

Taxonomic Revision of the Polypodiaceous Genera of India—VI.

Lepisorus excavatus Group¹

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In an earlier paper Bir and Trikha (1972) treated 13 species of the *Polypodium lineare* complex in the Himalayas, one of which was *Lepisorus excavatus* (Bory) Ching. Further examination of herbarium material obtained from the Central National Herbarium, Howrah, India, and the U. S. National Herbarium, Washington, has shown that there are a few more species in the Himalayas belonging to the *L. excavatus* complex.

Taxonomically, *Lepisorus* (J. Smith) Ching is a most confusing and difficult genus because of the great similarity of its species and their variation (hybridization occurs between some of the species, especially those of the *L. excavatus* and *L. kashyapii* complexes).

The systematic position of *Lepisorus* is itself controversial. It has been recognized as a distinct genus (Christensen, 1938, p. 547; Ching, 1940, p. 258; Nayar, 1961; Holttum, 1968, p. 151; Bir & Trikha, 1968a, 1972) or merged with *Pleopeltis* (Copeland, 1947, p. 183; Panigrahi & Patnaik, 1965). Furthermore, *Lepisorus* (and also *Pleopeltis*) have similarities with *Microsorium* (Bir & Trikha, 1968b). Some species of the genus also have a superficial resemblance to *Phymatodes* because of the similar fronds and soral arrangement, but *Phymatodes* can be distinguished by its hair-like, club-shaped, elongate paraphyses and by the prominent lateral veins of its laminae. Holttum (1968, p. 151) separated *Lepisorus* from other polypodiaceous genera and mentioned the characteristic umbrella-shaped paraphyses which protect the sporangia, especially in young stages. Although the under surface of the laminae of some of the taxa described here is covered with scales, these scales are different from those of *Pleopeltis*, like *P. macrocarpa* (Bory ex Willd.) Kaulf. In *Lepisorus* the laminar scales are absent or deciduous, but in *Pleopeltis* they are persistent. Furthermore, the rhizome scales in *Lepisorus* are attached towards the base, but in *Pleopeltis* they are centrally attached. The distinction between these two genera does not appear to be very sharp. But for the very close resemblance in external morphology and scale structure of the scaly *Lepisorus* species (e. g., *L. oligolepidus*, *L. suboligolepidus*, *L. excavatus* var. *himalayensis* and var. *mortonianus*, and *L. amaurolepidus* var. *longifolius*) with the non-scaly ones, the scaly species could have easily been included in *Pleopeltis*.

As a consequence of our cytotaxonomic studies on the Himalayan members of *Lepisorus*, we discovered several new taxa. All the species treated resemble each other very closely and are sympatric. The chief diagnostic characters are in the rhizome scales and spores. The total number of fully described and illustrated

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Lepisorus species in India is now 20 (see also Bir & Trikha, 1972; Bir & Shukla, 1971). In addition, three taxa of *Pleopeltis* have been described for India (Bir & Trikha, 1968a).

KEY TO THE SPECIES OF LEPISORUS

1. Rhizomes more than 5 mm in diam.
 2. Rhizome scales with large, clear, isodiametric lumina, concolorous.
 3. Laminae coriaceous, the venation hidden; sori nearer to the midrib than the margin; spores tuberculate 1. *L. oligolepidus*
 3. Laminae chartaceous or subcoriaceous, the venation apparent; sori medial; spores verrucose.
 2. *L. suboligolepidus*
 2. Rhizome scales with large, clear, isodiametric lumina, concolorous.
 4. Laminae broadly ovate-lanceolate, broadest in the lower third, chartaceous or coriaceous; sori not sunken; spores verrucose 3. *L. sublinearis*
 4. Laminae lanceolate or narrowly ovate-lanceolate, broadest in the middle, papyraceous, membranaceous, or subcoriaceous; sori deeply sunken; spores tuberculate or verrucose.
 5. Laminae broadly lanceolate with an acute apex, 4–5 cm wide, subcoriaceous, yellowish-brown when dry 6. *L. oosphaerus*
 5. Laminae lanceolate or narrowly ovate-lanceolate, 2–4 cm wide, not subcoriaceous, not yellowish-brown when dry.
 6. Laminae lanceolate with an acuminate apex, 2–2.5 cm wide, papyraceous, blackish-brown when dry 4. *L. leiopteris*
 6. Laminae narrowly ovate-lanceolate with an acute apex, 2–4 cm wide, membranaceous, pale greenish when dry.
 7. Rhizome scales serrate-dentate; sporangial paraphyses either 1- or 2-celled or stellate with protruding teeth 5c. *L. excavatus* var. *himalayensis*
 7. Rhizome scales erose or nearly entire; sporangial paraphyses all umbrella-shaped with an entire margin.
 8. Rhizome scale cells uniformly thickened; spores tuberculate.
 - 5a. *L. excavatus* var. *excavatus*
 8. Rhizome scale cells thin-walled at the margin and thick-walled at the center; spores verrucose to tuberculate-granulate 5b. *L. excavatus* var. *mortonianus*
 1. Rhizome up to 3 mm in diam.
 9. Rhizome scales concolorous, sparingly toothed 7. *L. sordidus*
 9. Rhizome scales bicolorous, prominently toothed.
 10. Stipes 2–4 mm distant, 0.5–1 cm long; laminae 4–8 mm wide, linear; sori submedial, confluent toward the lamina apex 8. *L. subconfluens*
 10. Stipes 5–10 mm distant, 1–3 cm long; laminae 5–20 mm wide, linear-lanceolate; sori medial, not confluent towards the lamina apex.
 11. Fronds 6–25 cm long; laminae beneath almost glabrous except for a few scales at the midrib; young paraphyses without marginal glandular cells.
 - 9a. *L. amaurolepidus* var. *amaurolepidus*
 11. Fronds more than 25 cm long; laminae beneath entirely covered with deciduous scales with glandular apical cells; young paraphyses with marginal glandular cells.
 - 9b. *L. amaurolepidus* var. *longifolius*

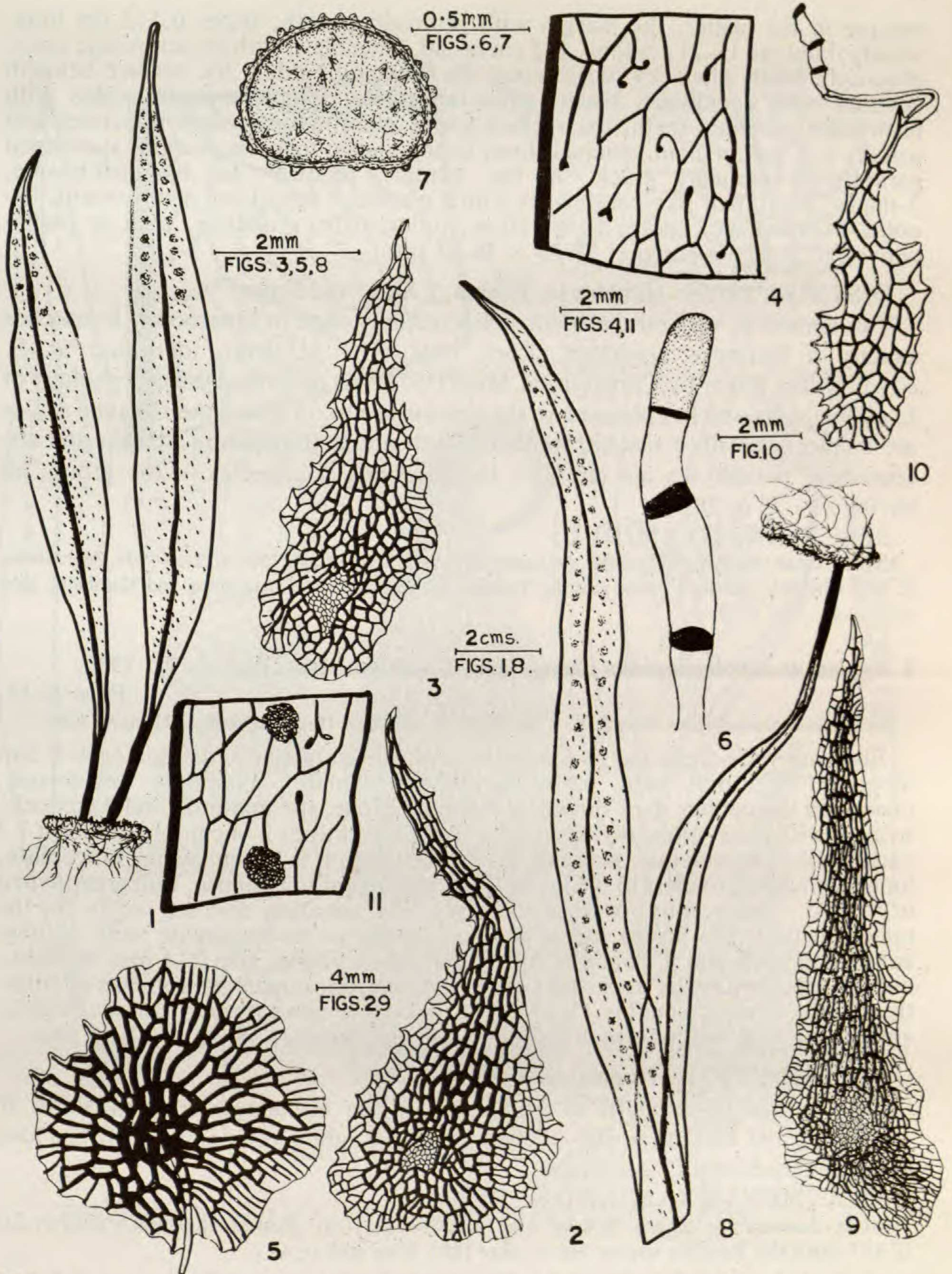
1. *Lepisorus oligolepidus* (Baker) Ching, Bull. Fan Mem. Inst. Biol. 4: 80. 1933.

Figs. 1–7.

Polypodium oligolepidum Baker, Gard. Chron. n.s., 14: 494. 1880.

Polypodium lineare var. *oligolepidum* (Baker) Christ, Bull. Soc. Bot. France 52, Mém. 1: 15. 1905.

Rhizome 5–8 mm in diam., densely scaly, the scales 5–8 mm long, 0.5–0.7 mm wide, narrowly ovate-lanceolate to subulate with a broad base, rigid, bicolorous,



FIGS. 1-7. *Lepisorus oligolepidus*. FIG. 1. Fronds. FIG. 2. Rhizome scale. FIG. 3. Frond scale. FIG. 4. Lamina venation. FIG. 5. Sporangial paraphysis. FIG. 6. Hair-like sporangial paraphysis. FIG. 7. Spore. FIGS. 8-11. *L. suboligolepidus*. FIG. 8. Frond. FIG. 9. Rhizome scale. FIG. 10. Frond scale. FIG. 11. Lamina venation.

opaque in the center, the margin with protruding teeth; stipes 0.5–2 cm long, woody; laminae 15–21 cm long, 1–2 cm broad, lanceolate with an acuminate apex, obscurely black when dry, coriaceous, the venation hidden, the surface beneath covered with deciduous, black, ovate-lanceolate, long-acuminate scales with protruding marginal teeth, the surface above glabrous and often punctate; sori usually 4–5 mm in diam., round, closer to the midrib than the margin; sporangial paraphyses circular, thick in the center, reddish- to blackish-brown, 2–many-celled, hair-like paraphyses with a glandular apical cell also present; annulus 14–16-celled; spores light yellow, tuberculate, granulate, oval or plano-convex to concavo-convex, $55\text{--}80 \times 46\text{--}63 \mu\text{m}$.

DISTRIBUTION: Himalayas, Burma, China, and Japan.

This species is very rare in India, collected only once in Mussoorie. It matches exactly a Burmese specimen, *Rock 7494* (US 1211846), identified as *P. oligolepidum* Baker by Christensen. Mitui (1971) has described the morphology of *L. oligolepidus* and has placed it in the opaque group, in which the rhizome scales are bicolorous with a blackish-brown midrib and a transparent margin and the sporangial paraphyses are circular. He describes six species in the group, all having $x = 25$ or 26 .

SPECIMENS EXAMINED:

INDIA: Uttar Pradesh: Mussoorie, Aruigadh stream in South East, 1500 m, Feb 1903, *Mackinnon* (CAL). **BURMA:** Between Sadon and the Yunnan, China border at Chaugtifang and Kambaiti, Nov 1922, *Rock 7494* (US).

2. *Lepisorus suboligolepidus* Ching, Bull. Fan Mem. Inst. Biol. 4: 77. 1933.

Figs. 8–13.

Polypodium neurodioides form 2. C. Chr. Contr. U. S. Nat. Herb. 26: 319. 1931, *nom. illeg.*

Rhizome wide-creeping, 5–6 mm in diam., densely scaly, the scales 4–9 mm long, ca. 0.05 mm wide, narrowly ovate-lanceolate, acuminate, bicolorous, opaque in the center, dark brown, the margin erose, the marginal and basal cells hyaline with clear, elongate lumina and thin walls; stipes 2–4 cm long, at least 1.5 cm distant, stramineous; laminae 16–28 cm long, 1.5–2.5 cm wide, lanceolate, long-attenuate, broadest in the lower third, decurrent to the base, dull green when dry, rigid, chartaceous, or subcoriaceous, the venation distinct, scaly on the under surface, the scales lanceolate to broadly ovate-lanceolate with a long-acuminate apex and a glandular apical cell when young; sori 2–4 mm in diam., medial, confined to the upper part of the laminae; sporangial paraphyses circular, thick, dark brown; annulus 12–17-celled; spores hyaline to pale yellow, slightly verrucose, oval to reniform or concavo-convex, regular, $58\text{--}79 \times 37\text{--}46 \mu\text{m}$.

DISTRIBUTION: Himalayas and China.

This species is epiphytic or lithophytic in the Himalayas from Kashmir to Darjeeling and Sikkim, at 300–1500 m elevation, and is not common. It has long been confused with *L. excavatus*.

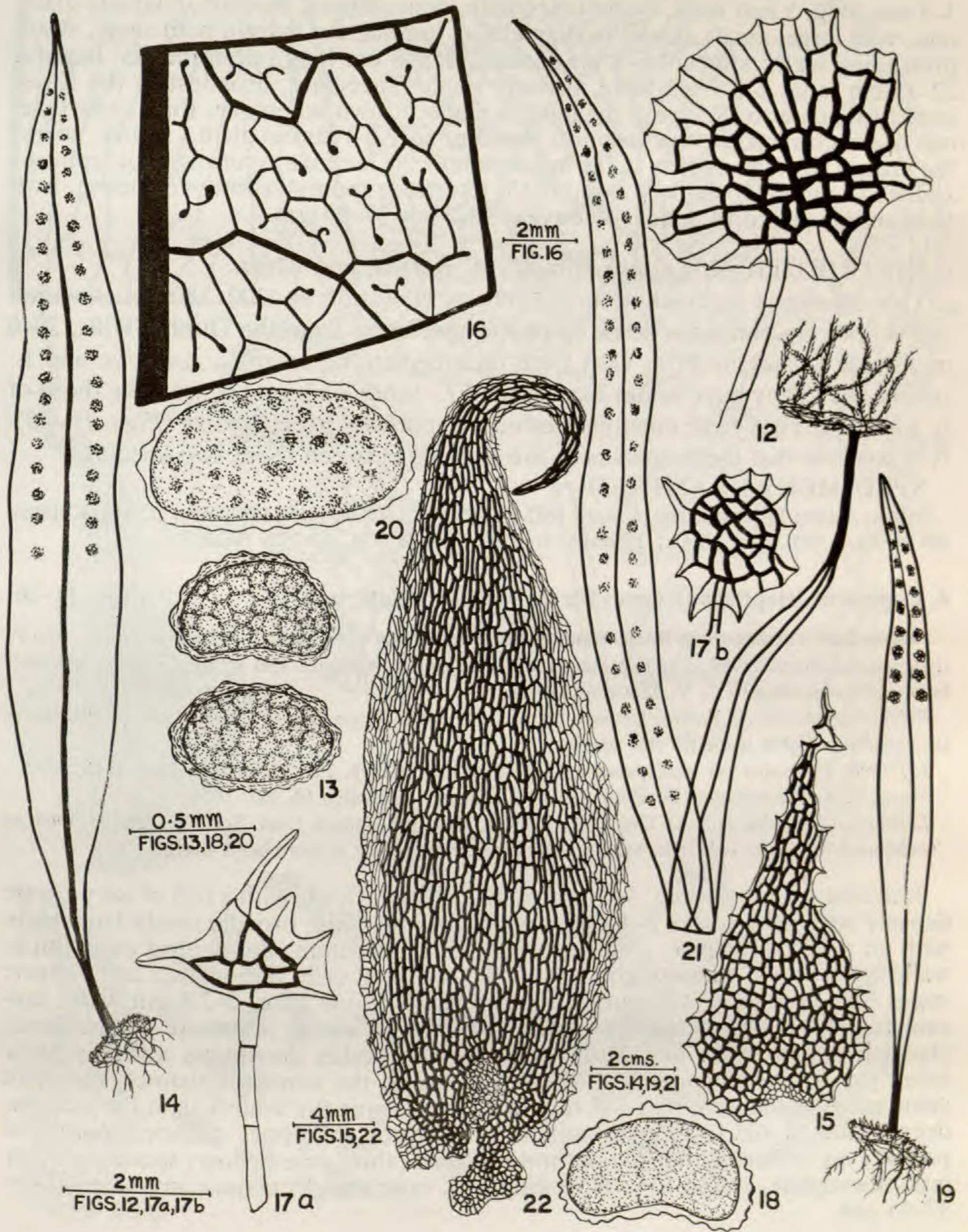
SPECIMENS EXAMINED:

INDIA: Kashmir: Sonamarg, 1050 m, Aug 1921, *Stewart* (US). **ASSAM:** Sept 1882, *Godfrey 273* (CAL). **SIKKIM:** Rangbee stream, 500 m, Sept 1887, *King 4005* (CAL).

3. *Lepisorus sublinearis* (Baker) Ching, Bull. Fan Mem. Inst. Biol. 4: 78. 1933.

Figs. 14–18.

Polypodium sublineare Baker ex Takeda, Notes Roy. Bot. Gard. Edinb. 8: 276. 1915.



FIGS. 12-13. *Lepisorus suboligolepidus*. FIG. 12. Sporangial paraphysis. FIG. 13. Spore. FIGS. 14-18. *L. sublinearis*. FIG. 14. Frond. FIG. 15. Rhizome scale. FIG. 16. Lamina venation. FIGS. 17a, b. Sporangial paraphyses. FIG. 18. Spore. FIGS. 19-20. *L. sublinearis* × *sordidus*. FIG. 19. Frond. FIG. 20. Spore. FIGS. 21-22. *L. leiopteris*. FIG. 21. Frond. FIG. 22. Rhizome scale.

Rhizome creeping, hypogeous, at least 5 mm in diam., densely scaly, the scales 3–5 mm long, 5 mm wide, ovate-lanceolate, concolorous, fuscous, coarsely clathrate, with large, clear, almost isodiametrical lumina, the margin with short, stout, protruding teeth; stipes 0.5–1 cm distant, 2.5–8 cm long, stramineous; laminae 22–35 cm long, 2–2.7 cm wide, broadly ovate-lanceolate, broadest in the lower third, attenuate to the apex, the margin plane, brown when dry, thick, chartaceous or subcoriaceous, the venation obscure; sori 2–3 mm in diam., round, nearer the margin than the midrib, in the apical half of the laminae; sporangial paraphyses stellate to umbrella-shaped; annulus 13–16-celled; spores yellow, verrucose, oval to round or plano- to concavo-convex, $50\text{--}75 \times 37\text{--}50 \mu\text{m}$.

DISTRIBUTION: Eastern Himalayas, Burma, and China.

This species is an epiphyte in the forests of Assam at 1200–1800 m elevation and is not very common. Some epiphytic specimens from the Duphia Hills, 2040 m altitude (*Lister* in 1874, CAL) are intermediate between *L. sordidus* and *L. sublinearis*. They have scales like those of *L. sublinearis* and fronds like those of *L. sordidus*. They have minutely verrucose spores of irregular size (*Figs. 19–20*). It is possible that these specimens are hybrids between these two species.

SPECIMENS EXAMINED:

INDIA: Assam: Manipur, 1800 m, April 1882 *Watt* (CAL), 600 m, April 1882, *Watt* (CAL); Kohima, 400 m, April 1896, *King* (CAL). **BURMA:** Nov 1922, *Rock* 7424 and 7509 (both US).

4. *Lepisorus leiopteris* (Kunze) Bir & Trikha, comb. nov.

Figs. 21–26.

Polypodium scolopendrium Buch.-Ham. ex D. Don, Prodr. Fl. Nepal. 1. 1825, *nom. illeg.*, non *P. scolopendria* Burm., 1768. The two names are orthographic variants, and so Don's name is a later homonym, according to C. V. Morton (*in litt.*).

Polypodium leiopteris Kunze, Linnaea 23: 279, 319. 1850. According to Ching (1933, p. 69), this is the earliest available name for this species.

Lepisorus excavatus var. *scolopendrium* (D. Don) Ching, Bull. Fan Mem. Inst. Biol. 4: 69. 1933.

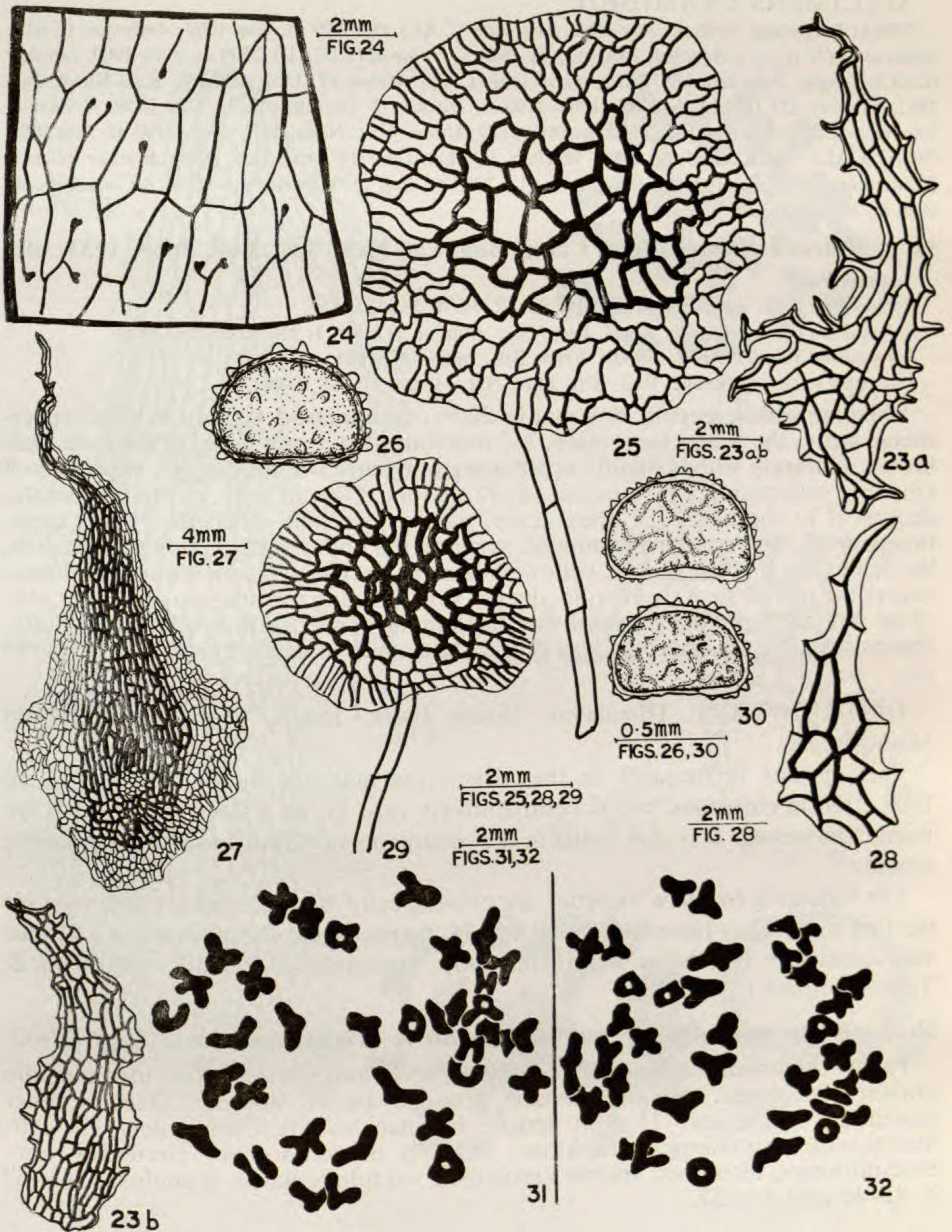
Pleopeltis scolopendrium (D. Don) Alston & Bonner, Candollea 15: 207. 1956.

Lepisorus scolopendrium (D. Don) Mehra & Bir, Res. Bull. Panjab Univ. Sci. n.s., 15: 168. 1964, as "*scolopendrius*." The old, indeclinable generic name ought not to have been altered.

Rhizome wide-creeping, 5–6 mm in diam., superficial, with a tuft of wiry roots, densely scaly, the scales 3–8 mm long, 1–1.5 mm wide, broadly ovate-lanceolate with an acuminate apex, concolorous, brown, clathrate, the central cells thick-walled and brown, the margins erose, the marginal cells thin-walled and yellow; stipes 0.5–5 cm long, stramineous; laminae 30–40 cm long, 2–2.5 cm wide, lanceolate with a long-acuminate apex, the margin wavy, attenuate to the base, blackish-brown when dry, scaly beneath, the scales deciduous and glandular when young, papyraceous with prominent veins, the venation distinct, the main veins quite prominent; sori 3–5 mm in diam., nearer the midrib than the margin, deeply sunken and forming prominent pustules on the upper surface; sporangial paraphyses umbrella-shaped, clathrate, peltate, thin, pale yellow; spores more or less tuberculate, round to oval or elliptical, concavo- to plano-convex, $63\text{--}75 \times 37\text{--}55 \mu\text{m}$.

DISTRIBUTION: Himalayas.

This is one of the commonest species of the genus at 1500–2700 m altitude in the eastern Himalayas, and is either epiphytic or lithophytic. The rhizome apex often projects away from the substrate and is borne on a tuft of wiry roots.



FIGS. 23-26. *Lepisorus leiopteris*. FIGS. 23a, b. Frond scales. FIG. 24. Lamina venation. FIG. 25. Sporangial paraphysis. FIG. 26. Spore. FIGS. 27-32. *L. excavatus* var. *mortonianus*. FIG. 27. Sporangial paraphysis. FIG. 28. Frond scale. FIG. 29. Sporangial paraphysis. FIG. 30. Spore. FIGS. 31-32. Spore mother cell at metaphase-I showing 37 bivalent chromosomes.

SPECIMENS EXAMINED:

INDIA: Darjeeling: Peshok, Aug 1862, *Anderson* (CAL), 600–900 m, Aug 1862, *Anderson* (CAL), *Anderson 1472* (CAL); Senchal, 2400 m, July 1880, *Gamble 8212* (CAL), 2500 m, June 1900, *Levinge* (CAL); Tonglu, Aug-Sept 1887, *King's collector* (CAL), *Mehra 12* (US). **ASSAM:** Kula Kawa, July 1882, *Godfrey 253* (CAL); Khasya, 1200–2100 m, *Hooker & Thomson* (US), July 1850, *Hooker & Thomson* (CAL); Khasya Hills, 1500 m, Aug 1889, *Mann* (US); Naga Hills, 1800–2100 m, Aug 1862, *Prain* (CAL). **SIKKIM:** July 1887, *Wallich* (CAL), *Devi* (CAL), Oct 1887, *Hooker* (CAL); Phedoucher, 2400 m, July 1880, *Gamble* (CAL), 2400 m, Aug 1910, *Smith 4399* (CAL); Choongthung, 1950 m, May 1886, *King* (CAL).

5a. *Lepisorus excavatus* (Bory) Ching, Bull. Fan Mem. Inst. Biol. 4: 68. 1933, var. *exavatus*²

Polypodium excavatum Bory ex Willd. Sp. Pl. ed. 4, 5: 158. 1810.

Polypodium lineare Clarke, Trans. Linn. Soc. London II, Bot. 1: 558. 1880, *pro parte*.

Polypodium simplex Bedd. Handb. Ferns Brit. India 347. 1883.

Pleopeltis excavata Sledge, Bull. Brit. Mus. Nat. Hist. 2(5): 138. 1960.

Rhizome wide-creeping, 4–9 mm in diam., compressed, woody in some specimens, scaly, the scales lanceolate, 3–7 mm long, 1–1.5 mm wide, acuminate, dull brown, clathrate with a slightly erose margin; fronds 1–2 cm distant; stipes 0.5–4 cm long, yellowish-green; laminae 14–42 cm long, 2–4 cm wide, ovate-lanceolate, decurrent at the base, the apex acute, pale or greenish when dry, stiff, membranaceous, the venation prominent, scaly on the under surface along the midrib, the scales thick in the center, yellowish-brown, deciduous; sori 3–5 mm in diam., nearer the midrib than the margin, deeply sunk forming pustules on the upper side of the laminae; sporangial paraphyses thick in the center, with a rather short stalk; spores light brown, more or less tuberculate, oval to reniform, 48–69 × 34–45 μm.

DISTRIBUTION: Himalayas, South India, Japan, tropical Africa and Madagascar.

This species is frequent in the Himalayas and usually is an epiphyte at 1500–2100 m elevation, but is comparatively rare in the Eastern Himalayas towards Darjeeling. It is also found in the mountains of South India at comparable altitudes.

The following two new varieties are cytologically distinct, and are reported for the first time. They have $n = 37$ and $n = 36$, respectively, in contrast to $n = 35$ for var. *excavatus* (Malhotra in Mehra, 1961; Panigrahi & Patnaik, 1961; Bir & Trikha, unpubl.).

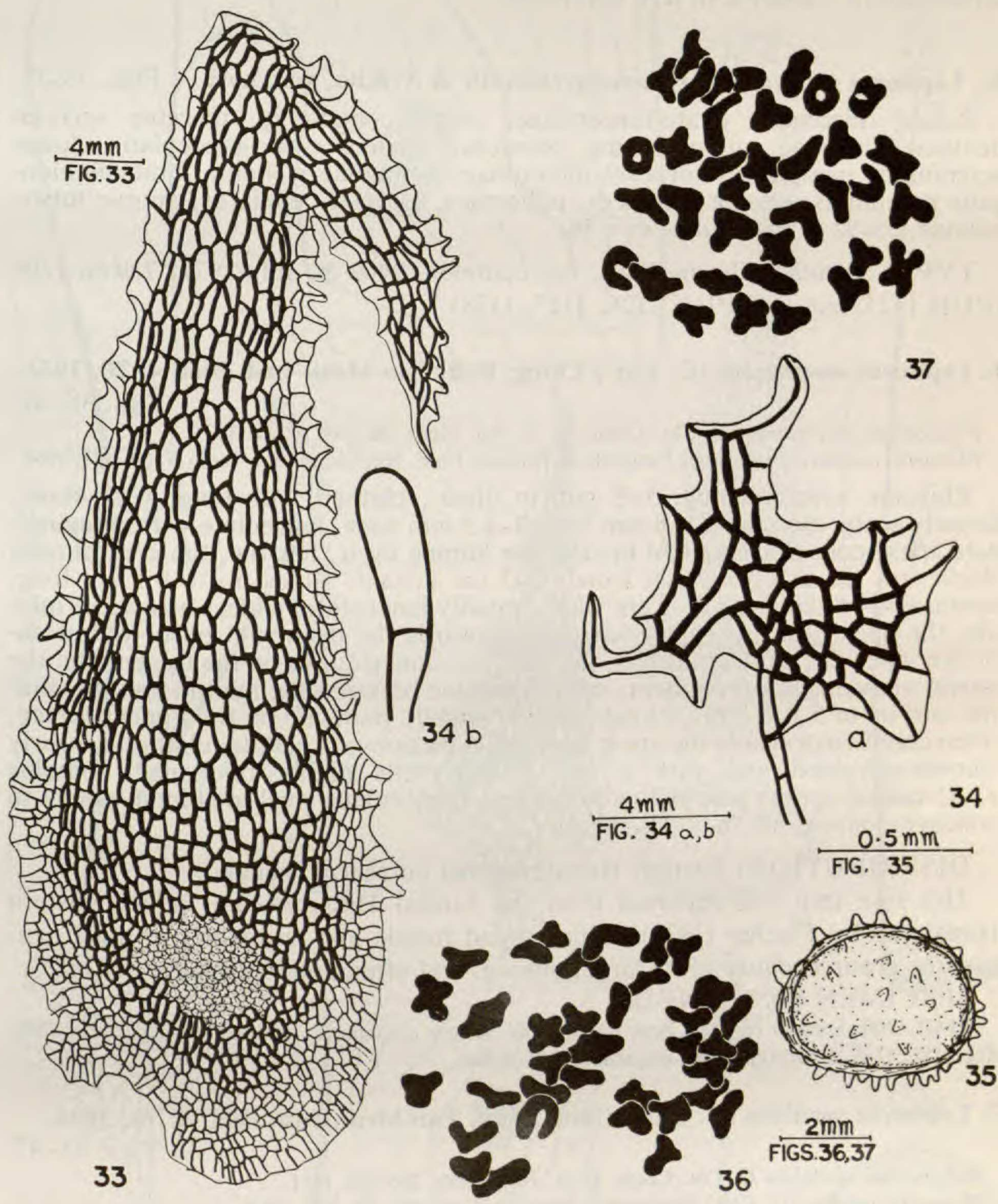
5b. *Lepisorus excavatus* var. *mortonianus* Bir & Trikha, var. nov. Figs. 27–32.

Paleae rhizomatis late ovato-lanceolatae, apice longe acuminatae, medio paullo crassae, bicolores, margine erosae; frondae paullo approximatae, breviter stipitatae, stipite ca. 15 mm longo; laminae subtus cum paleis eis var. *himalayensis* similibus; paraphyses sororum monomorphae, circulares, umbraculiformes, bicolores; sporae verrucosae vel tuberculatae, granulosaе, 63–67 × 42–46 μm; $n = 37$.

TYPE: Near Tiffon top, Nainital, epiphytic, 2250 m, July 1971, *Trikha 1905* (PUN 1121;³ isotypes PUN 1122, 1123, 1124).

²For illustrations, see Bir and Trikha (1972, *f.* 3, 46–49).

³Abbreviation for the herbarium of Punjabi University, Patiala 147 002, India.



FIGS. 33-37. *Lepisorus excavatus* var. *himalayensis*. FIG. 33. Rhizome scale. FIGS. 34a, b. Sporangial paraphyses. FIG. 35. Spore. FIGS. 36-37. Spore mother cells at metaphase-I showing 36 bivalent chromosomes.

This variety is named in honor of the late C. V. Morton, who initiated the senior author's interest in fern taxonomy.

5c. *Lepisorus excavatus* var. *himalayensis* Bir & Trikha, var. nov. Figs. 33–37.

Paleae rhizomatis ovato-lanceolatae, saepe concolores, margine serrato-dentatae; laminae subtus parce paleaceae, paleis ovato-lanceolatis, longe acuminatis; paraphyses sororum dimorphae, nonnullae stellatae, brachiis elongatis patentibus, alterae simplices, piliformes, 1- vel 2-cellulares; sporae tuberculatae, $55\text{--}92 \times 35\text{--}63 \mu\text{m}$; $n = 36$.

TYPE: Nainital, Cheena Peak, not common, 2400 m, July 1971, *Trikha 1100* (PUN 1125; isotypes PUN 1126, 1127, 1128).

6. *Lepisorus oosphaerus* (C. Chr.) Ching, Bull. Fan Mem. Inst. Biol. 4: 70. 1933.

Figs. 38–42.

Polypodium oosphaerum C. Chr. Contr. U. S. Nat. Herb. 26: 334, pl. 29. 1931.

Pleopeltis oosphaera (C. Chr.) Panigrahi & Patnaik, Proc. Nat. Acad. Sci. India B, 34: 482. 1964.

Rhizome wide-creeping, 5–8 mm in diam., clothed with long, wiry roots, densely scaly, the scales 2–8 mm long, 1–2.5 mm wide, lanceolate with an acuminate apex, concolorous, light brown, the lumina clear, narrow, the central cells thickened, the margin erose; fronds 2–3 cm distant; stipes up to 0.5 cm long; laminae 30–40 cm long, 4–5 cm wide, broadly lanceolate, widest below the middle, the apex acute, abruptly narrowed towards the decurrent base, yellowish-brown when dry, subcoriaceous, the venation conspicuous on the upper side, the lateral midveins not prominent, up to 6 areolae between the margin and the midrib; sori up to 5×8 mm, oblong, medial, slightly punctate on the upper surface, often confluent towards the apex; sporangial paraphyses peltate, clathrate, nearly smooth-margined and with a few middle cells highly thickened; annulus 12–15-celled; spores pale yellow to hyaline, tuberculate, oval to elliptic, plano- to concavo-convex, $59\text{--}76 \times 37\text{--}55 \mu\text{m}$.

DISTRIBUTION: Eastern Himalayas and northern Thailand.

This rare fern was reported from the Lushai Hills, Assam, in the eastern Himalayas by Fischer (1938). It has broad fronds and is distinct in the *L. excavatus* group because of its large, oblong, and often confluent sori.

SPECIMEN EXAMINED:

THAILAND: Summit of Doi Chom Cheng, Doi Sootep mountains, 1500–1600 m, 1–6 Nov 1920, *Rock 1515* (US, a paratype of *P. oosphaerum* C. Chr.).

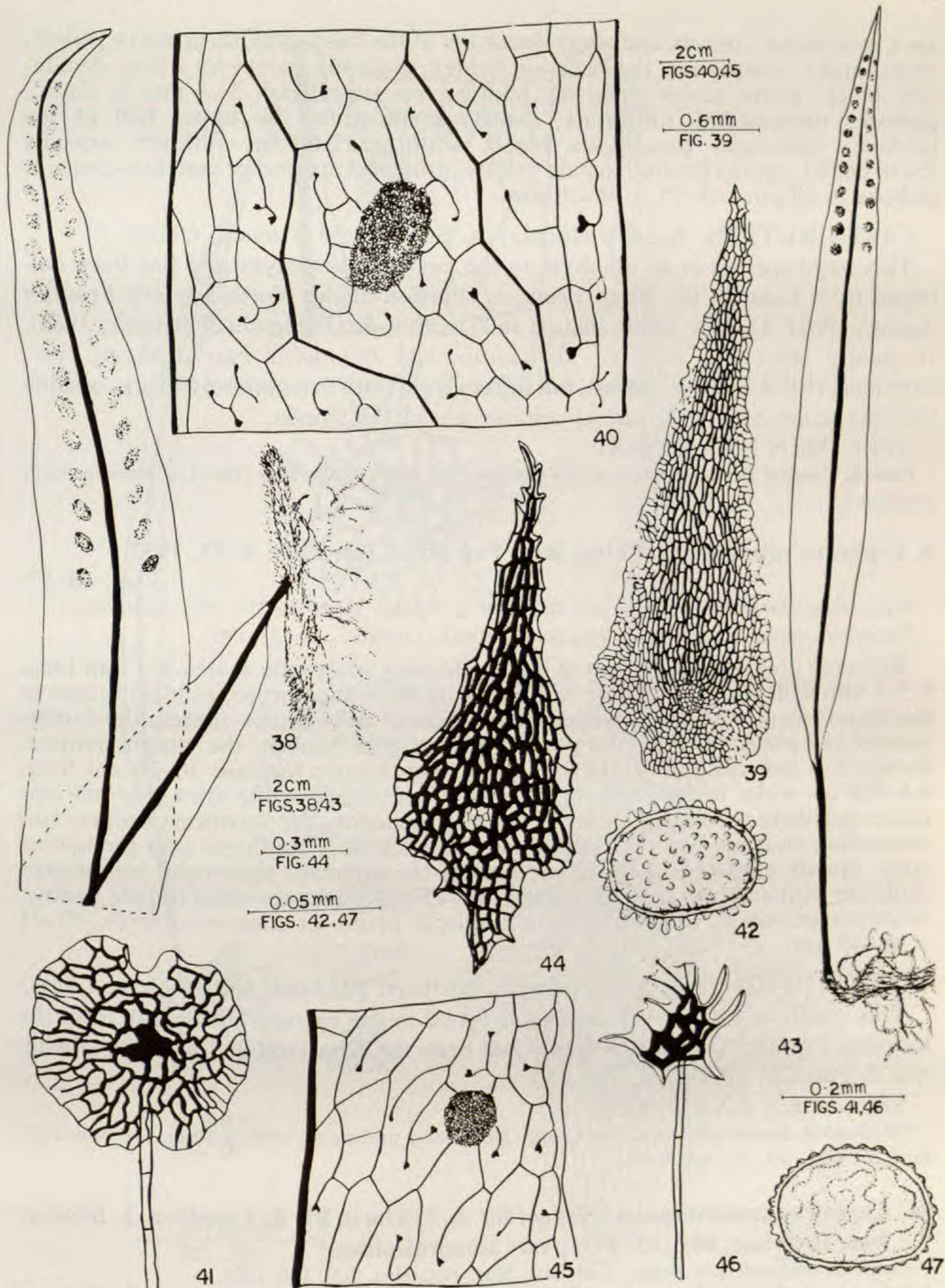
7. *Lepisorus sordidus* (C. Chr.) Ching, Bull. Fan Mem. Inst. Biol. 4: 78. 1933.

Figs. 43–47.

Polypodium sordidum C. Chr. Contr. U. S. Nat. Herb. 26: 320. 1931.

Pleopeltis sordida (C. Chr.) Panigrahi & Patnaik, Curr. Sci. 34: 127. 1965.

Rhizome rather short-creeping, ca. 3 mm in diam., hypogeous, black, covered with a mass of fibrous roots, the young portions scaly, the scales 1–2 mm long, 0.5–0.8 mm wide, lanceolate with an acuminate apex, sparingly short-toothed, concolorous, blackish-brown to black, entirely opaque, rigid, the lumina of the cells small and narrow; fronds up to 0.25 cm distant, articulate to short pseudopodia; stipes 6.5–9 cm or more long, green-stramineous, sulcate above, glabrous; laminae 20–45 cm long, 2–3.5 cm wide below the middle, lanceolate, the



FIGS. 38-42. *Lepisorus oosphaerus*. FIG. 38. Frond. FIG. 39. Rhizome scale. FIG. 40. Lamina venation. FIG. 41. Sporangial paraphysis. FIG. 42. Spore. FIGS. 43-47. *L. sordidus*. FIG. 43. Frond. FIG. 44. Rhizome scale. FIG. 45. Lamina venation. FIG. 46. Sporangial paraphysis. FIG. 47. Spore.

apex acuminate, cuneate and short-decurrent at the base, grayish-green to yellow, often smoky, coriaceous, the venation hidden, glabrous except for a few, deciduous, black, ovate scales along the midrib; sori superficial, 3–4 mm in diam., globose, suprasedial, uniseriate, usually confined to the upper half of the laminae; sporangial paraphyses black, clathrate, stellate, filiform; annulus 12–16-celled; spores hyaline to pale yellow, granulate, plano- or concavo-convex, globose to elliptic, $63\text{--}75 \times 46\text{--}50 \mu\text{m}$.

DISTRIBUTION: Eastern Himalayas, Burma, and Yunnan, China.

This large species is an epiphyte in the eastern Himalayas and has been collected from Laju, in the Tirap Frontier Division of the North Eastern Frontier Agency (NEFA), now Arunachal, at 1600 m altitude (Panigrahi & Patnaik, 1965). It greatly resembles both *L. sublinearis* and *Pleopeltis macrosphaera* var. *astrolepis* (Bir & Trikha, 1968a), but differs from both in its entirely black, opaque rhizome scales and in the smoky appearance of the fronds.

SPECIMEN EXAMINED:

CHINA: Yunnan: Between Tengueh and Lunging, Oct–Nov 1922, *Rock 7160* (US, holotype of *P. sordidum*).

8. *Lepisorus subconfluens* Ching, Bull. Fan Mem. Inst. Biol. 4: 83. 1933.

Figs. 48–52.

Polypodium neurodioides C. Chr. var. 4, Contr. U. S. Nat. Herb. 26: 319. 1931, *nom. illeg.*

Pleopeltis subconfluens (Ching) Panigrahi & Patnaik, Curr. Sci. 34: 127. 1965.

Rhizome creeping, ca. 2 mm in diam., densely scaly, the scales 2–3 mm long, 0.5–1 mm wide, linear-subulate with an ovate base, bicolorous, reddish-brown to blackish-brown, with thick-walled, dark colored cells in the center, the lumina narrow and elongate, the basal portion and margins hyaline, the margin dentate; fronds 2–4 mm distant; stipes 0.5–1 cm long, terete; laminae 10–20 cm long, 0.4–0.8 cm wide, linear-elongate, gradually acuminate at the apex, the margins rather narrowly revolute, greenish-brown, coriaceous, the venation obscure; sori submedial, elongate-oblong, approximate, more or less confluent near the lamina apex, mostly confined to the upper half of the laminae; sporangial paraphyses clathrate with an erose margin; annulus 13–15-celled; spores clear to pale yellow, reticulate-granulate, round to oval or elliptical, plano- or concavo-convex, $50\text{--}71 \times 46\text{--}59 \mu\text{m}$.

DISTRIBUTION: Eastern Himalayas, northern Thailand, and Yunnan, China.

This small, narrow-leaved species is found in the eastern Himalayas from the Kameng Frontier Division (NEFA) and from the Khasia Hills in Assam (Panigrahi & Patnaik, 1964).

SPECIMEN EXAMINED:

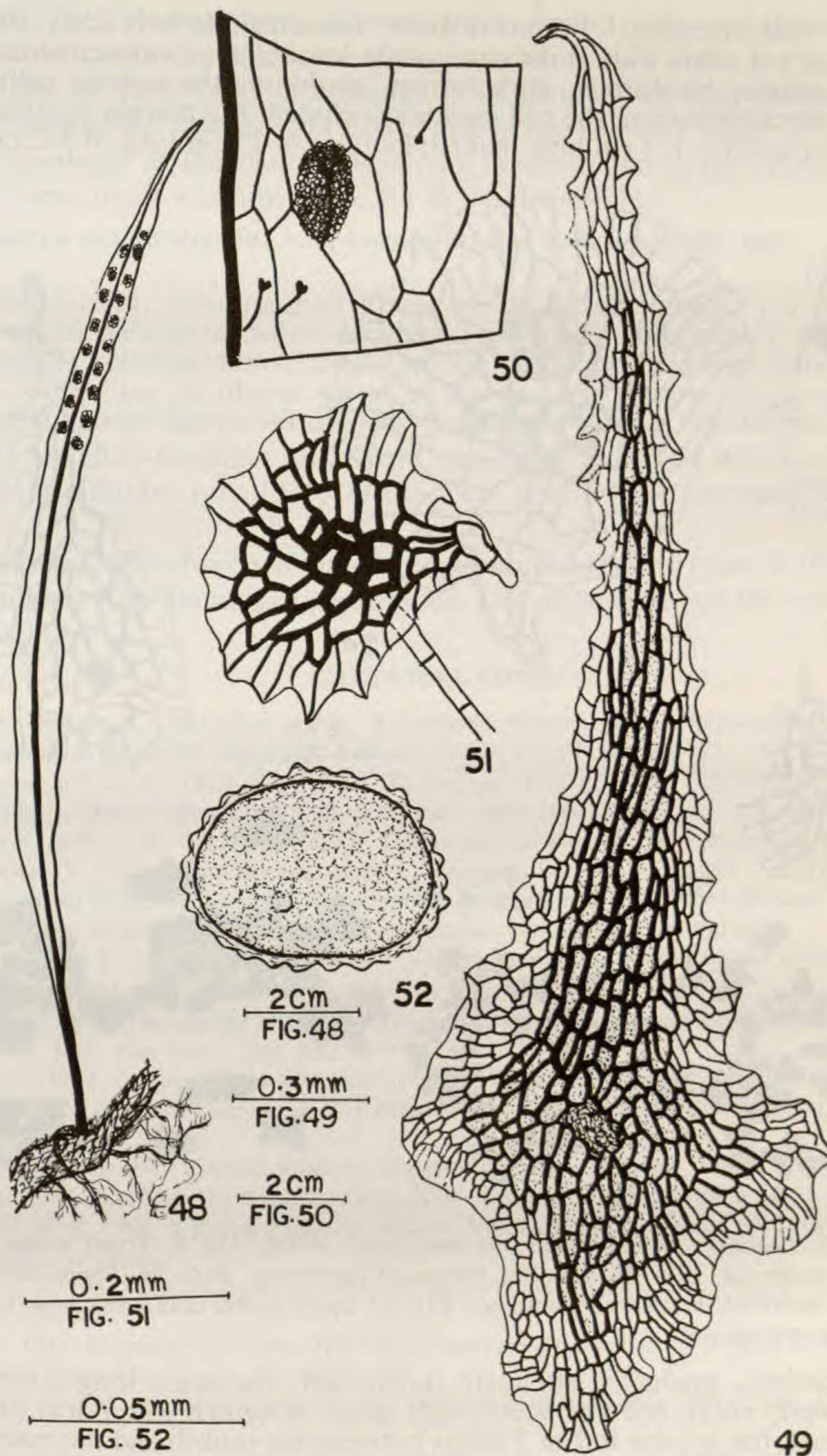
THAILAND: Summit of Doi Chom Cheng, Doi Sootep mountains, 1500–1650 m, 1–6 Nov 1920, *Rock 358* (US, det. K. Iwatsuki).

9a. *Lepisorus amaurolepidus* (Sledge) Bir & Trikha in Bir & Vasudeva, J. Bombay Nat. Hist. Soc. 68: 192. 1971, var. *amaurolepidus*.⁴

Pleopeltis amaurolepidus Sledge, Bull. Brit. Mus. Nat. Hist. 2(5): 136. 1960.

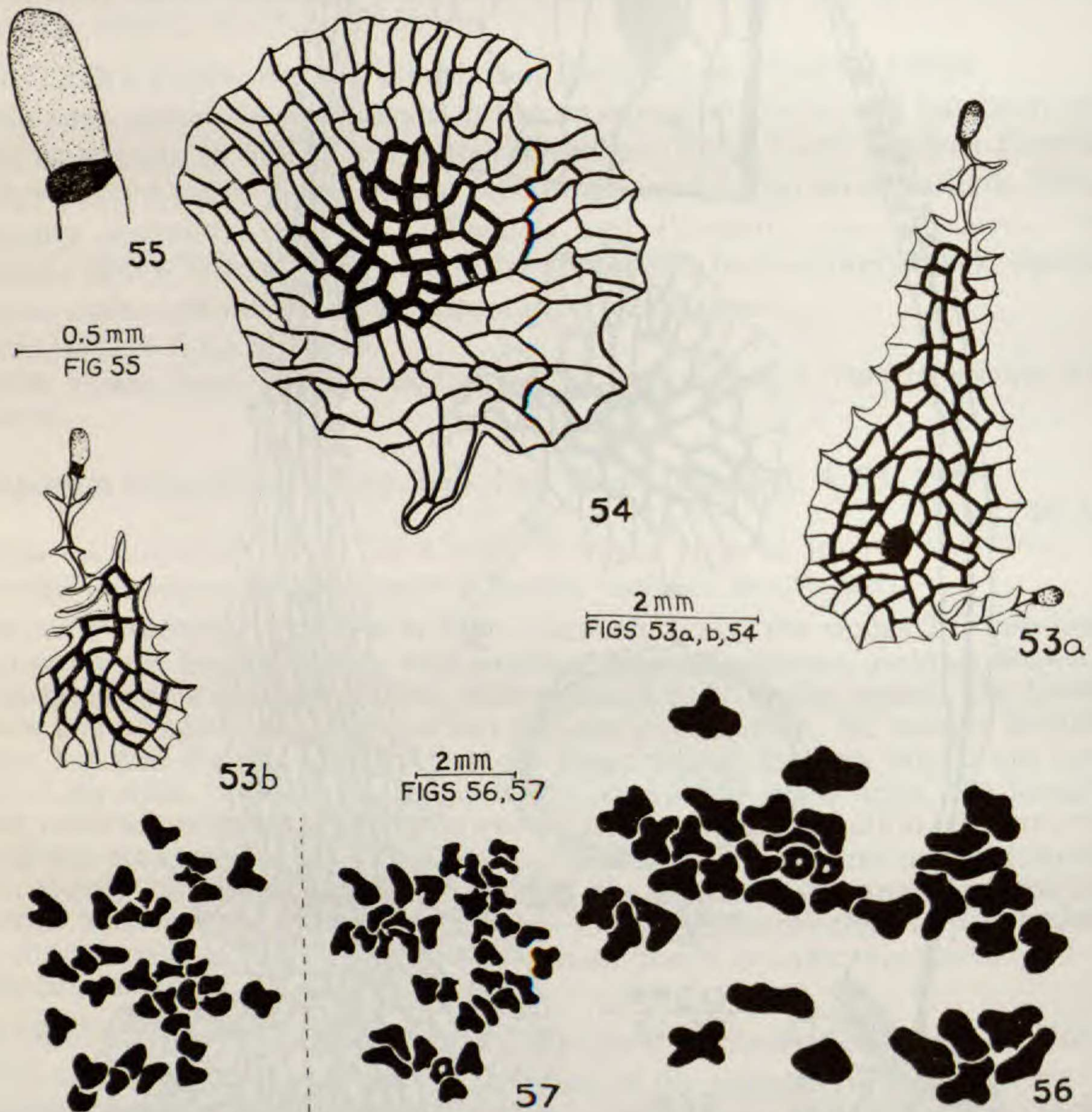
Polypodium gladiatum Wall. Num. List. no. 279. 1828, *nom. nud.*, non *P. gladiatum* Kunze, 1834.

⁴ For illustrations, see Bir & Trikha (1972, f. 18–22). Bir and Trikha (in Bir & Vasudeva, 1971) proposed the new combination incorrectly as *Lepisorus amaurolepidus*.



FIGS. 48-52. *Lepisorus subconfluens*. FIG. 48. Frond. FIG. 49. Rhizome scale. FIG. 50. Lamina venation. FIG. 51. Sporangial paraphysis. FIG. 52. Spore.

Rhizome wide-creeping, 1.5–3 mm in diam., branched, densely scaly, the scales 2–3 mm long, 1–1.5 mm wide at the base, ovate-lanceolate, short-acuminate, firm, orbicular, peltate, bicolorous, dark brown, clathrate, the central cells highly thickened, blackish-brown, the cell cavities occluded, the margin dentate; stipes ca. 0.5–1 cm distant, 1–3 cm long, naked; laminae 6–25 cm long, 0.5–2 cm wide,



FIGS. 53–57. *Lepisorus amaurolepidus* var. *longifolius*. FIGS. 53a, b. Frond scales. FIG. 54. Sporangial paraphysis. FIG. 55. Hair-like sporangial paraphysis. FIG. 56. Spore mother cell at metaphase-I showing 35 bivalent chromosomes. FIG. 57. Spore mother cells at anaphase-I showing 35 chromosomes at each pole.

linear-lanceolate, gradually attenuate downward, the apex long-acuminate or rarely abruptly shortened and acute, light green or brown when dry, fleshy, the veins distinct, the areolae in 2 or 3 series between the midrib and the margin, both surfaces glabrous except for a few scales on the under surface along the midrib; sori 2–4 mm in diam., medial, golden brown; sporangial paraphyses with thickened and colored cell walls, without glandular cells when young; spores yellow, plano- or concavo-convex, sometimes reniform, the exine thick, $48\text{--}58 \times 29\text{--}42 \mu\text{m}$.

DISTRIBUTION: Himalayas, Central India, South India, and Ceylon.

This is the commonest species of *Lepisorus* in South India in the Palni and Nilgiri Hills at 1500–2000 m altitude. It is also known from Mahableshwar, Coorg, Coimbatore, and Kerala State, and is occasionally found in the central Indian mountains at Pachmarhi (Madhya Pradesh) and in the Himalayas. For details of specimens examined, see Bir & Trikha (1972).

9b. *Lepisorus amaurolepidus* var. *longifolius* Bir & Trikha, var. nov.

Figs. 53–57.

Frondae eis var. *amaurolepidi* longiores, 26–35 cm longae, 1–1.5 cm latae; laminae subtus paleaceae, paleis deciduis, clathratis, rufo-brunneis, margine dentatis, dentibus prominentibus, cellula apicali juventute glandulari; paraphyses dimorphae, nonnullae circulares, peltatae, margine fere integro, alterae piliformes, 2-cellulares; sporae laeves vel rugoso-verrucosae, $41\text{--}61 \times 35\text{--}48 \mu\text{m}$; $n = 35$.

TYPE: Nainital–Ranikhet bridle path, western Himalayas, abundant on rocks, 900–1200 m altitude, July 1971, *Trikha 1911* (PUN 1130; isotypes PUN 1131, 1132).

This variety differs from var. *amaurolepidus* in its larger fronds, in the presence of 2-celled, hair-like sporangial paraphyses, and in the scales on the under surface of the laminae.

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