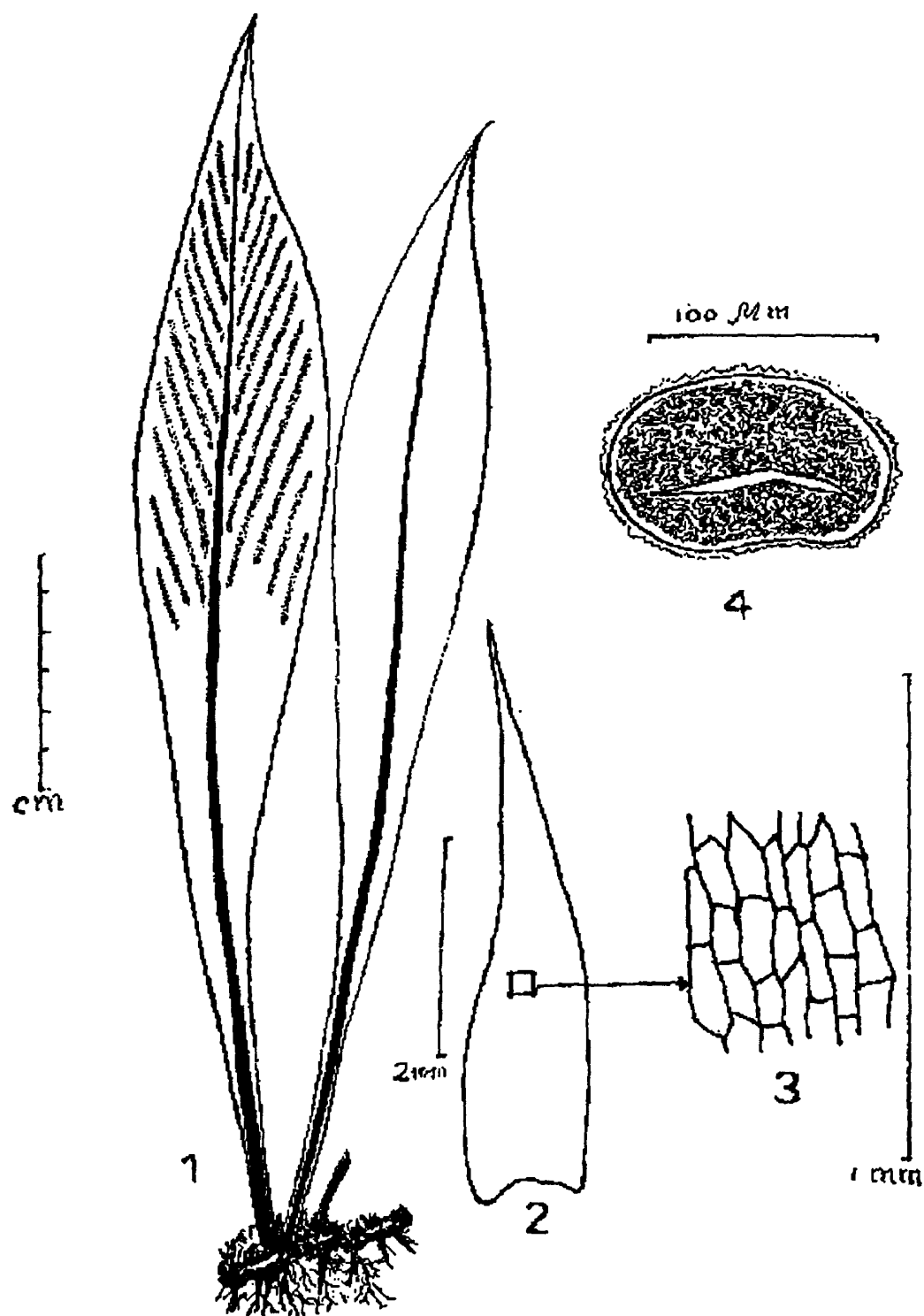


Fig.XVI : *Loxogramme poreata* Price : 1. habit ; 2, rhizome scales;
3. cells of rhizome scales; 4. proximal part of spores.

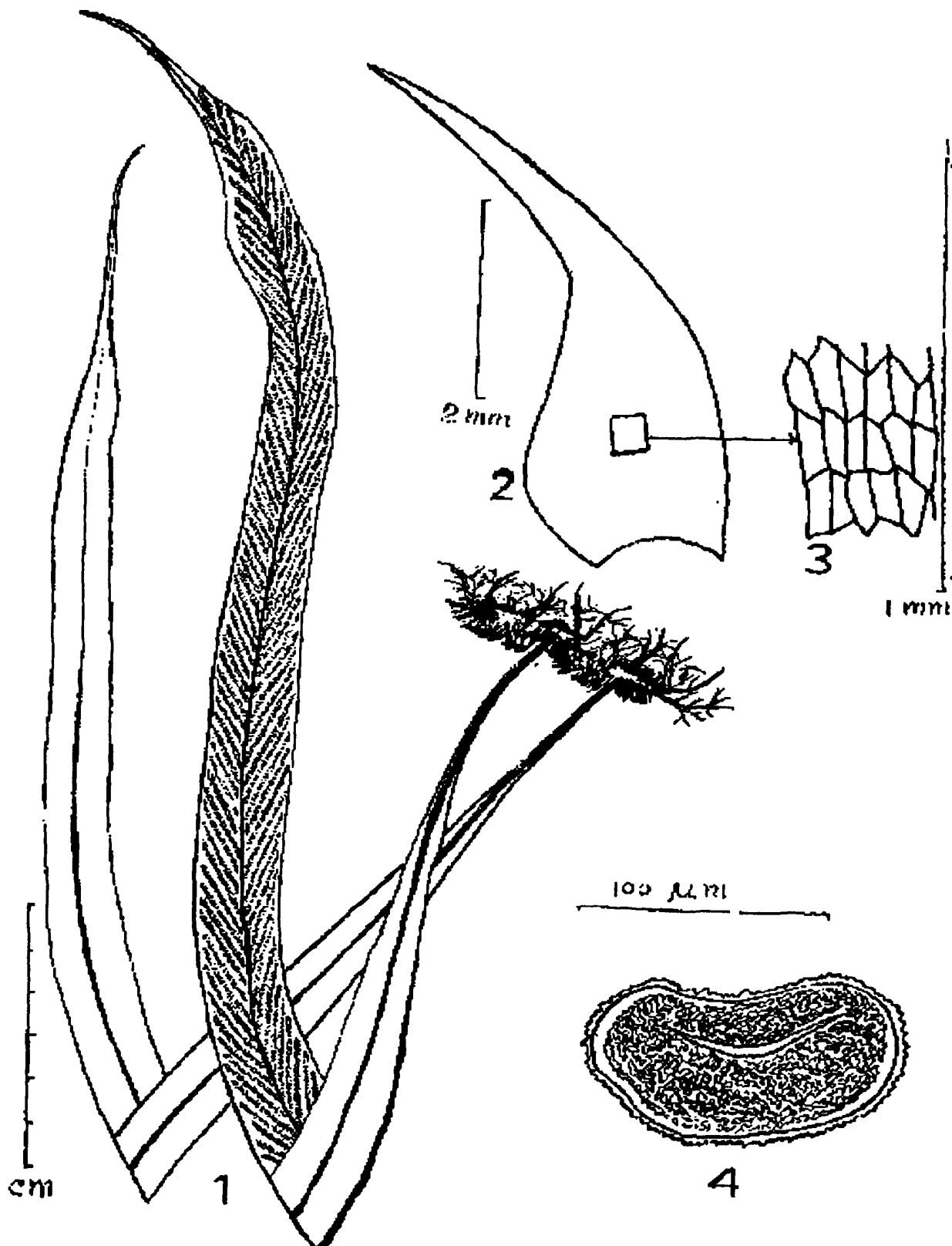


Fig.XVII : *Loxogramme remetefrondegera* (Hayata) C. Chr. : 1. habit ; 2, rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

Rhizomes slender, creeping, clothed with linear-lanceolate, clathrate scales $2.7 - 3.0 \times 0.3 - 0.5$ mm and spreading roots. Fronds elliptic-lanceolate, $15 - 16$ cm $\times$ $9 - 11$ mm. greenish on drying, midrib distinctly raised on the upper surface but not on the lower surface, distinct at base; margins wavy. Sori above the middle, nearer to margins. Lamina involute along the sori or wavy. Sori distinctly placed, not closed together, slightly oblique to the margins, never confluent, spores light yellow, trilete $100 - 120$ μ m, verrucoid. Fig. XIX (1-4).

Photograph examined : Ferns of Malayasia 125 t. 366. 1988. *Loxogramme brooksii* Copel. examined from Phillip. Journ. Sci., C. Botany. III: Plate II. 6. 1916.

Specimens examined : Meghalaya-Shillong, 1888. Acc. No. 242260. *s.l.s.n.* (CAL); Khasia hills, *Hooker* (CAL); MALAYA PENINSULA-Sedagunig Pulan Tiama, 1524 m, 9-5-1927. *Handarean* 18896 (CAL); Perak; Larut, 305-549 m, Aug. 1881, *King's collector* 2235 (CAL); Slangier, May 1896, *s.l.* 7842 (CAL).

Distrib. : INDIA, MEGHALAYA, MALAYASIA.

20. *Loxogramme wallichiana* (Hook.) Price in Amer. Fern. J. 74 : 64 ; Dixit & Das in India Fern Journ. 11 : 28 : f. 5-6. 1994. *Selleguea wallichiana* Hook., Icon. Pl. 3. t. 204. 1840.

Rhizomes thick, creeping, clothed with mass of thick roots and narrowly ovate-lanceolate rufo-brown, thin clathrate scales $7 - 8 \times 0.5 - 1.0$ mm. Fronds $1 - 2$ mm apart, lamina $25 - 45$ cm $\times$ $35 - 4.5$ cm, oblanceolate, long attenuate, sessile and decurrent, drying greenish in colour, apex acute to shortly acuminate, sub-membranous in texture; costa distinct throughout the lower side and raised at the base but not above, pink in colour on drying margins wavy, fragile on drying, surfaces wrinkled, veins reticulate, areoles irregular. Sori oblique, long, starting from basal region upto apex, leaving apex $5 - 8$ cm not reaching upto margins; spores monolet $80 - 90 \times 50 - 60$ μ m, verrucoid. Fig. XX (1-4).

Photographs examined : Lectotype Malay: Penang, 18223, Wallich 10 (CAL), ISO-Lectotype Malay : Penang 1829, Wallich 10 (CAL).

Specimens examined: SIKKIM 25.4.1980. *P.K. Hajra* 93 (SHC) ; 20.07.1981, *P.K. Chakraborty* 1243 (SHC); 20-9-1982; *S.R. Ghosh* 56551 (CAL); 16-3-1984. *S.R. Ghosh* 57777 (CAL); Darjeeling, Karseong 17-5-1983; *S.R. Ghosh* 56897, 57503 (CAL).

Distrib. : INDIA (Sikkim & Darjeeling Himalaya), MALAYA (PENANG).

The species can be easily distinguished from all other species by its oblanceolate fronds, acute at apex, pinkish midrib, lamina on drying-greenish, in colours and sub-membranous in texture.

ACKNOWLEDGEMENT

Grateful thanks are due to Dr. B.D. Sharma, Ex-Director and Dr. P.K. Hajra, Director, Botanical Survey of India, Calcutta for encouragement. Thanks are also due to the Heads of the Regional Circles, B.S.I., Eastern Circle (Shillong); Western Circle (Pune); Southern Circle (Coimbatore); Northern Circle (Dehra Dun) and F.R.I., (Dehra Dun) for sending the specimens on loan.

REFERENCES

- BEDDOME, R.H. The ferns of Southern India, Madras 1863-64, Repri. edn., New Delhi. (1970)
- A Handbook to the ferns of British, Ceylon and the Malay Peninsula, Thacker Spink & Co., Calcutta. 1883.
- Supplement to the ferns of British India, Ceylon and the Malay Peninsula, Thacker Spink & Co., Calcutta. 1892.
- CHANG, YU-LUNG. Studies in the Spore morphology of *Loxogramme* Presl. *Acta Bot. Sin.* 11(1): 26 - 37. 1963.
- CHING, R.C. On the natural classification of the family Polypodiaceae. *Sunyatsenia* 5: 201-268., 1940.
- CHING, R.C. AND WU SU-KUNG. Flora of Xiangica, Vol.1, Pteridophyta ed. by Wa Cheng-Yita, Science Press, China, 6 350. 1983.
- COPELAND, E.B. The genus *Loxogramme*, *Phillip. Journ. Sci. Bot.* 11(1): 43 - 47. 1916

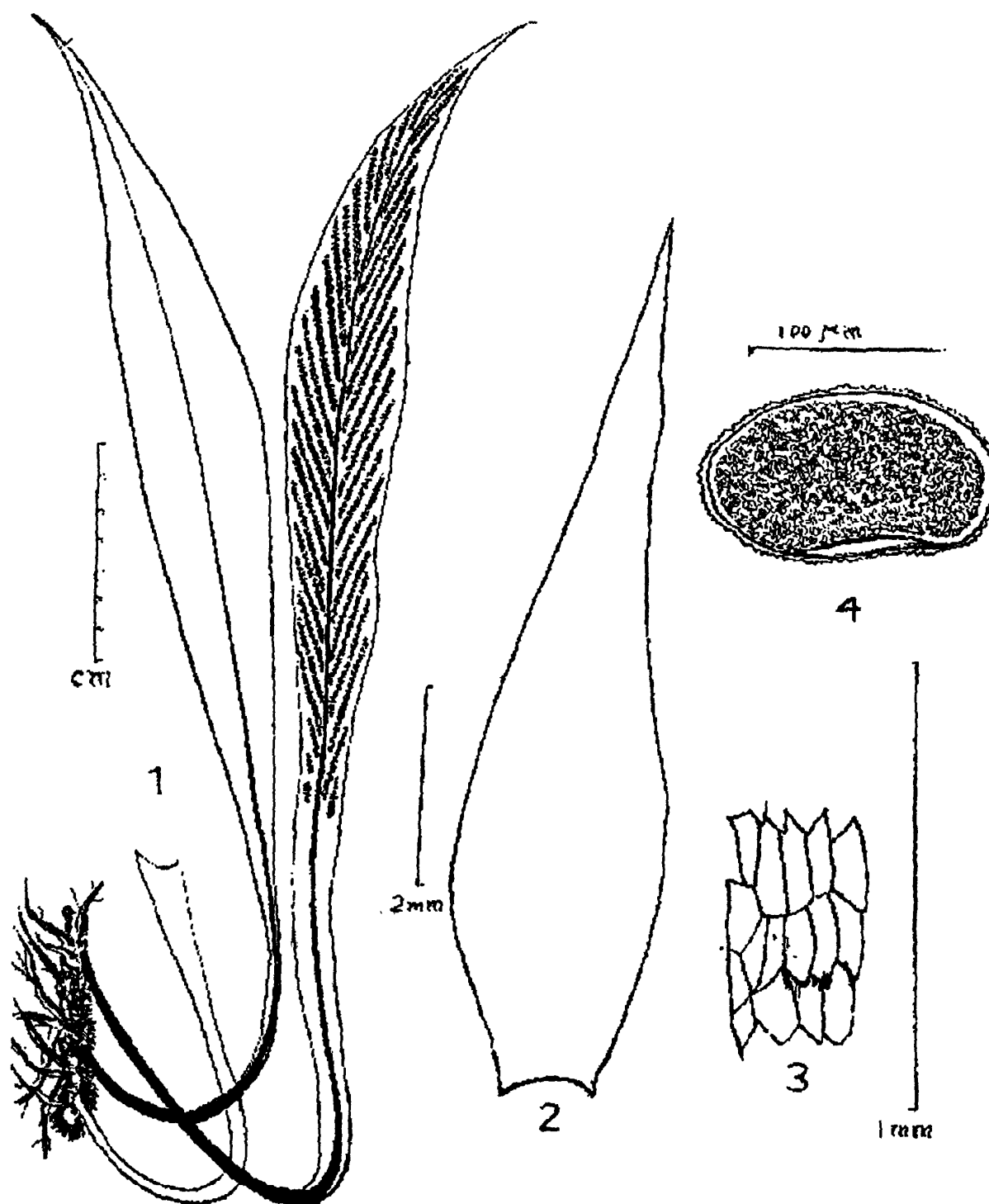


Fig.XVIII (1-4): *Loxogramme salicifolia* Makino: 1. habit; 2, rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

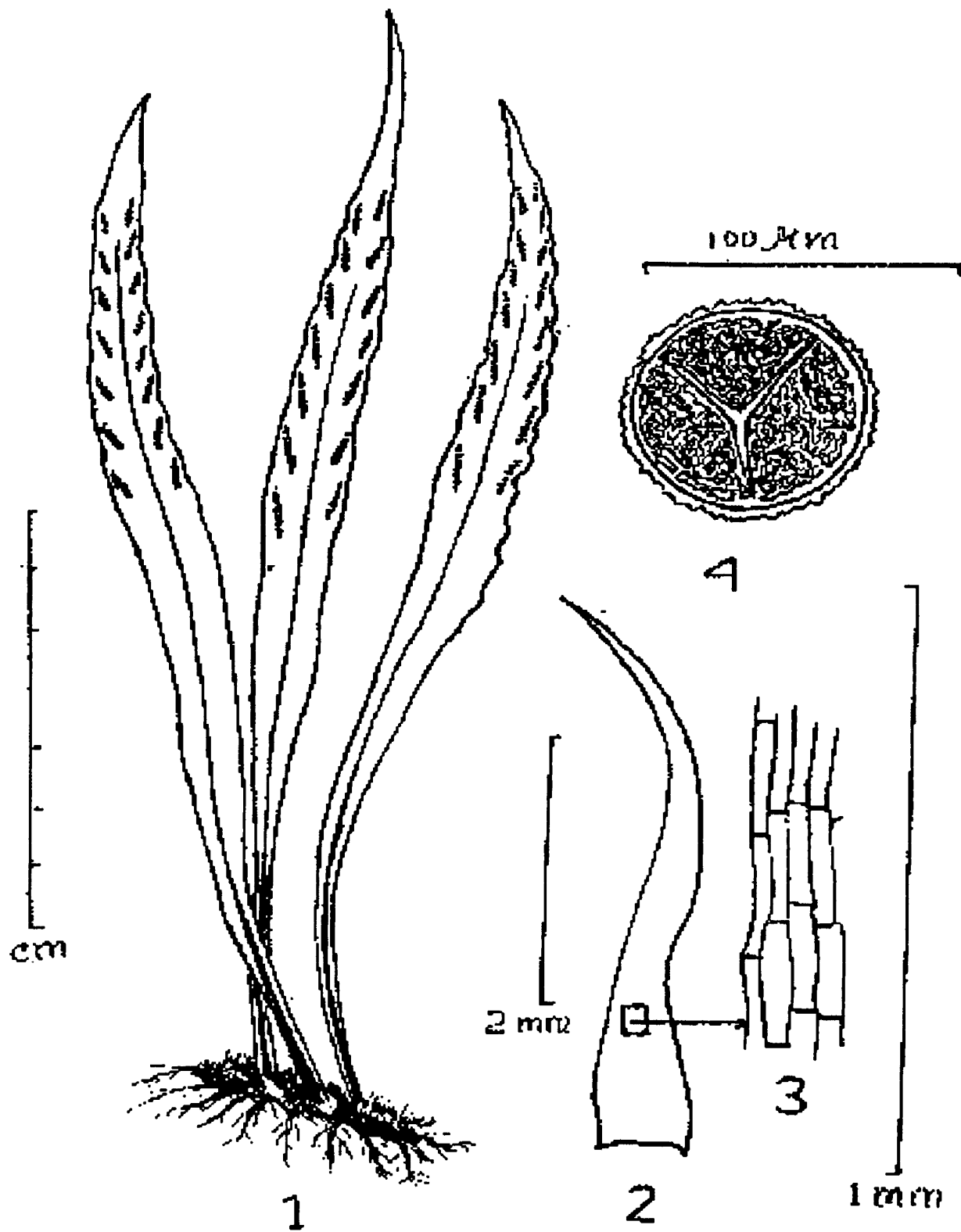


Fig.XIX (1-4): *Loxogramme subcestate* (Hook.) C. Chr. : 1. habit ; 2. rhizome scales; 3. cells of rhizome scales; 4. proximal part of spores.

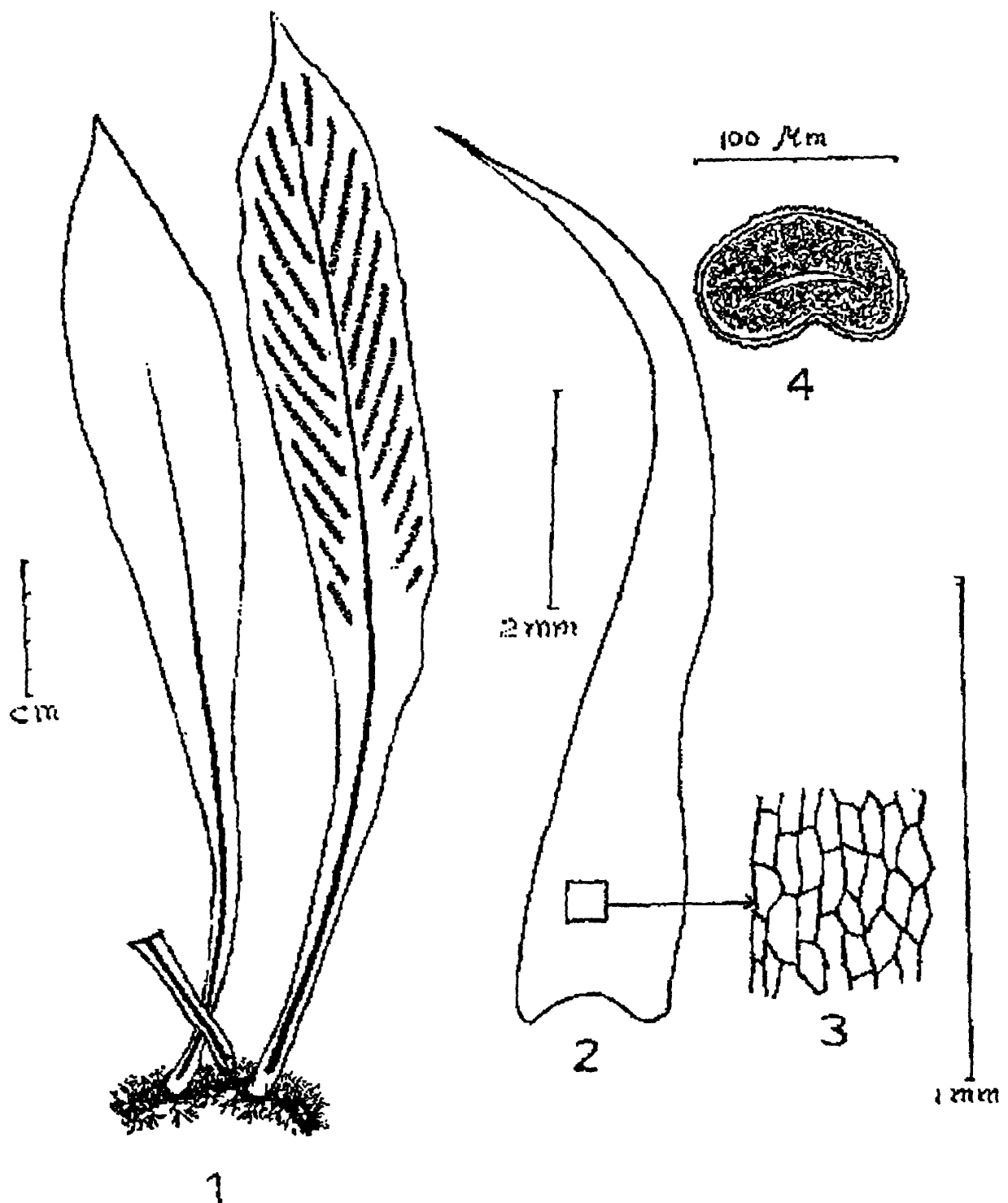


Fig. XX (1-4): *Loxogramme wallichiana* (Hook.) Pic.: 1. habit ; 2. rhizome scales;
3. cells of rhizome scales; 4. proximal part of spores.

- DIXIT, R.D., D. HAJRA AND B.D. KAR. *Loxogramme remote-frondigera* (Hayata) C. Chr. A new record for India and China, *Bull. Bot. Surv. India*, 18: 222, f. 1-3, 1976.
- A Census of the Indian Pteridophytes. Bot. Surv. India, Calcutta, 1984.
- AND SILPI DAS. *Loxogramme mussooriana* Dixit and Das a new species of Fern from India, *Indian Fern Journal* 11: 62, f. 1-3, 1976.
- Two species of *Loxogramme* Presl-new to India, *Indian Fern Journal* 11: 27-30, f. 1-6, 1994.
- AND — *Loxogramme cuspidata* (Zenk.) Price a little known endemic fern from South India with conservation Strategy, *Bull. Bot. Surv. India* 35(1-4): 139, 1994.
- AND — A new species of fern genus *Loxogramme* Presl. from South India, *Bull. Bot. Surv. India* 35(1-4): 133, 1994.
- AND — Proper distribution and correct Identity of *Loxogramme involuta* (D. Don) Presl in India, *Bull. Bot. Surv. India* 35(1-4): 136, 1994.
- AND — Two species of fern genus *Loxogramme* Presl-new to India, *Andaman J. Sci.* 9(1-2): 85-86, 1993.
- DAS, SILPI : Need to conserve fern family *Loxogrammaceae* in India. National Symposium on perspective in Bio-diversity, 1995.
- *Loxogramme lanceolata* (Sw.) Presl not at all occur in Asia. *Botanical Society of Bengal*, 1995.
- Three additional species of fern genus *Loxogramme* Presl. new to India Proc. *Indian Sci. Cong.* (Patiala) 1996.
- HOOKE, W.J. AND GRAVILLE, R.K. *Icones Filicum*, Vol. 1. London, 1831.
- MEHRA P. N. AND S. S. BIR. Pteridophytic flora of Darjeeling and Sikkim Himalayas. *Res. Bull. Punjab Univ.* 15 (1-2) 69-181, 1964.
- NAYAR, B.K. Studies in Polypodiaceae III *Loxogramme* *J. Ind. Bot. Soc.* 34: 395-417, 1975.
- Phylogenetic classification of the Homosporus Ferns. *Taxon* 19: 229-236, 1970.
- AND S. KAUR. Companion to Beddome's Handbook Today & Tomorrow's Publ., New Delhi, 1974.
- OHASHI, H. Pteridophyte in H. Hara's Flora of Eastern Himalayas, 3rd report, *Bull. Univ. Mus. Tokyo* No.8, 166-205, 1975.
- PANIGRAHI, G. Pteridophytes of Eastern India: Enumeration of the species collected and their nomenclature, *Bull. Bot. Surv. India* 2: 309-314, 1960.
- PICHI-SERMOLI R.E.G. *Fragmenta Pteridologiae V. Webbia* 29: 1-16, 1974.
- PRICE, G.M. Three new combinations in *Loxogramme*. *Amer. Fern Jour.* 74 (2) : 61, 1984.
- Four new Asian *Loxogramme* *Amer. Fern. Jour.* 80 (1): 4-8, 1990.
- SINGH, S. AND PANIGRAHI, G. Notes on two species of *Loxogramme* Presl (Pteridophyte) in the Eastern Himalayas, *Bull. Bot. Surv. India*; 27 (1-4): 252-254, f. 1-7, 1985.
- SLEDGE, W.A. The Polypodiaceae and Grammitidaceae of Ceylon. *Bull. Brit. Mus. (N.H.) Bot.* 2(6): 133-158, 1960.
- TAGAWA, M. : *Loxogramme* of Japan. *Acta Phytotax Geobot.* 13: 118-129, 1943.
- Pteridophyta in H. Hara's Flora of Eastern Himalayas, Univ. Tokyo 494-495, 1966.
- Flora of Eastern Himalayas, 2nd report, *Bull. Univ. Mus. Univ. Tokyo* No.2: 218, 1971.