

JACKIELIA JAVANICA SCHIFFN.—A RARE AND INTERESTING TAXON FROM INDIA^{1,2}

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ABSTRACT

Taxonomic details of *Jackiella javanica* Schiffn.—a rare and interesting liverwort—have been given. Noteworthy features include 1-(2-4) celled gemmae at leaf margins towards apex of the plant, rhizoids with swollen tips harbouring mycorrhiza, occasional presence of six rows of cells in the jacket layer of the archegonium, the presence of marsupium, the seta with triseriate arrangement of cells into 8 peripheral, 8 middle and 4 central rows, the foot with numerous filamentous outgrowths forming a haustorial collar, the presence of a basal capsular disc, the dehiscence of the capsule into two valves with each valve secondarily partially cleft at apex and a mechanism of capsule dehiscence which is of an unique type. In India the plant commonly grows in the eastern Himalayas and its distribution extends to Java, Sumatra, Japan and Tahiti.

INTRODUCTION

Taxonomically, the genus *Jackiella* Schiffn. is a remarkable and interesting plant. Schuster (1972) has instituted a new monogeneric family Jackiellaceae Schust. for the placement of this genus.

Jackiella is characterized by dorsiventral plants with succubous, unlobed leaves and highly reduced underleaves which may even be absent. The leaf cells are collenchymatous with one—few large botryoidal oil-bodies. The branches are ventral-intercalary which may also bear antheridia or archegonia. The male branches are minute and spicate. The female branches have one pair of bracts and are devoid of bracteole and perianth but there is a distinct marsupium enclosing the developing sporophyte. The foot is considerably reduced and has a collar of haustorial septate filaments, the seta has

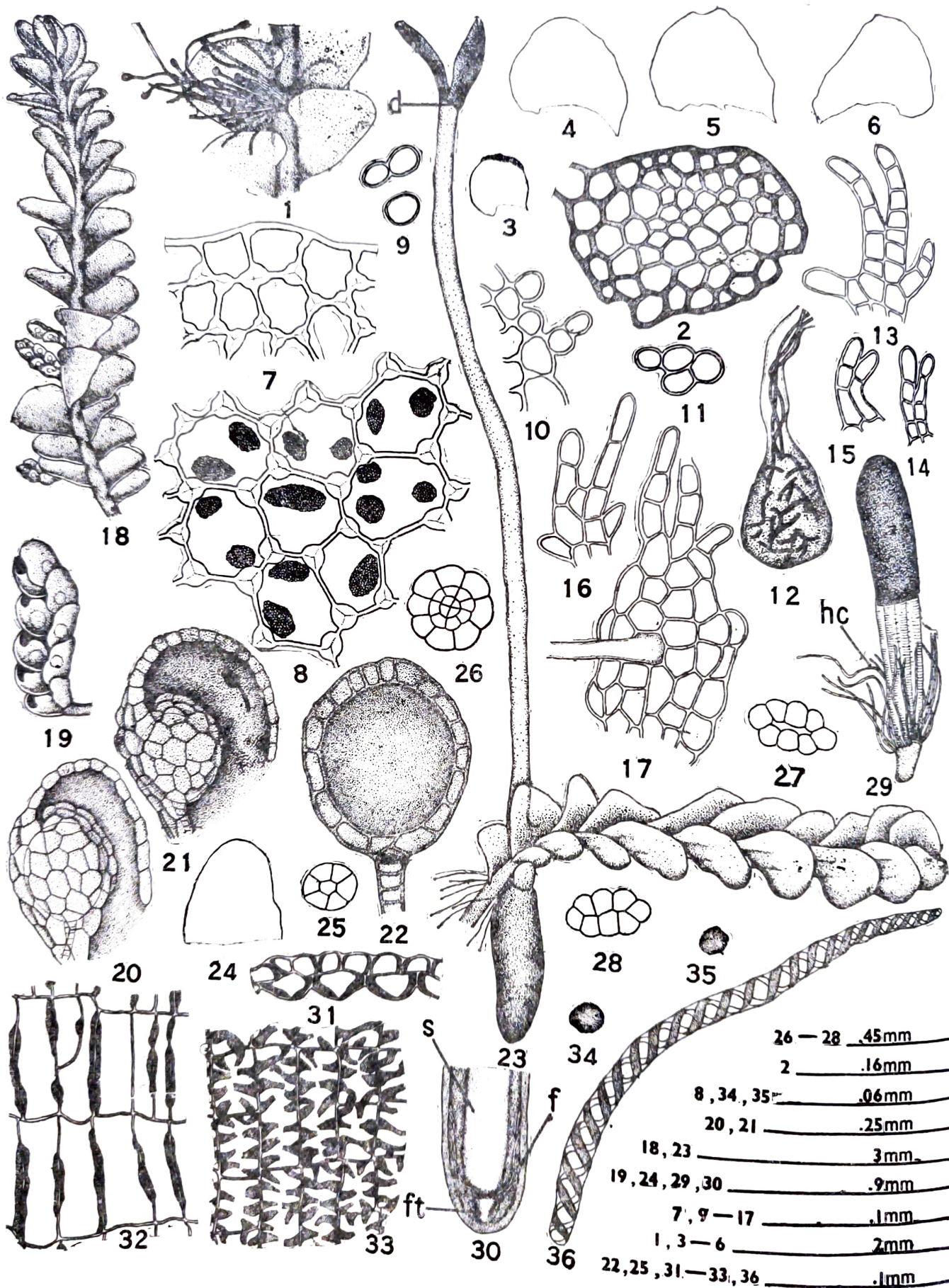
3 rings of cells with 8+8+4 cell rows, the capsule is bistratose with the epidermal layer of elongated cells having thickenings confined to longitudinal-radial walls. Asexual reproduction occurs by single-celled gemmae (Schuster, 1972).

Jackiella shows distribution in subtropical countries and its seven species and two varieties (see Bonner, 1966) are: *J. angustifolia* Herz. from Borneo, *J. brunnea* (Horik.) Hatt. from Taiwan, Japan, *J. ceylanica* Schiffn. ex St. from Ceylon, *J. javanica* Schiffn. from Java, *J. javanica* var. *cavifolia* Schiffn. from Java, Sumatra, *J. javanica* var. *cordifolia* Schiffn. from Java, *J. renifolia* Schiffn. from Sumatra, *J. singaporensis* Schiffn. from Singapore and *J. unica* St. from Caroline Islands. Hodgson (1958) has described *J. curvata* Allison et Hodgson from New Zealand. Of the above, *J. brunnea* (Horik.) Hatt. has been

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stated to be possibly allied to *J. javanica* Schiffn. (*In*: Hepaticae Japonicae Exciscae Ser. 4, 1951, packet No. 166, Ed. S. Hattori). Our study of these specimens shows that *J. brunnea* should be treated as a synonym of *J. javanica*.

Schiffner and Pande (1950) reported *J. javanica* var. *cavifolia* from eastern Himalayas on the basis of collections of liverworts made by Revs. Decoly and Schaul in 1897-98 from Kurseong. The plants were, however, never described for their details. Recent collections made from Sikkim and Shillong have revealed that *J. javanica* is fairly common in these areas. A number of excellent specimens showing full details of the plant were available for study which are being described in the present communication.

MATERIAL AND METHODS

The plants of *J. javanica* were collected in the months of December-January 1977-78 from Sikkim and later in the months of October-November 1979 from Shillong. Most of the details were observed from living plants. Specimens of *J. brunnea* (Horik.) Hatt. have also been examined. The herbarium specimens were stretched in fresh water for about 24 hours and mounted in Hoyer's solution or 70% glycerine.

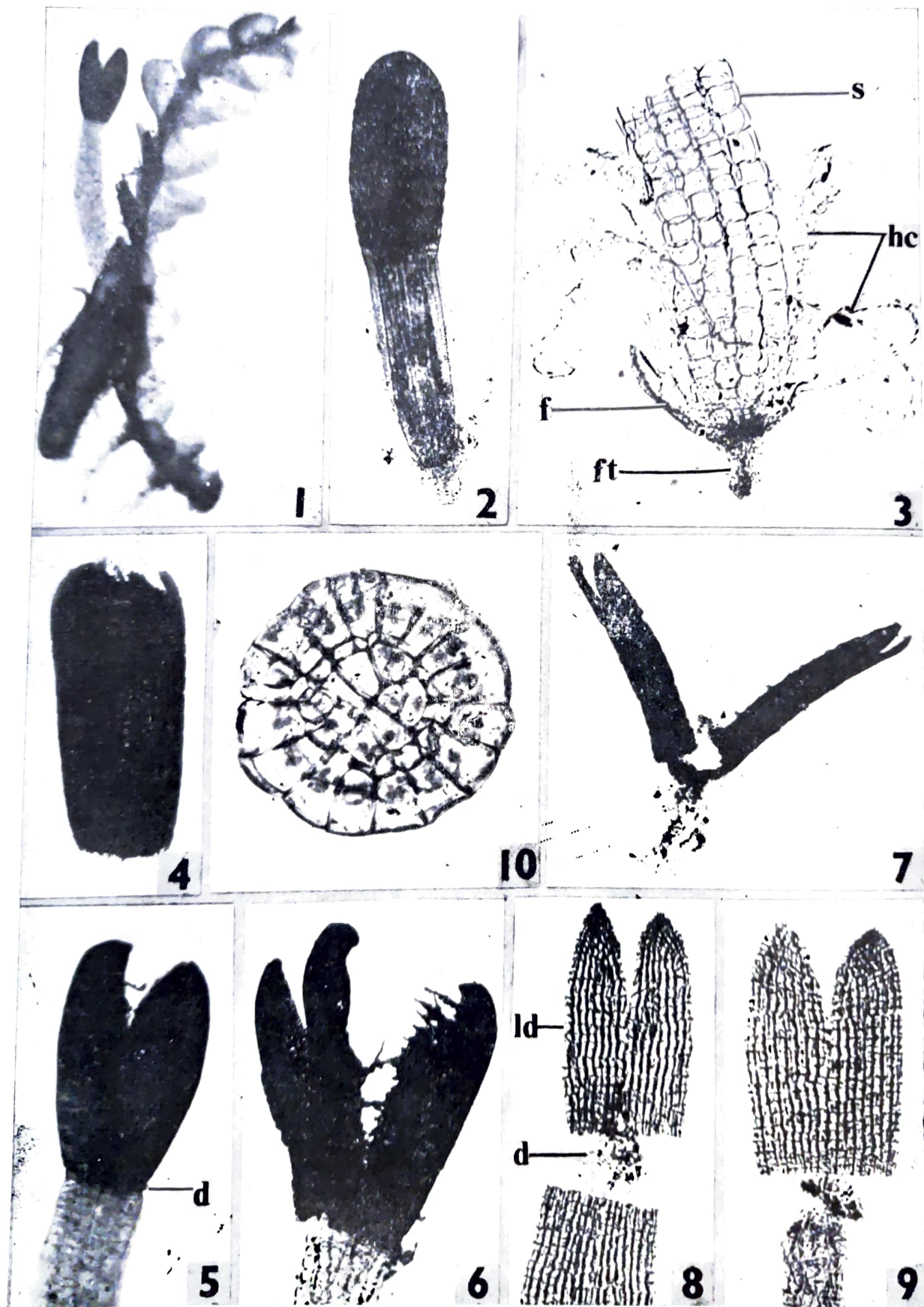
TAXONOMIC DESCRIPTION

Jackiella javanica Schiffn. Denkschr. Mat. Nat. Cl. Kais. Akad. Wiss. Wien **70**:217, 1900. Syn. : *Saccogyna indica* : nom. illeg., Abs. in J. Indian bot. Soc. (Suppl.) **58**:33, 1979 ; *J. brunnea* (Horik.) Hatt. *In*: Bull. Tokyo Sci. Mus. **11** : 48, 1944.

Plants light green, prostrate to suberect, 10-20 mm long, branches ventral-intercalary. Stem 8-9 cells across, 135-234 μ m in diameter; cortical cells brown, thick-walled, cuticle smooth to verrucose; medullary cells hyaline, thin-walled. Leaves simple, entire, broad, cordate, concave, apex obtuse, base wide, 572-880 \times 660-1100 μ m, antical margin decurrent, postical margin arched, sub-opposite, insertion oblique; marginal cells 12-29 \times 18-31 μ m, middle and basal cells 18-37 \times 16-31 μ m, trigones prominent, cuticle smooth to verrucose. Oil bodies (1)2-3 in each leaf cell, globose, 4-10 μ m in diameter, oval-elliptical, 9-21 \times 5-8 μ m, granular, botryoidal. Gemmae occasional, rounded, hyaline, 1-(2-4) celled at margins of the apical leaves. Underleaves reduced, 90-160 \times 50-76 μ m, bifid, tips usually uniseriate, margins dentate, cell-walls thin, without trigones, connate at base with the leaves of one side. Rhizoids few, usually restricted at base of underleaves, occasionally scat-

Text-figs. 1-36. *Jackiella javanica* Schiffn. Fig. 1. A portion of plant in ventral view ; rhizoids with swollen tips. Figs 2. T. S. of stem. Figs. 3-6. Leaves ; (fig. 3.) showing marginal gemmae. Fig. 7. Marginal cells of leaf. Fig. 8. Middle cells of leaf with oil-bodies. Figs. 9-11. Gemmae. Fig. 12. Swollen tip of rhizoid with mycorrhiza. Figs. 13, 16, 17. Underleaves on vegetative plant. Figs. 14, 15. Underleaves of male inflorescence. Fig. 18. Male plant showing male inflorescence. Fig. 19. Male inflorescence, one antheridium substended by each bract. Figs. 20, 21. Male bracts enclosing single antheridium. Fig. 22. Mature antheridium. Fig. 23. Female plant with dehiscent capsule. Note the downwardly directed marsupium. Fig. 24. Female bract. Fig. 25. T.S. of neck of abnormal archegonium. Fig. 26. T.S. of seta. Figs. 27, 28. T.S. of abnormal seta. Fig. 29. Young sporophyte with haustorial collar. Fig. 30. L. S. of mature marsupium showing lateral fascicles and seta. Fig. 31. T.S. of capsule wall. Fig. 32. Outer layer of capsule wall. Fig. 33. Inner layer of capsule wall. Figs. 34, 35. Spores. Fig. 36. An elater.

d, disc ; *f*, fascicle ; *ft*. foot ; *hc*. haustorial collar ; *s*, seta.



tered on the stem, usually with swollen tips. Male inflorescence short, ventral, spicate, at the base of male plant; male bracts 3-10 pairs, bilobed, saccate, 270-280 \times 195-245 μ m; underleaves reduced on the male inflorescence, bifid, tips uniseriate, margins usually smooth. Antheridium single, entirely enclosed within the male bract; body large, 70-107 (—154) μ m in diameter, dark-brown, stalk short, 40—57 μ m long, usually 5 cells in height, uniseriate. Marsupium on very short ventral branches, 1-2 (—3) mm long, cylindrical, 2—5 cells thick, base tapering; surface smooth, occasionally with few rhizoids; mouth encircled with 1—2 pairs of large entire bracts with obtuse apex, archegonium occasionally with 6 rows of neck cells. Foot small, inconspicuous, with narrow tapering base and broader apex having long septate, free, filamentous outgrowths forming haustorial collar. Seta 3-9 mm long, hyaline, 197-264 μ m in diameter with 8 peripheral, 8 middle and 4 inner cell rows, the former bulging. Capsule cylindrical, deep red-brown, ca 1 mm long on one-celled thick basal capsular disc with 4-5 small central and usually with 16 peripheral elongated cells; dehiscence in two valves, each with a small cleft at apex extending up to 1/3—1/2 of the length of capsule valve; wall bistratose, outer layer of cells rectangular, elongated, 36—70 \times 10—27 μ m with nodular to restricted-sheetlike thickenings on radial walls, inner layer of quadrate to rectangu-

late cells, 26—6 \times 21—25 μ m with incomplete to complete bands of thickenings with wide base and narrow ends. Elaters 88—283 μ m long, 10—12 μ m thick, reddish-brown, bispiral with tapering ends. Spores small, yellowish to reddish-brown, 7—11 μ m in diameter, exine minutely papillose.

Specimens examined:

LWU 3550/77, 3551/77. Coll.: S.C. Srivastava and party. Loc.: Gangtok (Sikkim), alt.: ca 2000 m. Date: 26 December, 1977. Det.: R. Udar and A. Kumar.

LWU 3726/79, 3727/79. Coll.: A. Kumar and U.S. Awasthi. Loc.: Elephant Fall, Shillong (Meghalaya), alt.: ca 2000 m. Date: 8 November, 1979. Det.: R. Udar and A. Kumar.

Habitat: Plants grow on soil in moist and shady places in association with species of *Jungermannia*, *Pogonatum*, and occasionally *Marchantia*.

DISCUSSION

Stephani (1909) reported *J. javanica* from Java, Sumatra, Japan and Tahiti. The taxonomic details provided by Stephani for these plants from Japan in the unpublished Icones No. 2022 provide features remarkably similar to those in the plants investigated here. There is only slight variation in the size of leaf cells which may only be ecological. Significantly one illustration shows the characteristic swollen tips of the rhizoids. Of particular rele-

Plate Figs. 1-10. *Jackiella javanica* Schiffn. Fig. 1. Female plant with dehiscent capsule (\times 10). Fig. 2. Young sporophyte (\times 49). Fig. 3. Basal portion of sporophyte with foot; haustorial collar; fascicle; a part of seta (\times 80). Fig. 4. Capsule showing initiation of dehiscence at apex (\times 40). Fig. 5. Two capsule valves on capsular disc (\times 40). Fig. 6. Showing left valve with apical cleft and right valve filled with spore-elater mass (\times 40). Note initiation of concavity in outer surface of left capsule valve and its partial detachment from capsular disc. Fig. 7. Valves showing apical cleft and their detachment from capsular disc (\times 40). Fig. 8. Partial attachment of valves with capsular disc (\times 32). Note line of dehiscence devoid of thickenings on radial walls. Fig. 9. One valve thrown off from capsular disc (\times 34). Fig. 10. Capsular disc (\times 100).

d, disc; f, fascicle; ft, foot; hc, haustorial collar; ld, line of dehiscence; s, seta.

vance in this context is the excellent discussion of the association of liverworts with other organisms given by Schuster (1966) who stated that similar swollen tips of rhizoids occur in *Microlepidozia setacea*, *Mylia anomala* and *Cephalozia connivens* and these show presence of mycorrhiza as also observed in Indian plants (Text-figs. 1, 12, 23). He also stated that these plants are restricted to localities where nitrogen deficiency occurs and the fungus has the ability to fix atmospheric nitrogen which has, at least, been experimentally demonstrated in *M. setacea*. In all probability a similar function is performed by the mycorrhiza in the plants described here.

A feature of interest is the occasional presence of six rows of neck cells (Text-fig. 25) instead of the usual five rows in the archegonium. Another noteworthy feature is the presence of 2-4-celled gemmae on an isolated plant. Normally the gemmae do not develop in the plants investigated by us.

The foot is reduced, relatively inconspicuous and develops numerous, septate, free, filamentous outgrowths forming a haustorial collar (Text-fig. 29hc; Pl. figs. 2, 3 hc). As the sporophyte reaches maturity these outgrowths basally unite into distinct lateral fascicles (Text-fig. 30f; Pl. fig. 3f). Anatomically the seta in *J. javanica* shows 8 large bulging peripheral, 8 small middle and 4 small inner rows of cells (Text-fig. 26). However, at maturity, the inner and the middle rows of cells apparently disintegrate leaving a central hollow cavity which is encircled by 8 large bulging outer rows of cells (Text-fig. 27). Schuster (1966) refers to a similar hollow cavity in *Zoopsisidella borinquena* and describes it as abnormal seta. However, this abnormality is rather common in mature seta of *J. javanica*. Sometimes the cavity is considerably obliterated and only 8 peripheral rows

of cells are present which are compactly arranged (Text-fig. 28).

The dehiscence of the capsule in two valves along the line of dehiscence (Pl. fig. 8, 1d), where the thickenings are absent on radial walls, is a rather distinctive feature (Text-fig. 23; Pl. figs. 1, 4-7) as four complete valves are never formed. The two valves retain a constant behaviour in showing only partial clefts in them towards the apex (Text-fig. 23; Pl. figs. 6-9) due to the presence of thickenings on radial walls below the cleft (Pl. fig. 8). Another feature of interest in the capsule is the presence of a basal capsular disc which is one celled thick, light pink-violet in colour and usually without thickenings in its cell walls (Pl. figs. 8d, 10). This disc provides a transversely disposed line of dehiscence along which the two valves finally get detached (Pl. figs. 9, 10).

The mechanism of capsule dehiscence is of unique type. The mature capsule, in dry weather, gradually loses water from the external surface with eventual shrinkage in the cells of outer layer. This together with the extra pressure developed by the mass of spores and elaters cause the rupture of the capsule in two valves along the line of dehiscence. Both the valves are basally connate with the basal capsular disc. With further loss of water one capsule valve shows a cleft at its apex (Pl. fig. 6) loosening the spore-elater mass. This condition is clearly seen on the valve on the left side; the one on the right side still holds the spore-elater mass. Later the same mechanism is also repeated in the other valve (Pl. fig. 7). Further shrinkage in cells causes concavity externally associated with twisting at the edge of basal disc from which the two valves eventually get separated (Pl. fig. 7). Initially these valves remain partially connate with the basal capsular disc (Pl. figs. 7, 8) but later

fling off one by one or together from it (Pl. figs. 9, 10). The spores are effectively dispersed due to this interesting mechanism of capsule dehiscence.

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