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財 団 法 人

服 部 植 物 研 究 所

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茲に謹んで哀悼の意を表します

A. wallichiana (L. et L.), *A. leptophylla* (Mont.) and *A. sanguinea* (L. et L.) from various parts of the Himalayas, South India and Assam. Thereafter followed a gap of about 40 years at the end of which Stephani (1900, pp. 97-140) added five more species to Indian flora, four of which, i. e. *A. angusta* (St.), *A. maculata* (St.), *A. parvipora* (St.), *A. multiflora* (St.), were new to science, while the fifth one, *A. blumeana* Nees., was reported for the first time from India. About 16 years later Kashyap (1916, pp. 344-345, and 1917, p. 279) added three more new Indian species, i. e. *A. mussuriensis* (Kash.), *A. pathan-kotensis* (Kash.) and *A. reticulata* (Kash.), and a few years later Gola (1914) added another new species, *A. calciatii* (Gola), from Kashmir. Simultaneously with this Stephani (1917, pp. 11-18) published five other new species from India, i. e. *A. butleri* (St.), *A. gollani* (St.), *A. indica* (St.), *A. mercarana* (St.) and *A. papulosa* (St.), and to these Kashyap (1932, p. 5) added *A. gangetica* (Kash.), another new species from Garhwal. Finally Chopra (1938, p. 241) published *A. mysorensis* (Kash.), a manuscript species earlier proposed by Kashyap. In this paper Chopra (1938, p. 241) recorded *A. vulcanica* (Schffn.) St., for the first time from India. In a census of Indian Hepatics, Chopra (1943) lists 24 species of *Asterella* from India.

The only morphological work on the Indian species of this interesting genus, as far as the authors are aware, is by Mahabalé and Bhatt (1945) on *A. angusta*.

As stated above, our knowledge of several of the Indian species of *Asterella* is yet incomplete. The authors had an opportunity to study authentic specimens of three such species, i. e. *A. multiflora*, *A. maculata*, and *A. khasiana* from the famous herbarium of E. Levier through the kindness of the late Prof. V. Schifner (Vienna). *A. khasiana* was also studied from specimens collected by one of us (Pandé) in 1941 from Jorpokhari (7,000') in the district of Darjeeling (Sikkim-Himalayas).

In the present article it shall be the endeavour of the authors to present, as far as possible, from the material available, an illustrated account of the three species listed above and to fill up the gap in our knowledge of these species in the literature on Indian Bryology.

Method of study

For the purpose of this study a few good specimens were carefully selected from the herbarium material and thoroughly soaked in warm water. Any dirt or soil particles adhering to the thalli were then carefully removed and the material thoroughly washed in water. It was then gradually dehydrated and brought to 70% alcohol and left in it for sometime to harden. A study of the various structures was made from the preparations from this material. All the figures and description given here are based on these preparations.

On the whole our observations are in agreement with those of Stephani (l. c.).

Description

1. *Asterella multiflora* (St.) Text-fig. I.

A. multiflora was established by Stephani (1900, pp. 124 and 125) to include

ON SOME LITTLE KNOWN INDIAN SPECIES OF
ASTERELLA BEAUV.¹⁾

By S. K. PANDÈ, K. P. SRIVASTAVA and S. A. KHAN²⁾

Introduction

Asterella Beauv. is a member of the *Marchantiales* assigned to the *Reboulia-ceae* (Evans, 1939, p. 94). As already pointed out by Haupt (1929) *Asterella* antedates Neese's genus *Fimbriaria* which should, therefore, be reduced to its synonyms. Unfortunately this practice has not been universally followed with the result that while the European bryologists, both on the continent as well as in the British Isles, have often adhered to *Fimbriaria*, the American writers, on the contrary, have given preference to *Asterella*. Verdoorn (1932), Buch, Evans and Verdoorn (1937) and Evans (1939) have adopted the genus *Asterella*. This is the correct procedure in keeping with the International Rules of Botanical Nomenclature and we have adopted it here.

According to Stephani (1900, pp. 97-140; 1917-24, pp. 11-18), *Asterella* includes 91 species of world-wide distribution. The figure, however, cannot be taken as an exact estimate because since then, several new species have been published by various authors (Horikawa, 1929, 1931, 1934; Kashyap, 1929, 1932; Chopra, 1938 and Shimizu and Hattori, 1952, 1953), while some of the later instituted species have been reduced to synonyms of the earlier ones. However, at present about a hundred species are assigned to the genus.

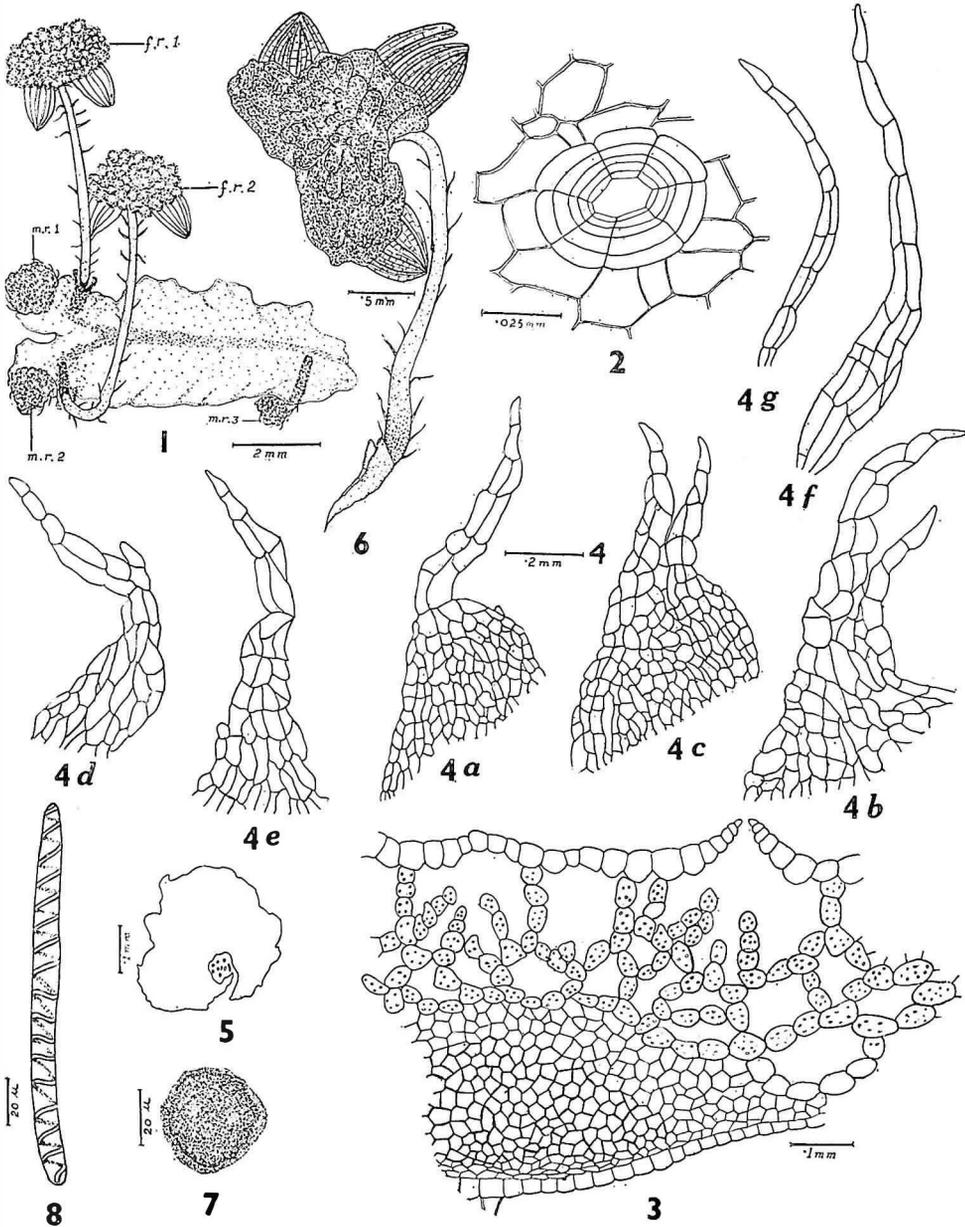
In India *Asterella* is represented by about two dozen species, most of which occur in the Himalayas and South India. The majority of the Indian species are known to us either from their Latin diagnosis (Stephani, 1900, pp. 97-140, and 1924, pp. 11-18) or through the contributions of Kashyap (1916, pp. 344-345, 1917, p. 279, 1929, pp. 63-65, and 1932, p. 5). Never the less our knowledge of some of these is yet far from complete. It was, therefore, thought advisable to pursue a detailed study of some of the little known species.

Previous work on the Indian species of *Asterella*

Although Royle (1839, p. 436) is apparently the first to record *Asterella* from India, reporting it from the Himalayas without reference to any specific locality, it is really in the Synopsis Hepaticarum (Gottsche, Lindenberg et Nees, 1844) that we find the first systematic treatment of some of the species of our country. An illustrated account of *Octoskepos khasyanum* Griff., later listed by Mitten (1860, p. 126) as *F. khasiana* (Griff.) Mitt., was published in the posthumous memoirs of William Griffith (1849, p. 343). Besides this species Mitten (l. c.) also records *A. nepalensis* (Tayl.), *A. elegans* (Sprengl.) var. γ ,

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Text-fig. I. *Asterella multiflora*

1. Plant. 2. Pore in surface. 3. T.S. of thallus. 4. Scales. 5. T.S. of stalk of female receptacle. 6. Female receptacle borne on an innovation. 7. Spore. 8. Elater.

a specimen collected by Duthie on January 5, 1892 from Mohand Pass (Sewalik Range) below Mussoorie (1,500 ft. – 2,500 ft.) in Dehra Dun district of the North Western Himalayas. An English translation of the Latin diagnosis of the species has been reproduced by Kashyap 1929, p. 68). The plant is rather rare and apparently has not been collected by any one else, except the original collectors, Duthie and Gamble. The specimen studied by us is from the original material (Stephani, sub. no. 306) determined by its author. The liverwort grows in patches of overlapping individuals and, as stated by Stephani (1900, pp. 124 and 125), is monoecious (fig. 1). The plants may be simple or lobed and produce apical and lateral innovations which are often aggregated towards the apex and bear the male and female receptacles (fig. 1, *m. r. 1*, *m. r. 2*, *m. r. 3*, and *f. r. 1*, *f. r. 2*). Ultimately the main thallus decays and the innovations get separated and serve as organs of vegetative propagation.

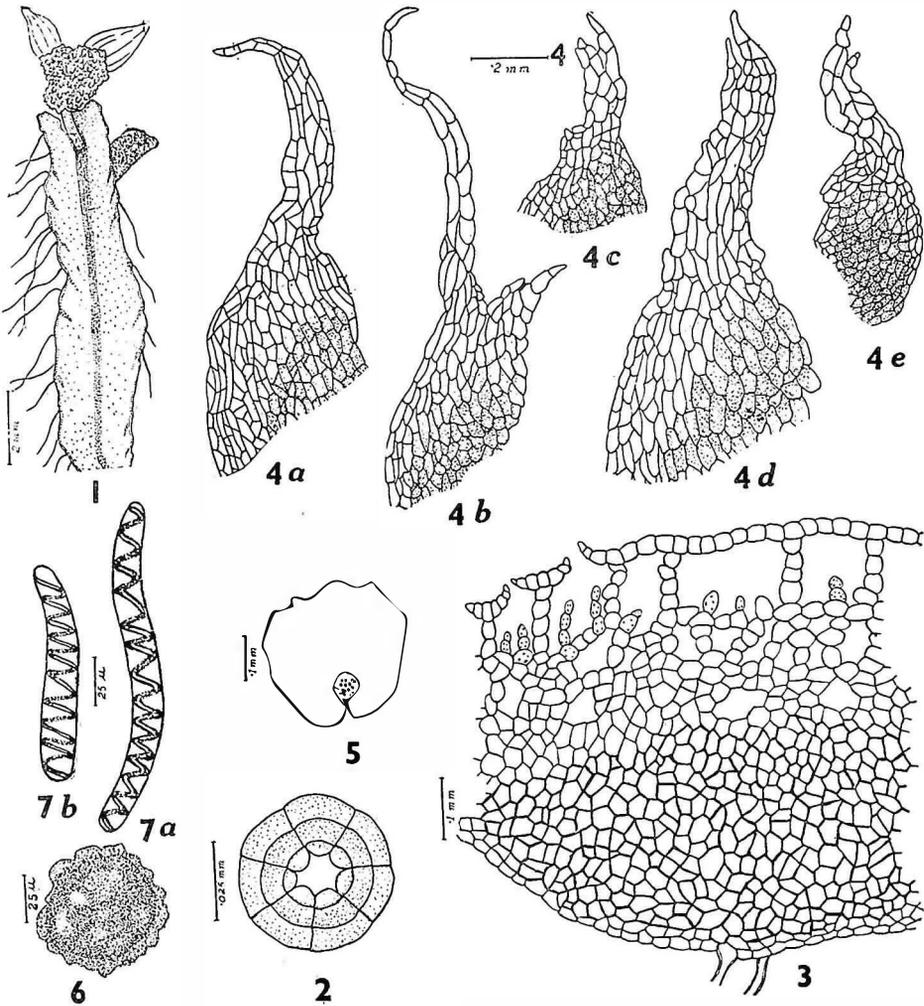
The thallus is 10–12 mm long and 2–3 mm broad. It is flat above and somewhat convex below and upto 20–25 cells thick in the middle. The epidermal cells are thin and delicate and the margin is dark purple underneath. The air-pore is somewhat elevated and bounded by five concentric rings of cells, with 6–7 cells in each series (fig. 2). According to Stephani (1900, p. 125) there are 8 cells in each series. The air-chambers are disposed in two layers in the median part of the thallus and the upper layer contains short filaments (fig. 3); elsewhere the chambers are in one layer and empty. According to Stephani (1900, p. 125) the air-chambers are large and contain numerous assimilatory filaments. The midrib cells have thick and pitted walls. The scales are small and appendaged (figs. 4a, 4b, 4c) and the appendage is long, narrow, lanceolate, setaceous, one cell broad towards the apex and two or three cells broad at the base (fig. 4a). Rarely the scale may have two appendages (figs. 4b, 4c). The male receptacle is borne towards the apex on the main thallus (fig. 1, *m. r. 1*, *m. r. 2*), or on ventral innovations (fig. 1, *m. r. 3*). It is disciform or circular and anteriorly covered with numerous upturned, violet scales (figs. 4d, 4e) which are comparatively smaller than the scales on the thallus. The antheridial papillae are inconspicuous and hyaline. The female receptacles occur on short ventral shoots (fig. 1, *f. r. 1*, *f. r. 2*) and sometimes 4 or 5 such shoots are borne on a single individual. The stalk is covered throughout with small hyaline simple linear scale (figs. 4f, 4g), which are more abundant towards the base and apex. The stalk has one rhizoidal furrow (fig. 5). The receptacle is planoconvex, prominently papillate and 3–4 lobed; the lobes being divergent and deeply extending. Each lobe of the receptacle encloses an involucre (figs. 1, 6), the latter includes an ovate perianth. The apex of the perianth is hyaline or violet. The capsule is delicate, shortly stalked and the operculum is well developed. The spores (fig. 7) are 54 μ across the diameter, light brown and narrow winged. The elaters (fig. 8) are of the same colour as the spore, about 170 μ long, tapering towards both the ends and monospiral.

2. *Asterella maculata* (St.) Text-fig. 11.

A. maculata was instituted by Stephani (1900, pp. 104 and 105) for a specimen collected from Sansidara (Sahashradhra), 3,000 ft., near Dehra Dun, West-

ern Himalayas. An English translation of the original Latin diagnosis has been reproduced by Kashyap (1929, p. 66). The specimen studied by us was collected by Gollan from Arnigadla near Mussoorie, 6,000 ft. - 7,000 ft., Western Himalayas, and determined by Stephani (sub. no. 1294 and 1297). The liverwort grows in dense patches and, as stated by Stephani (1900, pp. 104 and 105), is monoecious.

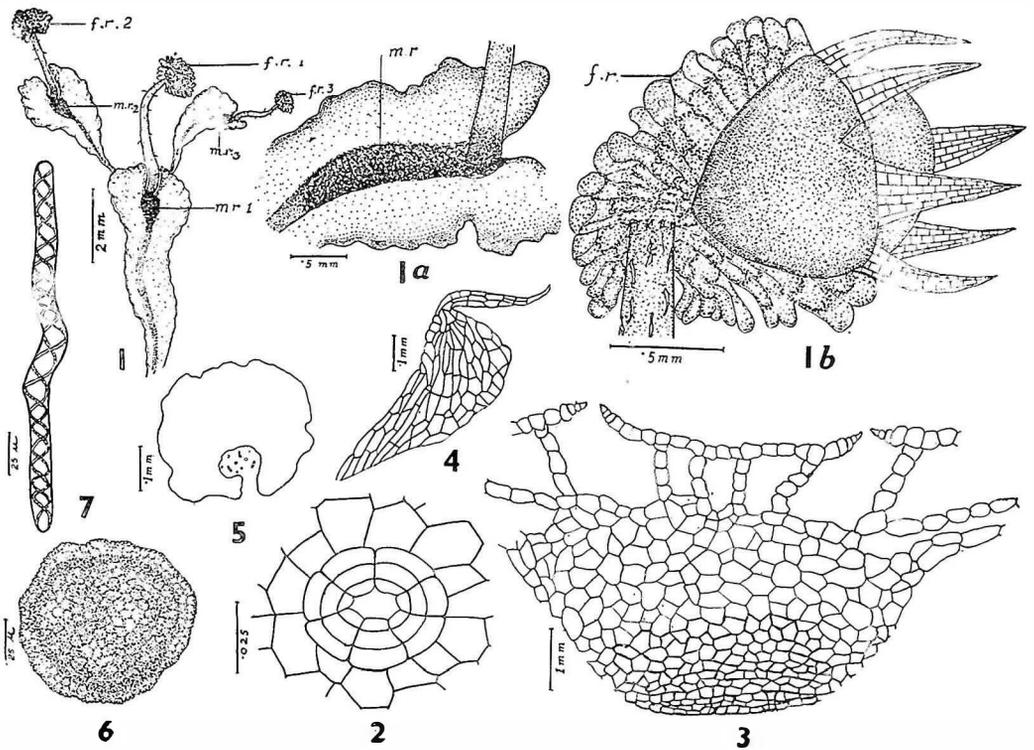
The thallus (fig. 1) is about one and a half cms. long and 3.4 mm broad. It



Text-fig. II. *Asterella maculata*

1. Plant. 2. Pore in surface view. 3. T. S. of thallus. 4. Scales. (Posterior pinkish portion shaded.) 5. T. S. of stalk of female receptacle. 6. Spore. 7. Elaters -a, normal elater; b, a very short stumpy elater.

often innovates at the apex and is generally purple underneath and along the margin which is turned upward. The pore is bounded by three concentric rings of cells and has 7-8, rarely 6 or 9 cells in each series (fig. 2). The air-chambers are disposed in three layers in the median part of the thallus and the upper layer contains short assimilatory filaments (fig. 3). The midrib cells are thick walled (fig. 3) and mycorrhizal. The scale is very characteristic and distinctive of the species. It is *purple below the middle*, hyaline above, obliquely ovate, and appendaged. The appendage is almost as long as the body; lanceolate and setaceous (fig. 4a). Often a small tooth is borne at the base of the appendage (fig. 4b); rarely the appendage may be bifid (figs. 4b, 4c, 4d). According to Stephani (1900, p. 105) male receptacles are borne on short posterior branches and the antheridial ostioles are inconspicuous and hyaline. None of the specimens, examined by the authors, bore undoubted male receptacles but in one case a short ventral shoot, answering to the description of the male shoot was seen, but no antheridia could be detected. The female receptacle is terminal, disci-



Text-fig. III. *Asterella khasiana*

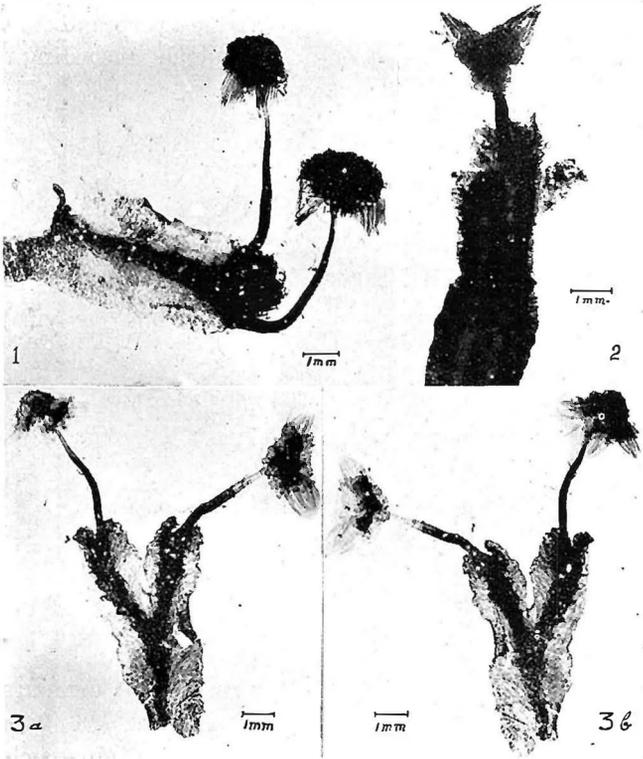
1. Plant. 1a. A part of the thallus with male receptacle. 1b. Female receptacle with one involucre. 2. Pore in surface view. 3. T. S. of thallus. 4. Scale. 5. T.S. of stalk of female receptacle. 6. Spore. 7. Elater.

form and stalked. The stalk has one rhizoidal furrow (fig. 5). The receptacle is small, somewhat convex, and 3-4 lobed; each lobe enclosing an involucre with obovate-oblong perianth; the latter having an acuminate apex. The capsule is shortly stalked. The spores (fig. 6) are 70μ , across the diameter, reddish and narrow winged. The elaters (fig. 7) are of the same colour as the spore, 170μ long, stout, rigid, short, stumpy and monospiral.

3. *Asterella khasiana* (Griff.) (Mitt.)

Text-fig. III.

A. khasiana, as has already been pointed out above, was originally described by Griffith (l. c. p. 343-344) as *Octoskepos khasyanum* and its Latin diagnosis included by Stephani (1900, p. 118). The authors have studied specimens of this liverwort collected by Rev. P. Decoly and Schaul from Kurseong (6,000 ft.) in 1899, and by Pandé from Jorpokhari (7,000 ft.) in the same territory in October, 1941. The Kurseongspecimen was determined by the late Professor V. Schiffner, while the one from Jorpokhari was identified by the authors. The species, as stated by various authors, is monoecious.



Text-fig. IV.

1. *Asterella multiflora* 2. *Asterella maculata*
3. *Asterella khasiana* a, dorsal; b, ventral.

The thallus is up to 15 mm long and about 2 mm broad and is often dichotomously branched. It is thin and delicate and generally shows wavy and hyaline margins and apical and lateral innovations. The latter, while yet attached to the main thallus, may develop male and female receptacles (fig. 1). The thallus is semicircular in cross-section with thin narrow wings. The pores are elevated and bounded by three concentric rings of cells with 6-7 cells in each series (fig. 2). The radial walls of the outer series of cells bounding the pore are somewhat thickened, the thickening becoming reduced in cells toward the aperture. The air-chambers are empty and generally in one layer, separated by vertical plates of cells (fig. 3). The ventral

scales (fig. 4) are small, purple, appendaged; the appendage is narrow, lanceolate, entire and shortly acuminate. The male receptacle (fig. 1, *m. r. 1*, *m. r. 2*, and *m. r. 3* and fig. 1*a*, *m. r.*) is borne behind the stalk of the female receptacle. The ostioles are drawn out and hyaline. The female receptacle (fig. 1, *f. r. 1*, *f. r. 2* and *f. r. 3* and 1*b*, *f. r.*) is terminal, on the main thallus (fig. 1, *f. r. 1*) or on innovations (fig. 1, *f. r. 2* and *f. r. 3*). Its stalk bears a few small scales and has one rhizoidal furrow (fig. 5). The receptacle bears 4-1, (often only 2 or 3) involucre, each of which subtends a small, ovate, pink pseudoperianth. The spores (fig. 6) are 80-94 μ , across the diameter, yellow and winged. The wing is narrow. The elaters (fig. 7) are of the same colour as the spore and 230-240 μ long. They taper towards both the ends and are bispiral. According to Stephani (1900, p. 118), the elaters measure 102 μ .

Distribution of Indian species of *Asterella*

1. *A. leptophylla* (Mont.) (21: 100) India orient. Nilgherry mts. (Perrottet).
2. *A. viridis* (L. et L.) (21: 103) Nepal, (Wallich).
3. *A. wallichiana* (L. et L.) (21: 105), Bhootan, (Griffith), Bhor Ghat, (Schiffner).
4. *A. nepalensis* (Tay.) (21: 108) Nepal, (Wallich), N. W. Himalaya, (Gollan, Gamble).
5. *A. khasiana* (Griff.) (Mitt.) (17: 126), (5: 343) and (21: 118) Darjeeling, Kurseong, (Decoly et Schaul) Jorpokhari, (Pandé).
6. *A. sanguinea* (L. et L.) (21: 124) and (14: 67) Nepal, (Wallich), Simla, (Griff.)
7. *A. blumeana* Nees (21: 102) and (14: 62), N. W. Himalaya, 8000', (Stolitzka, Duthie, Gamble). Madhya Pradesh, Pachmarhi, 3500', (Pande and Srivastava).
8. *A. elegans* Spreng., var. γ . (5: 126) Himalaya, Nepal, (Wallich).
9. *A. maculata* (St.) (21: 104) and (14: 66) Himalaya, Sansidara, 5000' (Duthie).
10. *A. angusta* (St.) (21: 104) and (14: 63) Himalaya, Mussoorie, Simla, 4000'-7000'. Madhya Pradesh, Pachmarhi, 3500', (Pande and Srivastava).
11. *A. multiflora* (St.) (21: 124) and (14: 68), N. W. Himalaya, (Duthie, Gamble).
12. *A. butleri* (St.) (22: 12), Sikkim-Himalaya, (Duthie, Gamble).
13. *A. gollani* (St.) (22: 13) and (14: 69); Himalaya, (Gollan).
14. *A. indica* (St.) (22: 14), India orientalis, Mysore, (Gollan).
15. *A. mercarana* (St.) (22: 16), India orientalis, (Pfeiderer); Mercara, Agumbe, (Pandé and Srivastava).
16. *A. parvipora* (St.) (21: 116), (14: 67), Kashmir, Liddar Valley 13000' (Duthie).
17. *A. papulosa* (St.) (22: 16), (14: 69), Himalaya, Mussoorie,

- (Gollan).
18. *A. pathankotensis* (Kash.) (10: 344) and (14: 63), Pathankot, Lahore, Dehra Dun.
19. *A. mussurriensis* (Kash.) (10: 345) and (14: 64) Mussoorie, 6000'-7000', Lahore (rare).
20. *A. reticulata* (Kash.) (13: 279) and (14: 65) Kashmir, Lahul, Keylong.
21. *A. calciatii* (Gola.) (5) and (15: 5) Kashmir.
22. *A. gangetica* (Kash.) (15: 5), Garhwal, Pipal Kothi, Bhuki. Note: S. R. Kashyap (1932, p. 5) remarks, "The species is very near *A. gollani* (St.), and may be the same."
23. *A. vulcanica* (Schffn.) (St.) (2: 241), South India, (21: 114).
24. *A. mysorensis* (Kash. ms.) (2: 241), Mysore, (Butler).

Acknowledgement

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* Not seen in the original.

Calycularia crispula ほか二、三の苔類の分布について

服 部 新 佐

Sinske HATTORI: A remark on the distribution of *Calycularia crispula* and some other liverworts

本誌99~102頁に *Treubia nana* を秩父雁坂峠から報告したが、まだまだ我国には分布上意義深い苔類が未発見のまま残されていると思はれる。その1例としてここに *Calycularia crispula* Mitten を紹介する。一昨年、高木典雄氏が南アルプス燕岩の採品を恵送されたが、その中に本種にあたるものが一点含まれて居た。雌花は無かつたが雄器を備え、葉状体は一見 *Pellia* か *Makinoa* の弱小なもの或は *Pallavicinia* か *Moerckia* の短広なものを思はせるが、特徴のある顕著な腹鱗片だけでも見誤ることはあるまい。本属は7種を含み、ヒマラヤ地方~印度・馬來が分布の中心であるが、我国には未記録であった。 *C. crispula* の既知の産地は勿論ヒマラヤで Mussoorie, Darjeeling その他であり、且つ上述の新産地(燕岩)から判断して、古生層に属する所謂「變速紀」山地に点々分布することが期待されたが、昨夏の奥日向植物調査に於いて清水大典、尼川大録両氏が宮崎県白岩山の頂上より西側へ下る溪谷(約1400米)で本種を採集した。本誌第9号に於いて清水及び筆者はヒマラヤ特産属 *Sauchia* 及び *Gollaniella* に属する2新種を記載したが、本種の発見も我が古い山地がヒマラヤ地方に關聯を持つと云ふ考えを支持する。更にこの点に關してヒマラヤ特産の *Athalamia* 属を次号に論ずる。

次に熊本県市房山頂(約1700米)のみに知られていた *Plagiochiton mayebarae* Hattori の第2産地を報告する。中島徳一郎氏が奈良県彌山の頂上(約1900米)で採集された標本中に本種が認められたが、基準産地のものとは葉形に少し異つた点がある。尚、この属は *Plagiochila* より分離新設したものであるが、余り似た属名でまぎらはしく、*Noguchia* と改めるのが最も適切と考える。即ち蘚苔類学に着実な貢献を続けられる野口彰博士に因む(次号83頁参照)。

新しい火山に特有な苔類では九州の久住山、由布岳、霧島高千穂峰に産する *Gymnomitrium noguchianum* Hattori が顕著である。比較的古い火山に就いては、我国に未知の2属 *Peltolepis* 及び *Sauteria* に属する2種が八ヶ岳の針葉樹帯上限あたりに発見された(次号参照)。之は歐米の高地~北部に産する *Peltolepis quadrata* 及び *Sauteria alpina* の各々 local species と見る可きもので、我国への分布は氷河時代と關係があると信ずる。次に低地に産する苔では熊本県(人吉近郊の人家の石垣上など)、福岡県(太宰府)、岡山県、大阪府、奈良県と特色のある分布を示す *Plagiochila furcifolia* Mitten は2深裂葉を有し他の邦産同属から直ちに區別出来る。

蘚苔類の分布に關しては色々面白い問題があるが、この際如何なる種を如何なる観点から採り上げると言ふこと、そして特に microdistribution と macrodistribution との混亂を注意することが肝要と考えられる。前者は環境条件、即ち microclimatic, edaphic, biological factors などの問題であり、後者は広く植物区系、植物地理学的考察である。

THE OIL-BODIES OF THE HEPATICAE.¹⁾ II
THE LEJEUNEACEAE

By R. M. SCHUSTER²⁾ AND Sinske HATTORI³⁾

1. Introduction

The value, as phylogenetic indicators, and in the practical problem of determination of incomplete materials, of the extra-nuclear cytological features of the Hepaticae, is becoming more and more widely recognized. It is especially in large and unwieldy groups, whose taxonomy is quite unsatisfactory, and where a great deal of parallelism in evolution has taken place, where the value of the oil-bodies and cell-wall types take on a special significance. The Lejeuneaceae, with their approximately 70 genera, whose limits in very many cases are uncomfortably vague, constitute such a group. The joint authors of the present paper had worked over the Lejeuneaceae of their respective regions independently, and prepared illustrations of the available species independent of each other. Most of the descriptive material, and many of the illustrations of the Japanese species have previously appeared in Japanese, by one of the authors (1951, 1953). All of the material on the North American species here presented is by the other co-author, and unpublished. The few European species of the group have been studied by Müller (1939) and his data are herein integrated. Subsequent to the completion of this manuscript the paper by S. Arnell (1953) has come to hand; the data regarding the oil-bodies of the South African species studied by him has been collated and interdigitated into the final manuscript of the present paper.

The present publication owes its genesis to the conviction by the authors that an integration of all of the data on the oil-bodies of the Lejeuneaceae would be much more widely useful than publication of the data by the authors separately. It should be emphasized that although 149 taxa in 42 genera are herein reported on in detail, study of many more genera and species is much desired.⁴⁾ In fact, before any profound discussion of the classification of the Lejeuneaceae can be attempted, much further data of this type must be forthcoming. It perhaps deserves to be emphasized that, except for the segregation of more generic

1) In this series of papers of the oil-bodies of the Hepaticae will be treated in detail, and whenever possible, illustrated. The completion of such a study rests largely on the availability of living materials. The authors would be grateful for living materials, of the rarer species, especially of genera not frequently collected. Several European species have been studied through the courtesy of E. W. Jones.

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4) The authors are each separately responsible for the descriptions and illustrations of the various species and genera they treat. The first-named of the authors has had the responsibility of integrating the data derived from the joint studies; he is also largely responsible for the introductory materials. Both authors, jointly, have worked over the conclusions here presented.

groups in some cases, our knowledge of the classification of the Lejeuneaceae has scarcely progressed since the time of Spruce (1885). The sole exception to this is formed by the admirable paper by Evans (1935) on the stem-anatomy. It is suggested that further comparative study of the features of the stem-anatomy, and of the cytological features, will accomplish much in clearing away the existing problems. The authors, furthermore, are convinced that such study will result in the reduction of a number of presently recognized genera to synonymy or to subgeneric standing.

II. The extra-nuclear cytology of the Lejeuneaceae

The Family Lejeuneaceae is by far the most difficult of all of the groups of Hepaticae as regards the correct delimitation of genera. This is due in part to (1) the very large number of genera (approximately 70 recognized at present), making this the largest family as regards number of genera, as well as species; (2) the relatively recent origin of most of these generic groups, compared with genera in such families as Ptilidiaceae, Hygrobiellaceae, etc.⁵⁾; (3) the entirely extrinsic fact that probably a large number of "genera" have been founded on insufficient basis. The separation of *Lejeunea* from *Microlejeunea* we would regard as an example of this type of unnecessary generic cleavage. The consequence of the integration of these difficulties is that the determination of material in this family has become extremely difficult. If the history of most of the well-known species is examined, it will reveal usually several shifts in "position." The present study is partly an attempt at defining the genera, utilizing a basis not before employed. It is the contention of the authors that the cytological features (wall-thickenings, oil-bodies, and their size relationships to the chloroplasts, secondary pigments laid down in the cell-walls) are to a larger degree "non-adaptive" than such gross features as the shape of the leaves and underleaves, form of the perianth, size of underleaves, etc. Though some of these cytological features are perhaps apt to vary slightly with environmental differences, the same must be admitted for the gross features of the plants (which have hitherto been used in species and generic classification). The cytological features of the various genera and species are therefore to be considered as a valuable supplementary set of criteria for the circumscription and differentiation of the species and genera. In some cases, at least, they are decidedly significant in indicating generic relationships.

A second, and perhaps equally important manner in which especially the oil-bodies are pertinent, is in the identification of material, especially of sterile specimens and of species in such very difficult genera as *Lejeunea* (s. str.) and *Euosmolejeunea*. For instance, the study of the oil-bodies indicates that the

5) The first-named author would further postulate that the Lejeuneaceae have become strongly diversified only in geologically relatively recent times, concurrent with the diversification of the Angiosperms. This contrasts strongly with many other, less specialized families, such as the Lepidoziaceae, Ptilidiaceae, in which the genera are much more ancient, and usually contain fewer species, and are more sharply definable. This point of view is at variance with that recently expressed by Fulford (1951).

arctic and tropical species of *Lejeunea* that occur in Japan and North America are divisible into two distinct groups, one with smooth, homogeneous, glistening oil-bodies (*L. cavifolia*, *L. glaucescens*, etc.) and one with oil-bodies of the grape-cluster type, e. g., composed of many small discrete spherules (*L. floridana*, *patens*, *flava*, etc.). This genus has been notorious in that its species are almost indeterminable when sterile, or when poorly developed. However, living plants can now be determined readily in most cases, when the oil-body features are utilized. In *Euosmolejeunea*, the first-named author had long been puzzled by a species similar to *E. duriuscula*, (= *E. rigidula*), but bearing occasional to frequent caducous leaves. Study of living plants revealed this material had 3-4 oil-bodies per cell that were never crescentic; in our two other dioecious species, there are 1-2 oil-bodies per cell, one of which at least is always crescentic. This indicated that gross differences observed were correlated with constant cytological differences, and that a species discrete from *E. duriuscula* was at hand.

Finally, since many of the genera are so poorly defined and not readily identifiable when sterile, the cytological features (especially the oil-bodies) acquire a very profound importance in determination of scraps of living material. For instance, *Euosmolejeunea* when sterile may be difficult to separate habitually from *Lejeunea* s. str.; the oil-body features make generic recognition possible, at a glance, however, since the former has few (1-4, rarely more) very large oil-bodies per cell, the latter has much smaller and more numerous (5-60) oil-bodies per cell. The use of oil-bodies in this group for identification is therefore particularly important to the ecologist, who by necessity often collects material because of its location, rather than because of its adequacy for study. Such recognition, from incomplete materials, now often becomes feasible, because of the extraordinary diversity (between many species) in form, size, and number of the oil-bodies per cell, and of the numerous differences in cell-wall form. The writers therefore propose the use of the oil-bodies in this difficult group in the same fashion in which the spores are used today in such groups as Selaginellaceae and Isoetaceae.

III. Oil-body types in the Lejeuneaceae

Müller (1939) was the first to suggest a system, admittedly partly arbitrary, of classifying the oil-bodies into different types. He distinguished 8 types, almost all of which are to be found in the family Lejeuneaceae. The great diversity in oil-body size and form, as well as number, is therefore to be stressed as one of the family characteristics of the group, contrasting it sharply to such related families as Radulaceae, Porellaceae, Frullaniaceae in which the oil-bodies differ from one family to the next, but are relatively similar in all species within the family. This suggests, of course, that the broad generic limits adopted in the Frullaniaceae appear warranted on a cytological basis, while the narrower generic limits in the Lejeuneaceae are also warranted (with some exceptions to be noted below).

The first-named author (Schuster, 1954 b) has suggested an emended form

of the classification of oil-body types adopted by Müller (1939). Since almost all of the oil-body types found in the rest of the Hepaticae occur within the sole family Lejeuneaceae, an outline of these oil-body types is here given, together with examples selected from the species treated in the present work:

- I. Oil-bodies occurring in all chlorophyllose cells (no chlorophyll-free cells), 1-many per cell, ocelli quite absent.
 1. Oil-bodies homogeneous (under the oil-immersion system of the microscope).
 - a. Oil-bodies very small (less than $2.5 \times 6 \mu$, usually much less), and numerous, usually more than 12 per cell. (*Taxilejeunea* type. *Taxilejeunea obtusangula*, *Lejeunea carifolia*, *L. glaucescens*, *L. aquatica*, *Ptychocoleus*, *Caudalejeunea*, *Brachiolejeunea*, etc.).
 - b. Oil-bodies large (over $3 \times 7 \mu$, usually much larger), and few, usually 1-5, at times becoming faintly segmented with age. (*Bazzania-Nardia scalaris* Type; not known among studied species of Lejeuneaceae).
 2. Oil-bodies formed of several to numerous globules or segments, not appearing homogeneous (under the oil-immersion system, of the microscope). At times the individual spherules of which the oil-body is composed of nearly the same refractive index as the matrix, hence difficultly perceptible.
 - a. Globules constituting the oil-body minute, scarcely or not protruding through the common bounding membrane: the oil-body thus appearing to be faintly granulose or papillose.
 - (1) Oil-bodies rather numerous, 4-15 or more, usually small ($2-3 \times 4-7 \mu$ or smaller, rarely some larger), not nearly filling cell-lumen. *Lejeunea* (most species), *Stylolejeunea*, *Microlejeunea laetevirens*, *Cololejeunea* spp., etc.
 - (2) Oil-bodies few, 2-5 per cell, otherwise as in (1). *Microlejeunea* (most species).
 - (3) Oil-bodies few (2-4, rarely 5 per cell), relatively large, ca $3-5 \times 6-9 \mu$ or larger. *Neurolejeunea breutelii*.
 - (4) Oil-bodies normally 1 per cell, large and plate-like, usually $6-9 \times 12-15 \mu$ or larger (*Radula*-type; also in *Scapania gymnostomophila*; not known in any studied Lejeuneaceae, but *Cololejeunea minutissima* (Pl. XIII, Figs. 5-6) may approach this type).
 - b. Globules constituting the oil-body coarse (the width of the oil-body usually formed by 1-3, rarely 4 rows of coarse segments), each strongly individually protruding, the oil-body thus evidently segmented in appearance.
 - (1) Oil-bodies small and numerous, usually less than $3-4 \times 5-7 \mu$. (*Drepanolejeunea* spp., most *Cololejeunea* spp., *Leptocolea* spp.)
 - (2) Oil-bodies large, ca 5×10 to $12 \times 24 \mu$, 1-3, rarely 4-5 per cell. (*Pycnolejeunea* type: *Pycnolejeunea*, *Mastigolejeunea*, *Rectolejeunea* spp., *Euosmolejeunea*, *Cheilolejeunea*, *Leucolejeunea*, etc.).
- II. Oil-bodies occurring in two forms: small and fewer in normal vegetative

cells, larger and more numerous (and nearly filling the cell-lumen), in "ocelli", the ocellus thus with several to many large oil-bodies. *Taeniolejeunea* type.

III. Oil-bodies occurring in two sharply discrete modes: several to many small oil-bodies in chlorophyllose, vegetative cells, and one very large, usually homogeneous oil-body (at least $10-12 \times 15-18 \mu$) in each of the ocelli. Several hundred species of Lejeuneaceae with dimorphic leaf-cells, of this type have been studied by Zwickel (1932), but unfortunately on the basis of dead material. Since this author did not distinguish between the cell-contents of the ocelli, and was unable to study the cell-contents (e. g., oil-bodies) of the chlorophyllose cells, his work is difficult to evaluate in a study of this type. The authors suggest, for the time being, that we call this cell-type the *Drepanolejeunea* Type, with several subtypes suggested below. This type of cell-differentiation occurs only in the Lejeuneaceae and Frullaniaceae. On the basis of the limited amount of material available, the following subtypes appear distinct:

- (1) Vegetative (e. g., chlorophyllose) cells with oil-bodies minute (less than $2 \times 5 \mu$ usually), formed of few, sharply distinct segments, or homogeneous in part. Ocelli scattered in the leaf-lamina, not in a basal group or line (*Diplasiolejeunea rudolphiana*, *Leptolejeunea elliptica*, *L. subacuta*, etc., *Harpalejeunea* spp.).
- (2) Vegetative cells with oil-bodies spherical to ellipsoidal, larger (usually $3 \times 5 \mu$ or larger), formed of many segments, usually papillose or fine-segmented in appearance. Ocelli not basal. (*Drepanolejeunea* spp.).
- (3) Vegetative cells with oil-bodies of a few minute segments, or of isolated droplets, appearing distinctly segmented; ocelli in a basal group. (*Rectolejeunea berteriana*; *Ceratolejeunea*, *Harpalejeunea*, spp.).
- (4) Vegetative cells with oil-bodies 2-4-5 per cell, readily evident, formed of numerous fine globules, appearing papillose; ocelli basal only. (*Microlejeunea ulicina*, *M. ocellifera*, *Harpalejeunea ovata*).

IV. Oil-bodies absent in vegetative cells, but present in scattered cells ("ocelli"), in which a single large oil-body occurs, but no chloroplasts. (This type found in the Marchantiales, in *Riella*, but apparently not in any Jungermanniales. This type is perhaps approached by *Rectolejeunea berteriana*, Pl. VIII, Fig. 2).

V. Oil-bodies totally absent. No Lejeuneaceae appear to lack oil-bodies.

Utilizing the classification suggested above (under I-III), we can suggest the following grouping of the genera of Lejeuneaceae examined. It is probable that in some cases (for instance in all the Holostipae) the suggested grouping rather closely follows phylogenetic principles. However, the authors do not wish to suggest that similar features as regards the oil-bodies necessarily implies close phyletic relationship. Therefore, some or all of the following groups surely contain phyletically discrete elements. It should be noted that, using the above classification, almost all species seen of a particular genus fall into a single category. In the few cases where this is not the case (*Rectolejeunea*, *Euosmo-*

lejeunea, *Lejeunea*), further study as regards delimitation of the genus, may show that our present taxonomic concepts are incorrect. It is also to be noted that "weakly separated" genera usually share very similar oil-bodies.⁶⁾

Utilizing the three fundamental divisions (Holostipae, Schizostipae, Paradoxae), we can tentatively suggest the following classification into groups that may be related because of similar oil-body types, and similar cell-wall features:

1. Holostipae

a) *Ptychanthus* group:- Including *Ptychanthus* (2 species), *Tuzibeanthus* (1 species), *Thysananthus* (1 species), *Mastigolejeunea* (2 species) and undoubtedly other genera. This group is well-defined in having several (less than 10, except *Ptychanthus*, which may have as many as 10) large oil-bodies, composed of discrete, individual protruding oil-globules (thus appearing vesicular, of the "grape-cluster" type of Müller). Each oil-body is usually formed of rather few (at most 15-20, rarely 24-30 in surface view) large globules, mostly 1.5-2 μ in diameter. This appears to be a primitive type, in that it is intermediate between the forms with numerous minute oil-bodies, and those with 1-2 very large ones; furthermore, ocelli never occur in this group.

b) *Neurolejeunea* group:- Including only, among the examined genera, *Neurolejeunea* (1 species examined). In this group we have, as in the previous one, relatively few (2-5 in the sole species seen) large oil-bodies (3-3.5 \times 6-9 μ). Each oil-body appears faintly granular, because it is formed of innumerable minute globules (much less than 0.3 μ in diameter, not individually resolvable under oil-immersion), which do not distinctly protrude through the common plasma membrane, hence the oil-body appears essentially smooth.

c) *Spruceanthus* group:- Including *Spruceanthus* (2 species), *Brachiolejeunea* (3 species), *Ptychocoleus* (3 species), *Archilejeunea* (1 species), *Lophole-*

6) For instance, those of *Lejeunea*, *Microlejeunea*, *Stylolejeunea* are essentially identical. We would suggest that these three groups might well be considered as only subgenerically distinct from each other. On the other hand, *Rectolejeunea* (which has a similar type of lobule as the above genera, with a proximal hyaline papilla, and differs only slightly in vegetative characters from some species of *Lejeunea*), differs radically in oil-body type (as well as in asexual reproduction). Therefore, the first-named author is content to consider this as a good genus. In spite of that fact that *Rectolejeunea* has a proximal hyaline papilla, and *Euosmolejeunea* a distal hyaline papilla, on the lobule, the two genera agree closely in the nature of the oil-bodies. Therefore, although the separation of the two by Evans is justified on morphological grounds, the cytology suggests, nevertheless, a close relationship. On the other hand, *Euosmolejeunea* and *Cheilolejeunea* agree closely in lobule form and position of the hyaline papilla. Furthermore, we find that the oil-bodies of the two groups are very similar (see discussion under *E. polyantha*). We would therefore suggest that these two genera may well be regarded as a single genus, with two subgenera.

On the other hand, such recently separated genera as *Archilejeunea* and *Leucolejeunea* are shown, by the cytological features, to be only very distantly related. Cytological study here shows that Evans, in splitting off *Leucolejeunea* from *Archilejeunea* performed a much-needed task, and gave us two groups each of which is a much more natural and homogeneous entity than the previous "portmanteau" genus *Archilejeunea* represented. The converse therefore also usually holds: if a group can be sharply separated on morphological grounds (and *Leucolejeunea* is very sharply circumscribable), it usually shows distinctive peculiarities as far as its cytology is concerned.

jeunea (4 species), *Caudalejeunea* (1 species), *Odontolejeunea* (1 species). This group is sharply defined in having the oil-bodies relatively numerous (mostly 18-40 per cell, rarely as few as 10), oblong to fusiform to nearly linear, and quite homogeneous within (hence strongly refractive and glistening); the individual oil-bodies are also relatively small and less than $3 \times 7 \mu$, more often on the order of $1.5-1.8 \times 3-5 \mu$. Ocelli are absent in all members of this group.

d) *Leucolejeunea* group:- Including only *Leucolejeunea* (8 species). Oil-bodies almost invariably 1 per cell (rarely 2), very large, formed of circa 40 or more (in surface view) globules that are relatively large ($> 1-1.5 \mu$), strongly protrude through the common membrane; the oil-bodies are thus essentially of the "grape-cluster" type. The genus appears to have an isolated position in the Holostipae, and may perhaps be more closely related to some genera of Schizostipae placed here in the *Pycnolejeunea* group.

e) *Stictolejeunea* group:- Includes *Stictolejeunea squamata* (Willd.) Schiffn. (of which only herbarium material has been seen) and *S. kunzeana* (which has not been studied). The oil-bodies of this group of Holostipae are not known, but the group can, nevertheless, be sharply separated because of the cellular dimorphism - the laminar cells being of two types, chlorophyllose (and presumably with small oil-bodies) and non-chlorophyllose, or nearly so (the ocelli). The ocelli are scattered and occur in large numbers (up to 30 per leaf).

The *Stictolejeunea* group is the most specialized of the Lejeuneaceae Holostipae, in many respects. This is as true for the cells as for the perianth form. The group differs from both the four preceding types, and the following in the scattered ocelli.

f) *Neurolejeunea catenulata* group:- Agreeing with the preceding group in the presence of cellular dimorphism. However, unlike the *Stictolejeunea* group, the present one shows a division between a basal group or vein of ocelli, and otherwise homogeneously formed chlorophyllose laminar cells. Only herbarium material has been seen of this group (*N. seminervis*, *N. catenulata*).

2. Schizostipae

The Schizostipae fall into several categories, as regards the oil-body types to be found. The range in variation in the non-ocellate types is from forms with numerous, minute homogeneous oil-bodies (*Taxilejeunea* type) to forms with the oil-bodies somewhat less numerous, but composed of fine, difficultly perceptible oil-globules (less than 0.6μ in diameter), therefore appearing finely to obscurely papillose (but not segmented) (*Lejeunea* type), to a final, third type (*Pycnolejeunea* type) in which the oil-bodies are very few (mostly 1-4 per cell, rarely 5 per cell in some cells), are composed of coarse globules, and thus distinctly segmented in appearance. It seems unnecessary to stress that these three types are not sharply differentiated from each other, but gradually intergrade.

a) *Taxilejeunea* group:- The oil-bodies numerous, ca. 12-50 per cell, minute (usually $1.3-1.8 \times 2-3.5 \mu$), highly refractive and glistening, appearing homogeneous under oil-immersion, quite smooth externally. Ocelli are quite lacking. The chloroplasts average as larger than the oil-bodies in surface-area. (Including

Taxilejeunea, 2 sp.; *Lejeunea glaucescens* and *cavifolia*, *aquatica*, *japonica*, and *scalaris*).

b) *Lejeunea* group:- The oil-bodies averaging somewhat larger (usually the larger $3 \times 5 \mu$ to $4-5 \times 8-10 \mu$), moderately frequent (4-12 per cell in most cases), and formed of small globules (less than $0.6-0.8 \mu$ in diameter, rarely to 1μ) which protrude slightly to indistinctly; the oil-bodies thus varying from obscurely papillose to very finely segmented. The medium-sized and larger oil-bodies formed usually of 3-5 or even 6 rows of globules (across their narrower diameter). Ocelli are quite lacking in all cases.

Including *Lejeunea flava*, *cladogyna*, *planiuscula*, *minutiloba*, *floridana*, *patens*, *vaginata*, *boninensis*, *mayebarae*, six (all examined) species of *Microlejeunea*, *Stylolejeunea spiniloba*, *Tuyamaella molischii*, and two species of *Euosmolejeunea*. Ocelli are quite lacking in all the examined species, except in some of *Microlejeunea*.

c) *Pycnolejeunea* group:- The oil-bodies very large, mostly 1-3, rarely 4-6 per cell, coarsely segmented and of large spherules (rarely less than 1.2, often $2-4 \mu$ in diameter), the spherules strongly individually protruding (thus of the "grape-cluster" type of Müller). The oil-bodies very usually nearly appearing to fill cell-lumen, their length usually more than one-half the cell-length (when well-developed). Ocelli constantly lacking. The oil-bodies of maximum size in each cell usually $4.5 \times 9-12 \mu$ up to $12 \times 22 \mu$, formed of ca. 15-30 coarse segments (in surface view). Including *Pycnolejeunea*, 2 sp.; *Euosmolejeunea*, 6 species; *Crossotolejeunea*, 1 sp.; *Cheilojeunea*, 1 sp.; *Rectolejeunea*, 3 species.

The preceding three types are primitive in the absence of cellular dimorphism, ocelli being lacking. Only in *Microlejeunea* (a specialized and reduced derivative of *Lejeunea*) do ocelli appear, in a few species. The preceding three groups are also "primitive" in that there is usually slight or no modification of the underleaves, and the leaf-form is usually of the unmodified, traditional type. The plants are also ecologically little specialized, lacking epiphyllous types. Furthermore, the perianth-types represented are little or not specialized or armed.

By contrast, the following three types represent exceedingly specialized, and often highly derivative forms. It is of some interest that these forms are not all derivable from one of the three preceding schizostipous forms, but appear (in at least some cases) to have evolved directly from the Holostipae. This appears to be the case at least with *Ceratolejeunea*.

d) *Ceratolejeunea* group:- Including only *Ceratolejeunea* (3 species) and possibly *Neurolejeunea* s. str., excl. *N. breutelii*. Cells with a basal group or line of enlarged cells that constitute the ocelli; vegetative cells with a small number (2-5 usually) of small, obviously few-segmented oil-bodies, which vary from $2.5-3 \times 5$ to at most ca. $3 \times 10 \mu$. Cells with walls deeply pigmented.

This group stands isolated in the Schizostipae studied. It is the only schizostipous complex with a well-defined tendency towards development of secondary pigmentation of the cell-walls. In spite of the divided underleaves, and the stem structure (see Schuster, 1954), perhaps more nearly allied to the Holostipae. Correlated with the extremely specialized cytology, we find specialized

vegetative features (utriculi) and reproductive features (modified perianths).

e) *Drepanolejeunea* group:- Including the complex of genera related to *Drepanolejeunea*, *Harpalejeunea* and *Leptolejeunea*. This complex is quite unrelated to either the preceding or following type, but appears rather to be derived from Type b (*L₂jeunea* group). Associated with the greatly increased specialization of the cells, and the clear-cut dimorphism of the cells, there is a high degree of specialization both in vegetative structure (leaf and underleafshape) and reproduction (specialized brood-branches; specialized perianths, etc.). The cells have colorless walls, very thin but with often discrete trigones and intermediate thickenings. Ocelli are present and almost always scattered in the leaf (either as an interrupted line, or irregularly dispersed; more rarely there is a basal ocellus or basal or subbasal group; the ocelli are usually few and range mostly from 1-6 per leaf); the ocelli average little or no larger than surrounding cells. The vegetative cells bear few (usually 2-8) rather small, non-homogeneous oil-bodies; they are formed of either very discrete and few globules (*Leptolejeunea*; in some cases evidently of a single spherule and homogeneous) or else of a larger number (*Drepanolejeunea*) in which case they are usually merely fine-segmented or papillose in appearance.

The cytological characters appear correlated with morphological characters that indicate a distinct relationship, among the genera of this group: shallowly bilobed underleaves with divaricate lobes; leaves strongly narrowed and usually tapering, narrowed at base as well, usually averaging at least twice as long as wide; lobule form; extreme delicacy and usually small size; inability to develop secondary pigmentation; specialized caducous brood-branches. The high incidence of epiphyllly in this group is also a mark of specialization.

In cytological features, the nearest relationship occurs with such species as *Microlejeunea ulicina*. Whether there is any fundamental basis for this similarity is doubtful.

f) *Rectolejeunea berteriana* group:- Including only *R. berteriana* and its immediate relatives. The cells in this group are unusually small, evenly thick-walled, and of three types: at the base of the leaf are a group of somewhat enlarged cells, each with a single large oil-body -- the basal ocelli; the rest of the lamina consists of cells that do not differ in size or form from each other but bear a single, large oil-body (which is segmented, at least with age). The cells of this last type (laminar ocelli) are numerous, often 10-18 to 24 per leaf.

Associated with the extreme modification of the cells, we find a highly specialized mode of asexual reproduction (modified caducous leaves on specialized shoots). This group is very restricted as to number of species; it apparently has evolved from group e, above (*Pycnolejeunea* group). With this it agrees in (1) the few oil-bodies per cell; (2) their sharply segmented form. It differs from this at once in the cellular polymorphism, and the much smaller oil-body size in vegetative cells.

3. Paradoxae

The Paradoxae include the genera sometimes placed into the Aphyllae and

Diplasiae. In this group there is no sharp correlation between genera and cytological types. With the exception of *Taeniolejeunea*, the cytological types appear to be important largely on the specific or species-group level, rather than on the generic level. The following cytological groups may be distinguished:

a) *Aphanolejeunea* group:- *C. biddlecomiae*, *diaphana*, *calcareo*, *Aphanolejeunea evansii* and *sicaefolia* belong to this group. In these species the oil-bodies are small, usually subspherical to fusiform to ellipsoidal, and formed of minute, barely perceptible globules. Superficially, the oil-bodies may appear virtually homogeneous (but, unlike true homogeneous oil-bodies, they break down shortly after the death of the plants). No ocelli are present.

b) *Cololejeunea* group:- *C. subcristata*, *minutissima*, *contractiloba*, *Leptocolea* spp., etc. In this group the oil-bodies are small (usually $1.8-2 \times 4-6$ to $3 \times 5-7 \mu$) and similar in form and usually in number (2-10 per cell) to the preceding group, but the oil-bodies are not smooth, being evidently segmented, with individually protruberant (each 1-2 μ in diam.) segments. No ocelli are present.

c) *Diplasiolejeunea* group:- Including *Diplasiolejeunea (rudolphiana)*, etc.), possibly some species of *Leptocolea* and *Cololejeunea*. In this group the cells are dimorphic, scattered laminar cells being differentiated as ocelli (usually equal to surrounding cells in size), each of which contains a single, glistening, homogeneous, oil-body. The surrounding vegetative cells usually bear 3-6 segmented oil-bodies (similar to those of group b, above). The ocelli are variously disposed, but never form a basal vitta (e. g., no ocelli monoliniate occur).

d) *Taeniolejeunea* group:- Including *Taeniolejeunea* (7 species studied), *Cololejeunea* pro parte (4 species). In this group belong specialized species with conical papillae on the dorsal leaf surface, and seriate ocelli at the leaf-base. In the laminar cells the oil-bodies are minute and few, nearly smooth (formed of minute and indistinct granules, recognizable only under very high magnification). In contrast, the ocelli are formed of larger cells, each bearing 1-several oil-bodies (which are evidently compound, formed of numerous and dense globules), filling most of the lumen of the containing cell.

e) *Colura* group:- Oil-bodies hyaline, homogeneous within, 20-40 per cell, ovate to fusiform, occasionally rotundate. (Two collections, of dried plants, of *C. meijeri* could be studied. The oil-bodies soon disintegrate and finally almost disappear after the cell died).

IV. Materials examined⁷⁾

Tribe and genus	Japan (Hattori)	North America, West Indies, Europe, Africa (Schuster)
Holostipae:		
Ptychanthus	striatus (I: 10-11)	
"		dioicus (A)

Tuzibeanthus	porelloides (I: 12-13)	
Thysananthus	aculeatus	
Mastigolejeunea	auriculata (V: 4)	
"	liukiensis (I: 14-15)	
Spruceanthus	semirepandus (I: 1)	
"	polymorphus (I: 2-3)	
Brachiolejeunea	sandvicensis (I: 4)	
"		bahamensis (NA; IV: 1-2)
Ptychocoleus	nipponicus (I: 6)	
"		heterophyllus (NA; IV: 3)
Phragmillejeunea		pappeana (A)
Caudalejeunea		lehmanniana (NA; V: 1-3)
Archilejeunea	kiushiana (I: 5)	
Marchesinia		chrysophylla (A)
Lopholejeunea		muelleriana (NA; IV: 4-7)
"	formosana (I: 7-8)	
"	nipponica (I: 9)	
"		subfusca (NA; IV: 8)
Neurolejeunea		breutelii (AN; VI: 1)
Leucolejeunea		clypeata (NA; V: 5)
"		knysnana (A)
"		rotundistipula (A)
"		capensis (A)
"		unciloba (NA)
"		conchifolia (NA; V: 7)
"	xanthocarpa (I: 16)	xanthocarpa (NA; V: 6)
"	japonica	
"	subalpina	
"	" var. yakumontana	
"	flavescens	
Odontolejeunea		sieberiana (WI)

Schizostipae:

7) In the majority of cases, the specimens studied were living, or had been dry for less than two weeks. Since most species involved withstand drying for this length of time without cytological changes that are irreversible, such plants may be considered valid for study. Where plants were dry for longer periods, this is generally noted after the description of the species involved.

In the following table the origin of the materials cited is given; those in Column I are all of Japanese origin; those in Column II either of North American or West Indian origin, or of European or South African origin. For that reason, the abbreviations N. A., W. I., E., and A. are used. The data for the North American and some West Indian materials are based on original studies by the senior author; the data for the European plants are based either on studies of living plants, leg. E. W. Jones (via Air-Mail), or based on Müller (1939); the data on the South African species is taken from Arnell (1953). Three West Indian species are cited from Jovet-Ast. The compilation of the latter data is by the senior author. Plate and figure citations (within parentheses) are given for those species illustrated.

Pycnolejeunea	tosana (I: 17-18)	
"	obtusilobula (I: 19-20)	
Ceratolejeunea		cubensis (NA; VI: 4-4a)
"		guianensis (NA; VI: 2-3b)
"		rubiginosa (NA)
Euosmolejeunea	osumiensis (I: 21-23)	
"	ontakensis (I: 24-25)	
"	nipponica (II: 1)	
"		clausa (NA; VII: 3-5)
"		rigidula (NA; VII: 6-8)
"		parvula (NA)
"		polyantha (NA; VII: 1-2)
"	obtusifolia (II: 4-5)	
"	claviflora	
"	auriculata	
Rectolejeunea		berteroana (NA; VIII: 1-2)
"		brittoniae (NA; VIII: 6-8)
"		maxonii (NA; VIII: 4-5)
"		phyllobola (NA)
"		rhodesiae (A)
Inflatolejeunea		capensis (A)
Anomalolejeunea		pluriplicata (A)
"		" var. tabularis (A)
Cheilolejeunea		decidua (NA; VIII: 3)
Nipponolejeunea	pilifera (II: 6-7)	
"	subalpina (II: 8)	
Drepanolejeunea		hamatifolia (E; IX: 1-2)
"		capensis (A)
"		papillosa (A)
"	japonica (II: 9-11)	
"	tenuis (II: 12)	
"	foliicola (III: 24-27)	
"		bidens (NA; IX: 3-4)
"		" ssp. appalachiana (NA; IX: 5-6)
Harpalejeunea		ovata (NA; IX: 9-10)
"	intermedia (II: 13-14)	
Leptolejeunea	subacuta (II: 15-16)	
"		elliptica (NA; IX: 7-8a)
Lejeunea	flava (II: 22-23)	flava (NA; X: 12; A)
"		cladogyna (NA; X: 3)
"		caroliniana (NA; X: 4-5)
"		floridana (NA; X: 9)
"		patens (NA; X: 6-8; XI: 1)
"		capensis (A)

//		convexa (A)
//		tabularis (A)
//		eckloniana (A)
//		helenae (A)
//		caespitosa (A)
//		microlobulata (A)
//	mayebarae	
//	vaginata (II: 19-21)	
//	boninensis (II: 17-18)	
//	japonica (II: 24)	
//	scalaris	
//	aquatica (II: 25-26)	
//		cavifolia (NA; XI: 2-3; E)
//		planiuscula (E)
//		glaucescens (NA; XI: 4-5)
//		macvicari (E)
Microlejeunea	rotundistipula	
	var. pallida (II: 27-28)	
//	punctiformis (II: 29)	
//		laetevirens (NA; XII: 2-5)
//		ruthii (NA; XII: 6)
//		ulicina (NA; XII: 7-9; E)
//		ocellifera (A)
//		bullata (NA)
Potamolejeunea		holtii (E)
Ciliolejeunea		capensis (A)
Strepsilejeunea		knysnana (A)
//		georgiensis (A)
Stylolejeunea		spiniloba (NA; XII: 1)
Crossotolejeunea		bermudiana (NA; XI: 7-8)
Taxilejeunea		obtusangula (NA; XI: 6)
//		eggersiana ? (WI)
//		conformis (A)
//		vallis-gratiac (A)
Prionolejeunea		aemula (WI)
Tuyamaella	molischii (III: 1-2)	
Paradoxae:		
Diplasiolejeunea		rudolphiana (NA; XIII: 1-4)
Colura	meijerii (text-fig.)	
Cololejeunea	denticulata	
//	minuta (III: 3)	
//	orbiculata	
//		minutissima (NA; XIII:

		5-7; XIV: 1-2)
//		myriantha (A)
//	rupicola (III: 4)	
//	shikokiana (III: 5)	
//	yamanakana	
//	spinosa (III: 6-8)	
//		biddlecomiae (NA; XIII: 8; XIV: 6-8)
//		calcareae (E)
//		contractiloba (NA; XIV: 3-5)
//		diaphana (NA; XV: 1-2)
//		subdiaphana (NA)
//		subcristata (NA; XIV: 9-10; XV: 3-4)
Aphanolejeunea		sicaefolia (WI; XV: 11)
//		evansii (NA; XV: 5)
//		ephemeroïdes (NA)
Leptocolea	gobelii	
//	dolichostyla	
//	horikawana	
//	japonica	
//	longilobula	
//	miyajimensis var. microdonta (III: 10-12)	
//	nakaii	
//	aoshimensis (III: 9)	
//	ciliatilobula (III: 13-14)	
//		scabrifolia (WI)
//		cardiocarpa (NA; XV: 6-10)
Taeniolejeunea	oshimensis (III: 15-19)	
//	pseudofloccosa (III: 23-24)	
//	ocelloïdes (III: 21-22)	
//	peraffinis	
//	appressa (III: 20)	
//	floccosa	
//	verdoornii	

Total genera: 42

Total species: 67

Total species: 84⁸⁾

V. Treatment of individual species

A. Ho'ostipae

Ptychanthus striatus (L. et L.) N. var. *perrottetii* (St.) Vrd. (Pl. I, Figs.

8) Not including those species already listed in Column I.

10-11). Oil-bodies mostly 10 per cell, grayish, very large, 5-15 (mostly 6-8) \times 3.5 μ , segmented (of "grape-cluster" type), formed of moderately numerous, large globules (ca. 1.5 μ in diameter). In the cells of leaf-margin, oil-bodies smaller, spherical or nearly so, composed of few adhering globules. (From fresh material; on rocks, ca. 350 m. alt., Kitago, Miyazaki County; *S. H.*)

Ptychanthus divicus (Sim) Arnell. Cells 12-18 μ marginally, 18 \times 20-30 μ medially, walls brown, with distinct trigones and intermediate thickenings. Oil-bodies persistent, 2-3 per cell, segmented, colorless, up to 6 \times 10 μ (South African material; fide *S. A.*).

Tuzibeanthus porrelloides Hatt. (Pl. 1, Figs. 12-13). Oil-bodies mostly 6-9 per cell, grayish, large, 4-10 \times 4-4.5 μ , segmented (of "grape-cluster" type), formed of moderately numerous (15-20), large globules (1.5-2 μ in diam.). In the elongated basal cells, oil-bodies 9-14 per cell, equal or \pm larger in size. In the marginal cells, oil-bodies 3-6 per cell, smaller (2.6 \times 2.4 μ), globules few and indistinct. (From two dry collections 20 and 50 days, respectively, after collection; on limestone, ca. 500 m., Watari, Kumamoto Co.; *S. H.*)

Thysananthus aculeatus Herz. Oil-bodies grayish, segmented (of "grape-cluster" type) formed of 10-20 large globules (1-2 μ in diam.). In the marginal cells oil-bodies 2-3 per cell, small, mostly spherical (2.5-3 μ in diam.), globules few and indistinct. In the middle cells, oil-bodies 3-4 per cell, 3-6 \times 3-4 μ . In the basal elongated cells, oil-bodies 3-5 (rarely 6) per cell, mostly 8 \times 4 μ (rarely 10 \times 4.5 μ) in size. (Based on material dry for 5 days; on barks, Isl. Yakushima *S. H.*)

Mastigolejeunea auriculata (Wils & Hook.) Schiffn. (Pl. V, Fig. 4). Cells characteristically diamond-shaped, ca. 13-15 μ wide \times 17-22 μ long, with very large bulging trigones that are often nearly confluent; walls more or less brownish to fuscous pigmented; marginal cells only 8-10 μ .

Oil-bodies typically bacilliform to narrowly ellipsoidal, (1) 2-3 per cell in the leaf-middle, in a few cells spherical and only 3.5-4 μ , mostly 3.5-4.5 \times 6-9 μ , relatively prominent, near leaf-base sometimes 5-6 \times 10-14 μ , formed of rather numerous, readily evident, somewhat protruding oil-globules of small size (less than 1 μ), thus appearing coarsely papillose other than segmented. Marginal cells with smaller, usually circular oil-bodies only 3-3.5 μ in diameter, absent from many marginal cells. Chloroplasts 5-6 μ long, unusually large, but averaging much smaller in surface-area than the oil-bodies. (Chunchulla, Alabama, 1950; *R. M. S.*)

Mastigolejeunea liukiensis (Horikawa) Hatt. var. *mayebarae* Hatt. (syn. *M. Mayebarae* Hatt. Hepat. Japon. Exsicc. Ser. 3, 195). (Pl. I, Figs. 14-15). Oil-bodies mostly 2 (but occasionally 3, or in the elongate basal cells 4) per cell, grayish, very large, 10-13 \times 5-6 μ (or in the elongate basal cell up to 15-20 \times 6-7 μ), segmented (of "grape-cluster" type), formed of 15-25 large globules (1.5-2 μ in diam.). In the marginal cells, oil-bodies smaller, often spherical (as separated globules). (Dry material 10 days after collection; on limestone, ca. 300 m., Isshoochi, Kumamoto Co.; *S. H.*)

Spruceanthus semirepandus (N.) Vrd. (Pl. I, Fig. 1). Oil-bodies numer-

ous, 20-30 per marginal cell, 30-40 (rarely up to 50) per middle cell, 40-50 (or more) per basal elongate cell, oblong in shape, 4-5 (rarely 6) \times 2-2.5 μ , or occasionally spherical, 2-2.5 μ in diameter, hyaline, homogeneous within (but appearing to be differentiated into two layers, an outer thin, skin-like layer, and an inner one). (From fresh material, and from material dry ca. 30 days; on tree trunks, ca. 500 m., Sakatani, Miyazaki Co.; on tree trunks, ca. 400 m., Isshoochi, Kumamoto Co.; on barks, Mt. Kaimon, Kagoshima Co.; *S. H.*)

The following 10 species of the *Spruceanthus* group have oil-bodies of the same type as this species.

Spruceanthus polymorphus (Lac.) Vrd. (Pl. I, Figs. 2-3). Oil-bodies 10-45 (mostly 15-25) per cell, hyaline, homogeneous, oblong (or often \pm fusiform), ca. 6 \times 3 μ (rarely 10 \times 3 μ), or occasionally spherical, ca. 3 μ in diameter. (From fresh material; on barks, ca. 350 m., Kitago, Miyazaki Co.; on barks, ca. 50 m., Obi, Miyazaki Co.; *S. H.*)

Brachiolejeunea sandvicensis (G.) Evs. (Pl. I, Fig. 4). Oil-bodies 30-35 per cell, oblong, 4-5 (rarely 6.5) \times 2-2.5 μ , occasionally rotundate, 2.5 \times 2 μ , hyaline, homogeneous within. (From fresh material and from material dry 35 days; on barks, ca. 250 m., Obi, Miyazaki Co.; on barks, ca. 400 m., Isshoochi, Kumamoto Co.; *S. H.*)

Brachiolejeunea bahamensis Evs. (Pl. IV, Figs. 1-2). (1.) Cells subisodiametric, quadrangular to hexagonal, thin-walled with trigones large, bulging usually on two sides, concave on the third; walls brownish. Median cells ca. 20-23 $\mu \times$ 25-28 μ . Oil-bodies mostly 15-22 per cell, narrowly ellipsoidal to narrowly fusiform, homogeneous, glistening, highly refractive, ca. 1.6-2 \times 5-8 μ . Chloroplasts ca. 4-5 μ in longer diameter, their area about equal to that of the oil-bodies, of slightly greater. (S 22915a, Paradise Key, Dade Co., Florida, *R. M. S.*)

(2.) Oil-bodies similar, but 22-30 per cell, 1.5-1.8 \times 3-5 μ ; chloroplasts ca. 4-5-5.5 μ (much larger than oil-bodies). (Long Key pineland, Dade Co., Florida; *R. M. S.*)

(3.) Cells 10-12 μ along margins, 15-18 \times 20-25 μ medially, with large trigones, bulging on 2 sides, concave on the third. Oil-bodies (9) 12-15 per cell, fusiform to bacilliform, homogeneous and glistening, ca. 1.2 \times 4.5 μ to 1.5 \times 5.5 μ , in some cells largely ovoid to subspherical and 1.5-2 μ or 1.5 \times 2 μ ; chloroplasts 4-4.5 μ , much larger than oil-bodies. (S 31748b, Monroe Co., Fla.; *R. M. S.*)

Ptychocoleus nipponicus Hatt. (Pl. I, Fig. 6). Oil-bodies 10-25 (mostly 15-20) per cell, hyaline, homogeneous within, oblong or rarely rotundate, 1.5-6 \times 1.5-2 μ (mostly 4-5 \times 2 μ); in marginal cells, oil-bodies smaller (1.2-3 \times 1.2 μ), 1-7 per cell or often disappearing. (Material dry 15 and 20 days; on barks, ca. 300 m., Hitoyoshi, Kumamoto Co.; on barks, ca. 350 m., Isshoochi, Kumamoto Co., *S. H.*)

Ptychocoleus pappeanus (Nees) St. Cells 12 μ on margins, 16 \times 26 μ in leaf-middle, with large trigones and intermediate thickenings. Oil-bodies 4-5 per cell, 4 \times 4 to 4 \times 6 μ , segmented, colorless (South African material; fide *S. A.*)⁹⁾.

Ptychocoleus heterophyllus Evs. (Pl. IV, Fig. 3) Cells of leaf-middle somewhat elongate-hexagonal, ca. 20-24 \times 25-35 μ , the walls very irregular, due to the

large trigones (which normally have two sides bulging, the third concave, thus irregular and undulate in shape), and the commonly present intermediate thickenings (usually occurring one between each pair of trigones, but absent on most shorter walls); cell walls thus strongly undulate, yellowish to yellowish-brown (except in the shade forms, where the walls are colorless). Oil-bodies 7-12 per median cell, homogeneous, glistening, colorless, bacilliform to narrowly fusiform, 2×3.5 to 2×5 μ , occasionally to 2×8 μ , in occasional cells ovoid to broad-ellipsoid and ca. 2.5×3 μ to 3 μ . Marginal cells with oil-bodies usually smaller, mostly nearly spherical. (Juniper Springs, Florida, December 22, 1951; *R. M. S.*)

Caudalejeunea lehmanniana (Gottsche) Evs. (Pl. V, Figs. 1-3). (1) Marginal cells only 14-16 μ , rarely 16-18 μ , averaging quadrate; median cells 20-22 μ wide \times 27-36 (42) μ long. Cells with characteristic arrangement, elongate in cell-middle, mostly narrowly hexagonal, tapering towards each end, almost diamond-shaped and arranged in essentially a shaped pattern. Cell walls hyaline, thin, except for the nodular, bulging trigones and numerous discrete intermediate thickenings (one, rarely two, of which occur between each pair of trigones). Oil-

9) As is evident on a comparison with the descriptions and figures given for the preceding (Japanese) and the following (Neotropical) species of *Ptychocoleus*, the present species has very different oil-bodies. They differ not only in number, but in size and structure. This suggests that *P. pappeanus* does not belong to *Ptychocoleus*. This is also clear from the form of the lobule (see Arnell, 1953, Fig. 12d). The inflated, pyriform perianth, with the very summit trisulcate (and hence with three weak folds), also excludes the species from *Ptychocoleus* (which has numerous supplementary carinae).

The form of the leaves, the nature of the cells and oil-bodies, and the form of lobules and underleaves, as well as the lack of more than three folds of the perianth suggest *Mastigolejeunea*. However, the presence of "female organs frequently several in groups in the top of somewhat elongated branches" does not suggest *Mastigolejeunea*. Neither does the evident lack of subfloral innovations, which uniformly occur in *Mastigolejeunea*. The tricarinate perianths, and tendency for dentition of the braeteole suggests *Caudalejeunea* (as does the terminal perianth on a more or less elongate shoot; however, the latter genus has cells with numerous, small homogeneous oil-bodies (as does *Ptychocoleus*, s. str.). The writer would suggest that this species be split off to form a separate genus. It is to be noted that Arnell (l. c., p. 288) defines *Ptychocoleus* as having "4-12 obtuse low plicae along the perianth from top to base", yet (p. 184) describes that of *P. pappeanus* as "inflated, with 3 short and shallow furrows in the apex," and illustrates it as inflated and eplicate. For *Ptychocoleus pappeanus* (Nees) St. (= *Phragmicoma pappeana* Nees, Syn. Hep. 296, 1844) the writer suggests the new combination:

Phragmilejeunea pappeana (Nees) Schuster, comb. n.

This species represents the type of the genus *Phragmilejeunea* Schuster. The latter may be defined to include those species of *Ptychocoleus* with (1) few, large, segmented oil-bodies; (2) lobules with only the apical tooth distinct; (3) perianths without numerous supplementary keels. A brief Latin diagnosis of the genus follows: Similis ad *Ptychocoleum*, differt a: (1) corpora oleifera magna, composita, hyalina, 4-5; (2) foliorum lobuli unidentati; (3) perianthia inflata, pyriformia, a oro trisulcata. Typus: *Phragmicoma pappeana* Nees.

It is to be noted that the genotype of *Ptychocoleus* is *P. aulacophorus* (see Evans, 1908). This species has the lobules with 7-8 small marginal teeth, and a pluriplicate perianth. In this it approaches *P. heterophyllus* Evs. from the New World, and *P. nipponicus* Hattori. Since the latter have numerous, small, homogeneous oil-bodies, it is presumed that the genotype (and all true species) of *Ptychocoleus* have such oil-bodies. (*R. M. S.*)

bodies numerous, characteristically narrowly ellipsoidal to bacilliform, in extreme cases almost vermiform, occasionally slightly crescentically arched, occurring mostly 19-25 per median leaf-cell; oil-bodies fuller near margin, absent in 1-2 marginal rows. Each oil-body appearing totally homogeneous (under oil-immersion), highly refractive, ca. $1.5 \times 3.5-7 \mu$; near margins smaller, mostly $1-1.5 \times 2-4 \mu$. Cells quite opaque due to the large and rather numerous chloroplasts (averaging $3.8-4.5 \mu$). (S 2290, p. p.) The oil-bodies of this species are quite characteristic.

(2.) Under other conditions, the median cells with 22-28 oil-bodies per median cell, and these nearly spherical and $2.5-3.2 \mu$ to ovoid and $2-2.5 \times 4-5 \mu$. (S 22016, on twigs of *Annamomis simpsoni*, Dade Co., Florida; *R. M. S.*)

Archilejeunea kiushiana (Horikawa) Vrd. (Pl. I, Fig. 5). Oil-bodies 10-20 per cell, hyaline, homogeneous within, oblong, often fusiform, ca. $6 \times 3 \mu$ (rarely $10 \times 3 \mu$), or occasionally spherical and small, $1.5-4 \times 1.5 \mu$; few smaller oil-bodies in marginal cells. (From 15, 30, and 45 days dried materials; on barks, ca. 200 m. and 300 m., Isshoochi, Kumamoto Co.; do., ca. 600 m.; do., ca. 400 m.; *S. II.*)

Marchesinia chrysophylla (L. and L.) St. Marginal cells ca. 20μ , median cells ca. $24 \times 26 \mu$, walls thin, trigones distinct. Oil-bodies numerous, single drops or small compound bodies, slightly yellowish (South African material; fide *S. A.*). It is probable that the above, much too brief, description is based on material in which the oil-bodies have started to disintegrate.

Lopholejeunea muelleriana (Gottsche) Schiffn. (Pl. IV, Figs. 4-7). (1.) Cells $24-30 \times 23-25 \mu$, the walls varying from thin (with large but scarcely bulging trigones and occasional intermediate thickenings), to thick, with the walls more or less pitted; walls fuscous. Oil-bodies mostly 8-17 per cell, polymorphic, linear to bacilliform to ellipsoidal to ovoid, occasional ones orbicular, normally homogeneous and glistening (the larger often weakly 2-4, rarely 5-6 segmented), mostly $1.8-2.5 \mu$, when subglobular, to $1.5-1.8 \times 4-6 \mu$. Marginal cells usually with smaller, more or less globular oil-bodies. Chloroplasts large, orbicular, $3.5-4.5 \mu$, their area 2-3 times that of the oil-bodies. (S F-120, Gulf Hammock, Florida; *R. M. S.*)

(2.) Median cells $22-25 \times 25-28 \mu$, the walls brownish, with strongly developed trigones and frequent intermediate thickenings, often confluent (the walls thus more or less irregularly thick-walled). Oil-bodies mostly 10-16 per cell, polymorphic, mostly ovoid to narrowly ellipsoidal, often bacilliform, occasionally narrowed medially and dumb-bell shaped, homogeneous and glistening, $2 \times 3-5 \mu$ to $1.8-2.4 \times 6-7 \mu$. (S 29200, 1.5 mi. e. of Whiteville, N. C.; *R. M. S.*)

(3.) Cells $19-23 \mu$ wide \times $22-24 \mu$ long, hexagonal and somewhat elongate; walls strongly equally thick-walled, with rather discrete middle lamella and difficultly visible pits; wall somewhat fuscous, at the angles between 3 walls, more deeply fuscous pigmented. Oil-bodies 9-19 per cell, homogeneous (rarely weakly 3-6 segmented), $1.5-1.6 \times 4.5-6 \mu$, to $1.8 \times 4.2 \mu$, mostly narrowly fusiform; in a few cells spherical (and 2μ) to broadly ellipsoidal and $1.8 \times 3.5 \mu$. Chloroplasts large, $4-6.5 \times 3-4.5 \mu$, their area 2.5-4 times that of oil-bodies. (S 22780a,

Hillsborough R., Florida; *R. M. S.*)

Lopholejeunea formosana Horikawa (Possibly identical with *L. subfusca*). (Pl. I, Figs. 7-8). Oil-bodies 8-15 per cell, hyaline and homogeneous, rotundate or mostly oblong, $2.5-7 \times 2.5 \mu$; in marginal cells less numerous, often only 5 per cell, almost rotundate. (From fresh and 15-days dried materials; on barks, ca. 20 m., Obi, Miyazaki Co.; on barks ca. 700 m., Hitoyoshi, Kumamoto Co.; *S. H.*)

Lopholejeunea nipponica Horikawa (Closely related to *L. formosana*, and these two together also related to *L. subfusca*). (Pl. I, Fig. 9). Oil-bodies 10-15 per cell, hyaline, homogeneous within, oblong-fusiform, $3.6 \times 2.5 \mu$, occasionally rotundate, $2.5-3 \mu$ in diam.; towards the marginal cells oil-bodies fewer and smaller. (From material dry 15 days; on barks, ca. 600 m., Mt. Ichifusa, Kumamoto Co.; *S. H.*)

Lopholejeunea subfusca (Nees) Schiffn. (Pl. IV, Fig. 8). (*L. sagreana* (Mont.) Schiffn.) Median cells mostly $24-28 \mu$ long \times $20-23 \mu$ wide, elongate hexagonal, not essentially diamond-shaped and not oriented in a diamond-shaped pattern. Cell walls irregularly thickened, the walls between the trigones often thicker than at the trigones, the trigones relatively small, concave; walls fuscous, with middle lamella slightly deeper pigmented. Oil-bodies mostly elliptical to fusiform, quite homogeneous, highly refractive, 8-15, rarely to 20 per median leaf cell, mostly $4-5 \times 1.8-2 \mu$, a few to $1.8-2 \times 5-6.5 \mu$; in some cells oil-bodies largely spherical to ovoid, then mostly $3-4 \mu$ in diameter. Chloroplasts mostly $4.5-5 \mu$ in diameter, relatively large, their surface area averaging greater than that of oil-bodies, their length averaging about equal to that of oil-bodies. (Living material; from 3 miles n. w. of Brooksville, Florida, S 22037; *R. M. S.*)

Neurolejeunea breutelii (Gottsche) Evs. (Pl. VI, Fig. 1). Median cells rounded elongate-hexagonal, ca. $10-14 \mu$ wide \times $26-32 \mu$ long, with somewhat thickened walls and large (but scarcely bulging) trigones, the walls golden-brown, with a slightly differentiated middle lamella. Oil-bodies mostly 3-4 per cell, unusually large for the cell size, grayish, appearing barely perceptibly, finely granular (evidently composed of numerous spherules at or near the limits of visibility under $950\times$); oil-bodies from short-ellipsoidal and $3 \times 6 \mu$ to narrowly ellipsoidal and $3 \times 8 \mu$, a few to $3.5 \times 9 \mu$. Chloroplasts few and large, ca. 4.5μ . (Living material, north of Escatawpa, Mississippi; *R. M. S.*)

Leucolejeunea clypeata (Schwein) Evs. (Pl. V, Fig. 5). (1.) Median cells thin-walled with small concave trigones to moderate but scarcely bulging trigones; no intermediate thickenings. Cells more or less hexagonal to polygonal, nearly isodiametric, ca. $16-20 \times 19-22 \mu$, cell-walls quite colorless. Oil-bodies always one per cell, very large, nearly obscuring the entire lumen, from $9 \times 18 \mu$ to $11 \times 20 \mu$, formed of numerous minute to small globules, each more or less individually protruding resulting in an opaque, coarsely papillose-appearing structure. Chloroplasts $3.6-5 \mu$ in longer diameter. (West Virginia; S 18300 b; *R. M. S.*)

(2.) Cells $21-23 \mu$, with large trigones and occasional intermediate thickenings, the trigones extending from the corners along the walls (on short walls often nearly confluent). Oil-bodies 1 per cell, ca. 8×12 to $9 \times 15-16 \mu$, formed

of numerous globules (ca. 1-2 μ in diameter) which protrude, the oil-body thus appearing coarsely papillose, of the "grape-cluster" type. Chloroplasts ca. 3.5-4 μ . (Whitehouse 22620, Jasper Co., Texas; *R. M. S.*)

(3.) Cells 19-21 \times 22-25 μ , with strong but scarcely bulging trigones and occasional intermediate thickenings. Oil-bodies one per cell, 10 \times 16-22 μ , occasionally accompanied by 1 (rarely 2) smaller oil-bodies (each ca. 4-5 \times 9-10 μ). Chief oil-body formed of coarse globules, ca. 3-3.5 μ in diameter, strongly protruding. (S 26781, Wyatt Hills, Miss.; *R. M. S.*)

Leucolejeunea knysnana S. Arnell. Marginal cells ca. 14 μ , median cells ca. 20-30 μ , walls rather thin with small intermediate thickenings and rather large trigones. Oil-bodies single, oval, of fine segments, slightly brownish, almost filling cell-lumen. (South African material; fide *S. A.*)

Leucolejeunea rotundistipula (Lindenb.) St. Cells ca. 14 μ marginally, ca. 20 μ medially; walls thin, trigones distinct. Oil-bodies single, compound, brown, 16-20 \times 12 μ (South African material; fide *S. A.*):

Leucolejeunea capensis S. Arnell. Oil-bodies 1 per cell, brown, ca. 5 \times 16 μ , rather coarsely segmented (South African material; fide *S. A.*).

Leucolejeunea unciloba (Lindenb.) Evs. Cells of leaf-middle from ca. 18-22 μ to an occasional maximum of 24-30 \times 22-27 μ , with distinct but not bulging trigones, and (on the longer cell-walls) occasional intermediate thickenings. Oil-bodies occurring singly per cell, varying from 8 \times 17 μ to a maximum of ca. 9-10.5 \times 22-24 μ in the leaf-middle; oil-body distinctly segmented, formed of numerous (4-6 rows in surface view) coarse globules (each ca. 1.5-3 μ) which strongly protrude through the bounding plasma membrane of the oil-body. Chloroplasts relatively few and inconspicuous, to 4.5 μ long. (S 27761, Harrison Co., Miss.; *R. M. S.*)

Leucolejeunea conchifolia Evs. (Pl. V, Fig. 7). (1.) Median cells elongate-hexagonal, thin-walled, with small, concave trigones; cells averaging 18-21 \times 21-26 μ ; walls colorless; intermediate thickenings rare or absent. Oil-bodies one per cell, very large and filling most of lumen, 7.5-8.5 \times 18-20 μ , near base to 10-24 μ , near margin smaller and ca. 7 \times 14 μ . Oil-body formed of numerous, unequal-sized protruding spherules, thus coarsely papillose, in appearance, and quite opaque. Chloroplasts relatively small, ca. 3-3.5 μ in longer diameter. (*R. M. S.*)

(2.) Cells of leaf-middle ca. 18-21 \times 19-23 μ , thin-walled with small trigones and few or no intermediate thickenings. Oil-bodies 1 per cell, varying from 6 \times 14 to 9 \times 16 μ , a few to 10 \times 18 μ , opaque, formed of innumerable, individually protruding, obvious globules (each ca. 1.2-2 μ in diameter); chloroplasts 3.5-4 μ , quite few. (S 28899c, Linville Gorge, N. C.; *R. M. S.*)

Leucolejeunea xanthocarpa (L. et L.) Evs. (Pl. I, Fig. 16; Pl. V, Fig. 6). (1.) Oil-bodies 1 — rarely 2 — per cell, large, 15-23 \times 7-8.5 μ (mostly 20 \times 8 μ), elliptical, grayish, compound (of "grape-cluster" type), globules 1-1.5 μ in diam., numerous (ca. 40) and dense; oil-bodies smaller towards the marginal cell, 6-10 \times 4-5.5 μ , rarely dissociating or disappearing. (Fresh material; on barks of *Cryptomeria japonica*, ca. 30 m., Obi, Miyazaki Co.; do., ca. 400 m., Nakago;

S. H.)

(2) Median cells ca. (19) $20-22 \times 22-27 \mu$ with colorless walls, the walls rather thin, the trigones very large and more or less bulging, occasional walls with evident intermediate thickenings (occurring one per longitudinal wall when present). Oil-bodies normally one per cell, coarsely segmented, the globules strongly protruding, variable in size, ca. $2-4 \mu$; oil-bodies from ca. $8-9 \times 17-18$ to a maximum of $12 \times 22 \mu$, bacilliform to ellipsoidal to slightly crescentic. Occasionally (in very large cells) a second, much smaller linear oil-body ca. $3 \times 9-10 \mu$, formed of much smaller globules. Chloroplasts small, ca. $3-4 \mu$. (Van Cleave, Miss., S 19199; *R. M. S.*)

Leucolejeunea japonica (Horikawa) Verd. Oil-bodies 1 per cell, large, compound (of "grape cluster" type) and grayish, belonging quite to the same type as those of *L. xanthocarpa*, (10 days dry material; on barks, Shiiba, Miyazaki Co.; *S. H.*).

The following species also have oil-bodies of the same type:

Leucolejeunea subalpina (Hatt.) Hatt., nom. nov. -Syn. *Strepsilejeunea rotundistipula* Hatt. in Journ. Jap. Bot. 20 (5): 270. Fig. 53 (1944), nec *L. rotundistipula* (Lindenb.) St. Hab. Japan (Nagano Pref.).

Var. *yakumontana* (Hatt.) Hatt., comb. nov. -Syn. *Strepsilejeunea rotundistipula* Hatt. var. *yakumontana* Hatt. in Journ. Hattori Bot. Lab. 5: 59. Fig. 39 (1951). Hab. Japan (Isl. Yakushima).

Leucolejeunea flavescens (Hatt.) Hatt. -Syn. *Archilejeunea flavescens* Hatt. in Bull. Tokyo Sci. Mus. 11: 95. Fig. 60 (1944). Hab. Japan (Sata Pen., Southern Kyushu).

B. Schizostipae

Pycnolejeunea tosana St. (Allied to *P. imbricata* (N.) St.) (Pl. I, Figs. 17-18). Oil-bodies 2 (rarely 1, or more rarely 3) per cell, more or less grayish, compound (of "grape cluster" type); one always large, $7 \times 4 \mu$ to $17 \times 7 \mu$, composed of ca. 20 large globules ($2-3 \mu$ in diam.), the other accompanying oil-body far smaller, and its globules also smaller ($0.5-1 \mu$ in diam.), no less in number. Towards the marginal cells, oil-bodies becoming smaller. (From fresh, 30 and 50 days dried materials; on barks, ca. 30 m., Obi, Miyazaki Co.; on rocks, ca. 600 m., Shimomatsukuma, Kumamoto Co.; on bank, ca. 200 m., Watari, Kumamoto Co.; *S. H.*)

Pycnolejeunea obtusilobula Hatt. (Pl. I, Figs. 19-20). Oil-bodies 2-3 per cell, compound (of "grape cluster" type), more or less grayish, one very large, $15-17 \times 7 \mu$, composed of 15-20 large globules ($2-3 \mu$ in diam.); the other (accompanying oil-body) far smaller (ca. $1/2$ as wide) and its globules also smaller, but almost equal in number; the third (when present) large, similar to the first. (From fresh material; on small branches of *Rhododendron*, ca. 20 m., Obi, Miyazaki Co.; *S. H.*)

Odontolejeunea sieberiana (Gottsche) Schiffn. Each cell with 10-27 oil-bodies, $4-6 \mu$ long, fusiform to bacilliform or weakly crescentic, homogeneous. (Martinique; fide *Jovet-Ast.*)

Ceratolejeunea cubensis (Mont.) Schiff. (Pl. VI, Figs. 4, 4a). Cells equally thick-walled, with almost imperceptible trigones, the walls yellowish to golden, the middle lamella deeper, prominent; walls usually nearly even, sometimes rather distinctly undulate. Median cells ca. $17-18 \times 20-23 \mu$; apical cells ca. $14-18 \mu$ wide $\times 18-22 \mu$ long within margin; cells of apex only $7-9 \mu$ along margins; basal cells (exclusive of ocelli) ca. $22-23 \mu$ wide $\times 24-27 \mu$ long. Ocelli ca. $24-27 \mu$ wide $\times 45-52 \mu$ long, occurring 2-4 per cell-base. Oil-bodies of median cells usually 2-3 per cell, distinctly segmented, of 2 (occasionally 3) rows of segments $1-1.2 \mu$ in diameter, the segments strongly individually protruding; oil-bodies varying from subspherical and $3-3.5 \mu$ to (more often) ellipsoidal to linear and $3 \times 6 \mu$ to $3 \times 10-12 \mu$. Chloroplasts ca. $3-4.5 \mu$. Basal cells with 3-4, occasionally 5 oil-bodies per cell, the spherical ones $3.6-4$, the elongate ones ca. $3 \times 8-9 \mu$ to $3 \times 12 \mu$, essentially like those of leaf-middle. Ocelli each containing a single large oil-body and no chloroplasts, homogeneous, glistening, ca. $20-21 \times 38-40 \mu$ occasionally $22 \times 45 \mu$. (Timms Hammock, Dade Co., Fla.; *R. M. S.*) This species exceedingly similar to *C. guianensis*, but some of the leaves with a few obtuse apical teeth, the median cells averaging slightly larger (with the maximum oil-body size slightly greater), and the ocelli (and included oil-bodies) decidedly larger.

Ceratolejeunea guianensis (Nees & Mont.) St. (Pl. VI, Figs. 2-3b). (1.) Cells equally thick-walled, with minute trigones, the walls pale brown to golden-yellow, with the middle lamellae prominent, more deeply brown pigmented. Median cells ca. $15-16 \times 16-20 \mu$, more or less hexagonal, averaging $15-16 \mu$, nearly isodiametric; marginal cells averaging only 9μ . Cells near leaf-base ca. $16-18 \times 18-22 \mu$. Oil-bodies (median cells) of pachydermous modification often subspherical, indistinctly segmented (2-6 segments), $3-4.5 \mu$, 2-4 per cell. Median and subbasal cells of mesodermous modifications usually with oil-bodies sublinear to narrowly ellipsoidal, rather inconspicuous, distinctly segmented, $2.5-3 \mu \times 5-7$ (rarely 8) μ , formed of 1-2, rarely 3 rows of strongly protruding globules, each ca. $1-1.3 \mu$ in diameter. Some cells with subspherical oil-bodies $3-3.5 \mu$ in diameter, to ovoid and $3-3.5 \times 4-5 \mu$. Oil-bodies mostly 2-4, rarely 5 per cell. Normally with two (rarely 3-4) almost basal ocelli (usually lying next to each other), formed of larger cells (usually $18-20 \times 36-40 \mu$), each containing a single large oil-body, glistening and homogeneous, ca. $15-16 \times 30-35 \mu$. Chloroplasts present in normal cells, ca. $3-3.5 \mu$ in longer diameter, but absent in ocelli. (F-118, Florida; *R. M. S.*)

(2.) Median cells ca. $14-16 \times 19-23 \mu$, thick-walled, the walls golden to brownish, the middle-lamellae deeper brown, prominent; trigones virtually absent. Oil-bodies coarsely segmented, of 1-2 rows of globules ca. $1.5-2 \mu$ in diameter (at times segmented on one end into 3-8 segments, with the other end forming a homogeneous appendix), ca. $3 \times 5-7$, occasionally $3 \times 8 \mu$, 2-3 per cell. Ocelli 2 per leaf-base. (8-9 miles north of Escatawpa, Mississippi, S 19184; *R. M. S.*)

Ceratolejeunea rubiginosa St. Cell walls somewhat evenly thickened, brownish, with deeper, obvious, middle lamella. Oil-bodies essentially similar to

those of *C. cubensis* and *guianensis*, segmented (dry material). Ocelli basal, as in *C. cubensis* and *guianensis*, but in 1-3 rows from base up to middle of leaf (the longer rows 4-5 cells long); ocellus ca. $18-21 \times 45-50 \mu$, each with a large homogeneous, glistening oil-body whose size is up to $16-18 \times 38-45 \mu$, nearly filling the cell. (Dry herbarium material; *R. M. S.*)

Euosmolejeunea osumiensis Hatt. (Pl. I, Figs. 21-23). Oil-bodies 1-2 per cell, elliptical, very large ca. $20 \times 10 \mu$, compound (of "grape cluster" type), grayish, globules 20-25, large ($2-3 \mu$ in diam.); the other (when 2 oil-bodies present in one cell) far smaller and its globules also smaller (no less in number). (Material dried 50 days; on barks, ca. 500 m., Watari, Kumamoto Co.; *S. H.*)

Euosmolejeunea ontakensis (St.) Hatt. (Pl. I, Figs. 24-25). Oil-bodies 1 per cell, ca. $15 \times 11 \mu$, composed of 15-20 large globules (of "grape cluster" type), otherwise same as *E. osumiensis*, the preceding species, with which it is very closely related (and possibly co-specific with). (From 15 days dry material; on barks, ca. 1100 m., Mt. Ichifusa, Kumamoto Co.; on barks, ca. 1000 m., Mt. Kajigamori, Kochi Co.; *S. H.*)

Euosmolejeunea nipponica (Hatt.) Hatt. (Pl. II, Fig. 1). Oil-bodies one per cell, grayish, large, $15-20 \times 10 \mu$, compound, (of "grape-cluster" type), formed of 20-25 large globules ($1.5-3 \mu$ in diam.). (From 25 days dry materials; on rocks, 80 m., Koonose, Kumamoto Co.; *S. H.*)

-Var. *calcicola* Hatt. (msc.) Oil-bodies 1 or mostly 2 per cell, very large, $15-20 \times 10-14 \mu$, formed of ca. 20 large globules ($1.5-3 \mu$ in diam.); the second, accompanying oil-body (when present) smaller, $10-15 \times 5-7 \mu$, its globules also smaller. (From 10 days dry material; on limestone, ca. 300 m., Isshoochi, Kumamoto Co.; *S. H.*)

Euosmolejeunea clausa (Nees & Mont.) Evs. (Pl. VII, Figs. 3-5). (1.) Cells near margin $14-16 \mu$, near middle $20-23 \mu \times 21-23 \mu$, nearly isodiametric-hexagonal, with large, bulging trigones; intermediate thickenings absent; middle lamella obscure; cell-walls colorless. Oil-bodies very large, usually a single large one (often 1 large one and a much smaller one) per cell. Large oil-body $7-10 \times 14-20 \mu$, usually crescentic, coarsely segmented with globules $2-3.5 \mu$ in diameter; smaller oil-body, when present and accompanying a larger one, usually less than $5 \times 12 \mu$. Marginal cells always with merely a single oil-body, $4-6 \times 8-10 \mu$ long. Chloroplasts $3.4-4.5 \mu$. (Chunchulla, Ala., S A-110; *R. M. S.*)

(2.) Cells medially ca. $19-21 \times 22-23 \mu$, subhexagonal, with very large, bulging trigones. Oil-bodies very large, one per cell, crescentic, ca. $7 \times 18-20 \mu$, of very coarse segments ($2-3 \mu$ in diameter) arranged in ca. 3 rows (in surface view). Chloroplasts ca. 4μ . (S 19250a, 2-3 miles north of Escatawpa, Miss.; *R. M. S.*)¹⁰⁾

10) Occurring intermingled with *E. rigidula*. The *E. clausa* plants with one (*E. rigidula* with 2) oil-body per cell, which is larger; cells with very large, strongly bulging trigones (*E. rigidula* with slightly bulging, less coarse trigones).

(3.) Cells ca. $18 \times 20 \mu$, with large, bulging trigones. Oil-bodies uniformly 1 per cell, usually crescentic, often thicker on one end than on the other, varying from $7-8 \times 16-18 \mu$, formed of numerous strongly protruding, slightly unequal globules, each ca. $1.5-2 \mu$ in diameter. (Highlands Hammock, Fla., S 26013; *R. M. S.*) It is to be noted that these plants were found admixed with *E. rigidula*. The latter (described under No. 5, under *E. rigidula*) have from 2-4 oil-bodies per cell, which are formed of much coarser segments.

It is quite unclear at present whether *E. clausa* (as accepted here, and in Frye and Clark, 1947) can be separated from *E. trifaria*. The latter is described as autoecious, but Evans (1903, p. 559) admits that "even here unisexual individuals occasionally occur." The plants treated here as *E. clausa* are dioecious; they, however, have coarse trigones, and have leaves that are quite concave; furthermore, their cells are more or less strongly convex. In the vegetative characters these dioecious plants closely approach *E. trifaria*.

Euosmolejeunea rigidula (N. and M.). (Pl. VII, Figs. 6-8) (1.) Cells nearly isodiametric, sub-hexagonal, ca. $14-17 \mu$ in leaf-middle, with very large (but scarcely bulging) trigones; walls colorless, middle lamella invisible or nearly. Oil-bodies 2 per cell, each of distinct, coarse, individually protruding globules, thus segmented (of the "grape-cluster" type), ovate and $4.5-5 \times 8 \mu$ to sausage-shaped or shallowly crescentic and $5 \times 10-13 \mu$, becoming (near leaf-base) $5-6 \times 12-15 \mu$, the two oil-bodies obscuring much to almost all of containing cell-lumen; segments or globules $2.5-3.5 \mu$ in diameter. Chloroplasts ca. $4.5-6.5 \mu$ long, large. (A-107, Chunchulla, Ala.; *R. M. S.*)

(2.) Cells nearly isodiametric, $15-20(25) \times 15-17 \mu$, with large, bulging trigones. Oil-bodies relatively small, not nearly obscuring lumen, 2 per cell, coarsely segmented, $4 \times 9 \mu$ to $4.5 \times 15 \mu$, the larger, somewhat crescentic, of globules $1.5-3 \mu$ in diameter. (S 19231b, Van Cleave, Miss.; *R. M. S.*) Mod. *Colorata-pachyderma-parvifolia*; with microphyllous branches, somewhat brownish cell-walls, small leaves.

(3.) Mod. *Viridis-leptoderma* (fo. *dentistipula*, with coarsely dentate underleaves). Median cells thin-walled with very small trigones; cells $18-19 \mu$. Oil-bodies 3 (rarely 2 or 4) per cell, ca. $4-5 \times 10-14 \mu$ in median cells, of coarse, protruding globules, thus segmented, of 3-4 rows of globules ca. $1-1.5 \mu$ in diameter. (Perhaps specifically distinct from *E. rigidula*). (Florida, *R. M. S.*; to be reported on in detail elsewhere).

(4.) Median cells $17-18 \times 20-22 \mu$, with large, but scarcely bulging trigones. Oil-bodies 2 per cell, ellipsoidal to crescentic, coarsely segmented (globules ca. $2-2.5 \mu$), 5×10 to $4.5 \times 12 \mu$. Chloroplasts ca. $5-6 \mu$ long. (S 19250, 2-3 miles north of Escatawpa, Miss.) This collection very significant, since the plants grew with *E. clausa*. The *E. rigidula* plants always with smaller trigones and 2 oil-bodies per cell; the *E. clausa* plants larger, paler, with one larger oil-body per cell and much larger, more bulging trigones.

(5.) Cells ca. $19-21 \times 30 \mu$ in and below leaf-middle; cells of older leaves with small, barely or not bulging trigones (and with 3-4 oil-bodies, averaging $4.5 \times 14 \mu$ to $6 \times 18 \mu$, coarsely segmented and almost filling lumen); cells of

upper, younger leaves with coarser, bulging trigones (each cell almost invariably with 2 larger, coarsely segmented oil-bodies, each up to $6 \times 21 \mu$). (Highlands Hammock, S 26013; plants growing among *E. clausa*; *R. M. S.*)

(6.) Cells ca. $22-27 \mu$ wide \times $28-31 \mu$ long in leaf-middle, with large, moderately bulging trigones. Plants a large, green shade modification. Cells each with 3-5 large oil-bodies, these almost filling lumen. Oil-bodies varying from $6 \times 12 \mu$ to $6 \times 20 \mu$, rarely to $5 \times 25 \mu$, very coarsely segmented (formed of 1-2-3 rows of coarse segments in surface view). Chloroplasts ca. $3-3.5 \mu$. (Highlands Hammock, S 26020; plants growing in shade in deep hammock forest; *R. M. S.*)

(7.) Cells $23-25 \times 26-31 \mu$ in leaf-middle, with moderately large, somewhat bulging trigones. Cells each with 3-4 (5) coarsely segmented oil-bodies, varying from $7.5 \times 13 \mu$ to $6 \times 25 \mu$, the segments ca. $3-5 \mu$ in diameter. (Highlands Hammock, Fla., S 26024; *R. M. S.*)

The seven collections above are pertinent in the clarification of this widespread and abundant neotropical species. These collections indicate either a certain polymorphism previously not recognized, or that two species are at hand. For some time it was believed that the plants with 3-5 oil-bodies (and larger leaf-cells) should be considered distinct from the plants with constantly 2 (rarely in isolated cells, 3) oil-bodies per cell (and smaller leaf-cells). It was believed that the name *E. duriuscula* could be maintained for these plants, and the name *E. rigidula* (N. et M.) applied to the more robust plants with larger cells and 3-5 oil-bodies per cell. However, the 2-oil-body type, with smaller cells, appears to be merely the xeromorphic extreme of a single species. Zwickel (1933) has shown that *Ceratolejeunea rigidula* (Nees et Mont.) St. (Hedwigia 34: 238, 1895) is a species of *Euosmolejeunea*. This has been accepted by Herzog (1951, p. 165), as well as by Fulford (1945, p. 402). However, no one appears to have made the formal combination *E. rigidula*, except Herzog (and the latter did not establish the previous synonymy necessary to satisfy the International Rules). Since the name *E. rigidula* has now been used for twenty years, without any clear citation of the synonymy, the following is tentatively suggested:

Euosmolejeunea rigidula (Nees et Mont.)

Euosmolejeunea duriuscula (Nees) Evans, Mem. Torr. Bot. Club 8: 135, 1902.

Lejeunea duriuscula Nees, in G. L. et N., Syn. Hep. 364, 1845.

Lejeunea rigidula Mont., Ann. Sc. nat. 336, 1840.

Lejeunea rigidula Nees et Mont., Syn. Hep. 371, 1845.

It deserves emphasis that this species is relatively stenotypic near the northern edge of its range. The plants occurring from Mississippi and Alabama northward to North Carolina (previously unreported from there) I find to have, constantly, 2 oil-bodies per cell, with a very occasional cell with 3 oil-bodies. In tropical and subtropical Florida, we find both the 2-oil-body type of plant, as well as the type with 3-5 oil-bodies per cell. The latter is always a greener, larger plant (up to $920-1050 \mu$ wide), occurs in deeper hammock-forests, under evidently less xeric conditions. The 2-oil-body type of plant is smaller, rarely over 800μ wide, has smaller cells, often with larger trigones; the plants also

are more often olive-green, with brownish stems. Detailed study, and probably comparative growth experiments, will prove necessary before these two types can be proved to be either genetically distinct or identical. Preliminary data are at hand to indicate that at times, at least, these differences may be seasonal. (For instance, in collection 5, above, the less xeromorphic cells show usually 3-4 oil-bodies per cell, the more pachydermous, xeromorphic cells, laid down evidently during the summer or fall (in the younger leaves) show almost invariably 2 oil-bodies per cell). (*R. M. S.*)

Euosmolejeunea parvula Evs. Cells somewhat pellucid, with slightly and nearly evenly thickened walls, the trigones small and concave; cells (11) 12-14 μ on margins, (14) 17-18 (20) μ \times 17-21 (23) μ medially. Oil-bodies typically 1 per cell, very large (5-6 \times 14-15 μ to 7 \times 18 μ , rarely 7 \times 20-22 μ or 9 \times 19 μ), formed of relatively few, very coarse and obvious segments (2-3, occasionally to 4-6 μ in size); frequently with 1 (rarely 2) smaller accessory oil-bodies, usually formed of much smaller segments (more rarely with 2 large, nearly equal, coarse-segmented oil-bodies in occasional cells); chloroplasts 3-3.2 μ . (S 31514, Lake Co., Fla.; *R. M. S.*)

The extremely large oil-body (rarely 2 subequal ones), and the extremely coarse, usually quite heterogeneous-sized segments of the oil-body recalls *E. clausa*. Since the species is very different from this, but closely similar to *E. rigidula* (which has 2-3, rarely 4-5 oil-bodies per cell), the oil-body form is of major importance in separating these species. A second specimen of *E. parvula* (S 31910; Marion Co., Florida) is absolutely identical in cytological characters to the above.

Euosmolejeunea polyantha (Evs.) Schuster, new comb. (Pl. VII, Figs. 1-2). (Syn. *Cheilolejeunea polyantha* Evans, Mem. Torr. Bot. Club 8: 141. 1902.)

(1.) Median cells 22-27 μ \times 23-27 μ , nearly isodiametric, thin-walled with moderate, concave-sided trigones and no intermediate thickenings; walls colorless; middle lamellae obscure. Oil-bodies 2-4 per cell, usually with 2 large, coarsely segmented ones (6 \times 15 μ to 7.5 \times 20 μ , the segments 3-4 μ in diameter), often accompanied by a third oil-body of somewhat smaller size, formed of much smaller globules. In a few cells 3-4 oil-bodies (rarely over 5-6 \times 14-16 μ), all formed of coarse segments. Each oil-body usually of 2-3 rows of coarse, strongly protuberant segments in surface-view (usually of 15-21 segments in surface-view). Chloroplasts relatively small, ca. 4 μ long. (S 22600, Paradise Key, Dade Co., Fla.; *R. M. S.*)

(2.) Median cells 16-18 \times 24-27 μ , somewhat elongate-hexagonal, thin-walled with moderate, concave-sided trigones, and (on longitudinal walls) with occasional, slight, intermediate thickenings (1 per wall). Oil-bodies 3-4 per cell, one often of smaller globules (as above). The coarse-segmented ones from 6 \times 14 μ to 6 \times 18 μ , occasionally only 5 \times 9 μ , the globules 1.2-1.5 μ in diameter, strongly protruding; each oil-body of 4-5 rows of coarse globules (obviously smaller in size than in the material of S 22600, above). Chloroplasts ca. 4 μ long. (S 22021; Dade Co., Florida; *R. M. S.* Form with caducous leaves.)¹¹⁾

Euosmolejeunea obtusifolia (St.) Hatt. (syn. *Harpalejeunea obtusifolia*

St.) (Pl. II, Figs. 4-5). Oil-bodies 2-4 (mostly 3, very rarely 5) per cell, oblong or oblong-fusiform, large, $8-14 \times 4-5 \mu$, occasionally rotundate, $4-6 \times 4 \mu$, smaller in marginal cells, compound and more or less grayish, containing numerous, small, and somewhat indistinct granules ($0.5-0.8 \mu$ in diam.), loosely arranged within the oil-body. (From material dry 20 and 60 days; on granitic rocks, ca. 1500 m. & 1700 m., Mt. Ichifusa, Kumamoto Co.; on rocks, ca. 700 m., Mt. Togawa, Miyazaki Co.; S. H.)

Euosmolejeunea claviflora (St.) Hatt. (syn. *Strepsilejeunea claviflora* St.). Oil-bodies 5-10 per cell, minute and translucent, oblong-fusiform, $6-8 \times 3-3.5 \mu$, containing 10-15 minute granules within; occasionally spherical, $3-3.5 \mu$ in diam., containing few and indistinct granules. (From material dry 55 days; on *Dicranum* sp., 400-650 m., Isl. Yakushima, Kagoshima Co.; S. H.)

Euosmolejeunea auriculata St. Oil-bodies 4-5, occasionally 6, per cell, rotundate or mostly oblong-fusiform, $3-9 \times 3-3.5 \mu$, translucent, containing minute and indistinct granules (from material dry 25 days; on rocks, 250 m., Isshoochi, Kumamoto Co.; S. H.).¹²⁾

Rectolejeunea berteriana (Gottsche) Evs. (Pl. VIII, Figs. 1-2). Median cells $12-14 \times 14-15 \mu$, equally thick-walled, non-collenchymatous, without intermediate thickenings; walls colorless, without discrete middle-lamella. Median cells of 2 types (of the *Stictolejeunea* type), the majority of cells with a few

- 11) If *Cheilolejeunea* and *Euosmolejeunea* are to be retained at all as genera distinct from each other, it is the opinion of the writer that the present species must be placed in *Euosmolejeunea*. In fact, sterile material of *E. polyantha* of the med. *parvistipula* can be separated from *E. rigidula*, typical form, only with extreme care. In my experience, the former always has 3 or 4 oil-bodies; very rarely isolated cells have only 2 oil-bodies per median cell. On the other hand, *Euosmolejeunea rigidula* usually appears to possess a pair of oil-bodies, usually crescentic in form, per cell. Sterile dead material of these two species at times cannot be certainly separated at all. (R. M. S.)
- 12) Formerly I described several species of the genus *Strepsilejeunea*. But now I am doubtful of the occurrence of the genus not only in Japan, but in Asia (although Stephani and Herzog described quite a number of species from that region). Moreover, I am not familiar with the typical species of the genus from the New World tropics and subtropics and wonder regarding the generic validity of the genus. It appears to me that the Lejeuneaceae have been divided into too many genera, some of which may be of no essential need. Therefore, I transferred the Japanese species of *Strepsilejeunea* to the genus *Euosmolejeunea*, except one to *Leuceolejeunea*. In the above-enumerated species of *Euosmolejeunea*, accordingly, three groups are distinct on the basis of their oil-bodies and in several other respects. (a) The first group, including *E. osumiensis*, *E. ontakenensis*, *E. nipponica*, *E. clausa*, *E. dariuscula*, are closely related to *Pycnolejeunea*. I suppose this group should be regarded as true *Euosmolejeunea* (s. str.), one of the chief reasons being because of their large oil-bodies (i. e. ample in size). The generic prefix "*Euosmo*-" originated because of the fragrance of the living plant, due to the large oil-bodies (as of the five species in the present group). (b) Two species, *E. claviflora* and *E. auriculata*, both described by Stephani under the present genus, are quite different from the first group in their oil-bodies which are similar to those of *Lejeunea* spp. and appear to be nearly related to them rather than to the present genus in their oil-body form, as well as in some other taxonomic features. (c) The remaining species, *E. obtusifolia*, originally described by Stephani under *Harpalejeunea*, seems to be more or less related to *Drepanolejeunea* rather than *Euosmolejeunea* and other genera. For the correct taxonomic treatment of these species, however, there is need of more intensive study, of diverse materials from outside the area here treated. (S. H.)

very large chloroplasts (which are distinctly granulose!), 4.5-6 μ long, and oil-bodies minute or appearing absent (at least in material 4-6 weeks dry), in some cells with 1-3 minute oil-bodies, less than 1 μ in diameter, formed of 1-3 globules. Scattered cells (ocelli) equal in size to chlorophyllose cells, lacking chloroplasts, but each with a single large oil-body virtually filling cell (thus ca. 10-12 \times 11-13 \times 12-15 μ). Oil-body of ocellus (in material dry 4-6 weeks) formed of numerous, unequal sized, protruding spherules, gray, opaque. Each leaf with ca. 10-18 (24) ocelli (above base), most of which occur singly (rarely 2, exceptionally 3, adjoining). At median base a group, in 2-4 cell-rows, of 4-10 larger ocelli, forming a short vitta 2-4 (5) cells long. Basal ocelli mostly 16-18 \times 32-37 μ , much larger than peripheral chlorophyllose cells (which are ca. 18 \times 24 μ); each ocellus with a large oil-body, nearly filling cell, ca. 15-17 \times 28-34 μ . (S 22592, Paradise Key, Fla.; *R. M. S.*)¹³⁾

Rectolejeunea brittoniae Evs. (Pl. VIII, Figs. 6-8). (1.) Cells of margins ca. 17 μ , of leaf-middle 21-24 μ wide \times 24-28 μ long, the walls thin to slightly thickened, with obvious but concave trigones and occasional distinct but not prominent intermediate thickenings; walls colorless. Oil-bodies normally 4-5 per cell (rarely 6), mostly spindle-shaped to ellipsoidal, occasionally crescentic or widest at one end and appearing subcaudate, varying from 4.5 \times 8 μ to 5 \times 10 μ , with occasional ones larger and 4.5 \times 14 or 5 \times 16 μ ; some cells also with several (or entirely with) spherical oil-bodies ca. 5 μ , in diameter, which are formed in surface view of only 3-6 coarse protuberant globules. Normal ellipsoidal oil-bodies also coarsely segmented, e. g., formed of few very large spherules, mostly 1.5-3.0 μ in diameter, individually strongly protruding through the peripheral membrane; thus coarsely "grape cluster" in form; oil-bodies usually obscuring only ca. 2/5-1/2 of the cell-surface; ocelli quite lacking. Chloroplasts much smaller than oil-bodies, 4.0-4.5 μ in longer diameter.

(2.) Oil-bodies from (2) 3-4, occasionally 5-6 per cell, ellipsoidal to spindle-shaped, occasionally crescentic, mostly 5 \times 8 or 6 \times 10 μ up to 5.5 \times 16 or 6 \times 20 μ (then 2-3 per cell), formed of numerous distinct, protuberant globules, mostly ca. 1.5 μ in diameter. In cells of caducous or potentially caducous leaves, the

13) It is very improbable (in the opinion of the senior author) whether this species and its immediate relatives can be satisfactorily retained in the genus *Rectolejeunea* (as typified by *R. phyllobola* and its relatives). The much more specialized features (scattered ocelli, exceedingly minute oil-bodies of vegetative cells, development of thick-walled cells of distinctly inferior size, specialized nature of the caducous-leaved shoots) of the *R. berteroa* complex suggest that they be considered at least subgenerically distinct from *Rectolejeunea* proper. The magnitude of differences separating the complex from *Rectolejeunea*, s. str. is as great or greater than those separating *Microlejeunea* from *Lejeunea*, s. str. For that reason, it is suggested the following division be utilized:

Subgenus *Eurrectolejeunea*, subg. n. (*R. phyllobola*, type).

Subgenus *Pictolejeunea*, subg. n. (*R. berteroa*, type).

Differing from the typical subgenus in the above-mentioned cytological features, and in the greater specialization of the asexual reproductive patterns. In addition to the scattered ocelli of the lamina, the majority of species of this complex have a group of larger, basal ocelli. (In *Eurrectolejeunea* both basal ocelli and laminar ocelli are lacking. In all species of *Pictolejeunea* known to the writer, the apical tooth of the lobule is long and falcate, in *Eurrectolejeunea*, small and undifferentiated.

oil-bodies often quite atypical, smaller and $3.5-5\ \mu$ in diameter, numerous (12-15 or more), nearly filling the cell and obscuring lumen, formed of globules approximately similar in size. (From S 22598a, Paradise Key, Fla.; *R. M. S.* This material definitely dioecious, with large underleaves typical of *R. brittoniae*; widely divergent from those cited above in the much smaller globule size).

Rectolejeunea mazonii Evs. (Pl. VIII, Figs. 4-5). (1.) Cells of leaf-margins (12-13) $15-17\ \mu$, isodiametric; median cells ca. $22-25\ \mu$ wide \times $24-26\ \mu$ long; cell-walls thin, with very occasional, scarcely gibbous, intermediate thickenings, and with concave but distinct trigones; walls colorless; ocelli absent both at base and in leaf-blade. Median and submedian cells with 4-6 fusiform to ellipsoidal-crescentic oil-bodies, occasionally with 3-4 additional smaller, spherical ($4-5\ \mu$) oil-bodies, thus with a maximum of ca. 10 oil-bodies per cell. Normal ellipsoidal oil-bodies varying from 4×8 and $5 \times 10\ \mu$ to a maximum of 4.5×15 , occasionally to $4.5 \times 17\ \mu$, formed of numerous but very distinct and individually protuberant oil-globules, the oil-bodies thus coarsely vesicular-papillose; individual spherules relatively small, ca. $0.8-1.1\ \mu$ in diameter, the breadth of the oil-body usually formed of 4-5, rarely 6, rows of such spherules; the oil-body thus of the "grape-cluster" type; oil-bodies generally obscuring $2/3$ to $3/4$ of the cell-surface. At and beyond leaf-middle oil-bodies similar but becoming much smaller (ca. $3-3.5 \times 6-8-10\ \mu$), only 3-5, occasionally 6, per cell. In and near marginal cells of apex, oil-bodies still smaller, short-ellipsoidal and only $3 \times 3.5-5\ \mu$ to $2.8-3.2 \times 5-8\ \mu$, obscuring less than $2/5$ the cell-surface in most cases. Chloroplasts obviously smaller than oil-bodies, only ca. $3.5\ \mu$ in longer diameter. Ocelli quite lacking, both at leaf-base and in blade. (*R. M. S.*)

(2.) Xeromorphic form; shoots mostly somewhat microphyllous (with lobes broad-ovate, ca. $360\ \mu$ long; lobules ca. $130\ \mu$ long). Cells nearly equally thick-walled, the oil-bodies (where developed to their most normal degree) much smaller than on leptodermous shoots; ca. 2.8×6 to $3 \times 8\ \mu$, a very few crescentic and up to $3 \times 11\ \mu$, composed of fine, but discrete spherules (less than $0.8\ \mu$ in diameter), occurring mostly 3-4 per cell (in a few cells 2 per cell, in others 5-6 per cell, then usually smaller); in many cells, especially of caducous leaves, oil-bodies mostly spherical, ca. $3\ \mu$ and more numerous, scarcely typical. (From material dry 3 weeks, S 22636, Mathesson Hammock near Cutler, Fla.; *R. M. S.*) (Plants placed here because of the large lobule of caducous leaves, which dehisce with the entire lobules attached.)

(3.) Strongly caducous-leaved form, with leaves largely modified for reproduction. Cells $16-18 \times 18-20$ (22) μ , somewhat thick-walled. Oil-bodies 2-3, rarely 4 per cell, ovoid and $3 \times 5\ \mu$ to $5 \times 6-7\ \mu$, but frequently smaller and spherical to subspherical (particularly in marginal and submarginal cells), then $2-3 \times 3-4\ \mu$; oil-bodies formed of fine (less than $0.9\ \mu$) globules, appearing very indistinctly segmented or papillose. (Bark of *Ilex opaca*, John's Cr., n. of Marion, N. C., S 28825).

(4.) Cells slightly thick-walled, with very small trigones and occasional, ill-defined shallow intermediate thickenings, polygonal, subsodiametric, $18-22\ \mu$. Each cell with 2-3 spherical to short-ovoid oil-bodies, relatively small ($3-5$

μ and spherical to $3-4 \times 4-5 \mu$ and ovoid), appearing papillose, formed of discrete, protruding spherules (these ca. $0.8-1.0 \mu$ in diam.). (Lake Waccamaw, N. C.; S 30020a, S 30021; *R. M. S.*)

(5.) Cells slightly, evenly thick-walled, with obsolete trigones, no intermediate thickenings, subisodiametric, $21-24 \mu$ in leaf-middle. Each cell with 3-5 oil-bodies, these mostly spherical and $3-4.2 \mu$, a few ovoid and $4 \times 7 \mu$, formed of many small, fine equal-sized globules, appearing papillose rather than segmented. Chloroplasts mostly $2.8-3.5 \mu$ long, usually subequal to oil-bodies in size. (Near Chunchulla, Ala.; S A -108; *R. M. S.*)

The plants of Nos. 2 and 3 are scarcely comparable to the plants of No. 1, as regards the form of the oil-bodies. The latter, in the oil-body size approaches *R. brittoniae*. It deserves emphasis, however, that with the development of xeromorphic forms, with very freely caducous leaves, the oil-body size radically decreases -- and the size of the constituent globules also becomes somewhat smaller. However, the number (mostly 2-4 per cell) of the oil-bodies remains relatively constant, except in caducous leaves (where they may be more numerous). In the final analysis, the cytological differences between *R. brittoniae* and *maxonii* lie largely in that the former has coarsely segmented oil-bodies (segments $1.5-3 \mu$, apparently consistently large, while the latter has the oil-bodies very finely segmented (spherules largely between $0.7-1.0 \mu$).

Rectolejeunea phyllobola (Nees et Mont.) Evs. Median cells ca. $16-18 \mu$ wide $\times 20-22 \mu$ long, with slight trigones and somewhat evenly thickened, colorless walls. Oil-bodies almost always 2, rarely 3, per cell, very coarsely segmented (formed of a single row of coarse segments each ca. $2.5-3.5 \mu$, or at least medially of 2, rarely 3 rows of segments 2μ or more in diameter); oil-bodies typically $3 \times 9 \mu$ to $4 \times 11-14 \mu$. (Collier-Seminole State Park, Fla., S 26100, determination slightly doubtful; *R. M. S.*)

Rectolejeunea rhodesiae (Sim) Arnell. Marginal cells $10-12 \mu$, median cells $18-20 \mu$, walls equally thickened, cells regularly polygonal. Oil-bodies small, segmented, spherical to sausage-shaped, 2-6 per cell. (South African material; fide *S. A.*)

According to Arnell (1953) this species, originally placed in *Stylolejeunea*, is intermediate between *Rectolejeunea* and *Stylolejeunea*. Arnell indicates that the strongly compressed perianth of these two genera, and of *Cheilolejeunea* indicates a close relationship. However, to the authors, the *distal* position of the hyaline papilla of the lobule of *Cheilolejeunea* suggests it is more closely allied to *Euosmolejeunea* (and perhaps not generically discrete from it). (*R. M. S.*)

Inflatolejeunea capensis Arnell. Marginal cells $10-12 \times 24 \mu$, inner cells about $24 \times 24 \mu$, walls thin, no trigones. Oil-bodies 3-6 per cell, slightly brownish, "numerous, very small or composed of small granulae." (*S. A.*) Except for the non-plicate perianth, this is essentially identical with *L. jeunea* s. str.

Anomalolejeunea pluriplacata Pears. Marginal cells $10-14 \mu$ in leaf-apex, $18-24 \mu$ in central part of leaf, walls rather thick, trigones large. Oil-bodies large (judging from the figure by Arnell, to ca. $12-15 \mu$ long or more), 2-3 per

cell, formed of coarse segments. (*S. A.*)

Anomalolejeunea pluriplicata var. *tabularis* S. Arnell. Oil-bodies occurring singly per cell, almost filling the lumen of the cell, composed of large drops (segments). (*S. A.*)

Cheilolejeunea decidua (Spruce) Evs. (Pl. VIII, Fig. 3). Cells of leaf-middle hexagonal-elongate to subrectangular, ca. 16–17 μ wide \times 22–25 μ long, moderately thin-walled, with large but concave-sided trigones, and numerous intermediate thickenings of the longer walls (these, occasionally 2–3 per wall), the walls thus irregular and undulate; walls colorless; middle lamella obscure; oil-bodies 3–4 per cell, mostly 5 \times 15 to 6 \times 17, up to 7 \times 21 μ , nearly filling cell-lumen, very coarsely segmented (formed of strongly protruding segments 2–3 μ in diameter, occasionally to 4–5 μ , arranged in 2, occasionally 3 rows, in surface-view). Occasional cells with 1–4 smaller oil-bodies, in addition to 1–several larger ones; the smaller ones ca. 6 \times 7 μ . Chloroplasts ca. 3–3.5 μ . (*S* 22606, Paradise Key, Fla.; *R. M. S.*)

Nipponolejeunea pilifera (St.) Hatt. (Pl. II, Figs. 6–7). Oil-bodies 3–4 (rarely 2 or 5–7) per cell, hyaline, oval, 5–10 \times 4–6 μ , rarely rotundate, 4 μ in diam., more or less discoid (see Fig. 7), containing ca. 20 spherules (ca. 1 μ in diam.) loosely and yet regularly arranged, the inner spherules less distinct or rarely imperceptible. (From materials dry 10, 20, 25, and 35 days; Isl. Yakushima, Kagoshima Co.; on tree trunks, 1400 m., Mt. Shiraga, Kumamoto Co.; on rocks, Tsugawa, Niigata Co.; on granitic rocks, 2970 m., Mt. Kisokoma, Nagano Co.; *S. H.*)

Nipponolejeunea subalpina (Horikawa) Hatt. (Pl. II, Fig. 8). Oil-bodies 3–4, occasionally 5 per cell, somewhat grayish, elliptical, ca. 4.5 \times 2.5 μ , rarely rotundate, ca. 2.8 μ in diameter, more or less formed of discoid, 15–20, somewhat indistinct granules, the inner ones less distinct (each less than 1 μ in diam.). (From material dry 15 days; on barks, 2100 m., Mt. Iiuchi, Niigata Co.; on barks of conifers, 2200 m., Mt. Hahu, Saitama Co.; Mt. Yatsu, Nagano Co.; *S. H.*)

Drepanolejeunea hamatifolia (Hook.) Schiffn. (Pl. IX, Figs. 1–2). Median cells ca. 19–21 μ , with walls scarcely to slightly thickened, often with ill-defined, sinuous intermediate thickenings, with small to moderate, concave-sided trigones. Ocelli, in well-developed leaves, two (one subbasal, the third cell from leaf-base, the second submedian, situated in the same row of cells as the first, usually with only one vegetative cell between the two); ocellar cells ca. 18 \times 21 to 19 \times 24 μ , slightly more elongate than vegetative cells, each containing a granular, grayish, opaque oil-body formed of numerous small globules (0.8–2 μ in diam.; occasionally partly fusing to form a large homogeneous sphere surrounded by smaller globules); oil-body ca. 12 \times 16 to 13 \times 20 μ . Vegetative cells with 4–9 oil-bodies per cell, these spherical, ca. 3–4.5 μ , occasional ones to 5.5 μ , formed of discrete, somewhat protruding, uniform, spherical globules (less than 0.8 μ in diameter), thus appearing coarsely papillose (rather than segmented). (Onich Glen, Inverness, Scotland, Aug. 1953, E. W. Jones; *R. M. S.*)

This species and *D. bidens* of the Southern Appalachians are apparently sibling species. It is worthy of note that in the present species, the average

number of oil-bodies per cell is 6, while in *D. bidens* the average number is 3 or 4, with rarely as many as 5-6, never more than 7 oil-bodies per cell.

Drepanolejeunea capensis St. Marginal cells 14-16 μ , inner cells about 20 μ , walls equally thickened, no trigones. Ocelli 1 (-3), about 20 μ , in basal or median portions of lobe. Oil-bodies 2-4 per cell, 2-6 μ and rounded, seldom ellipsoidal and 2 \times 4 μ , segmented, colorless or slightly yellowish. (South African material; fide *S. A.*)

This species is very closely related to *D. hamatifolia*, of which it was at one time considered to be merely a variety. The difference in oil-body number, per cell, suggests that two species may be at hand.

Drepanolejeunea papillosa Arnell. Cells 14-16 μ on margins, inner cells up to 20 \times 24 μ , walls with irregular thickenings. Ocelli lacking (neither described nor figured)? Cells with 1-2 oil-bodies per cell, 5 \times 5 to 5 \times 12 μ , segmented, slightly yellowish. (South African material; fide *S. A.*)

Drepanolejeunea japonica Horikawa (Pl. II, Figs. 9-11). Oil-bodies 2-9 per cell, rotundate to oblong, 6-15 \times 5-6 μ , grayish, compound, containing ca. 30 somewhat indistinct granules (0.5-0.7 μ in diam.). Ocellus almost filled with a big compound oil-body and numerous minute droplets around it; oil-bodies of ocellus oval in shape, 25-30 \times 20 μ , more or less grayish, with numerous protuberances on the surface (seemingly an aggregation of numerous droplets), or spherical, 20 μ in diam., smooth and shining, homogeneous within (possibly all droplets adhering to or fusing with the body). (From fresh and materials dry 30 days; on barks, ca. 500 m., Sakatani, Miyazaki Co.; on barks, ca. 300 m., Hitoyoshi, Kumamoto Co.; do., ca. 700 m., Mt. Kurobaru; *S. H.*)

Drepanolejeunea tenuis (R. B. N.) Schiffn. (Pl. II, Fig. 12). Oil-bodies mostly 2-4 (1-5) per cell, rotundate to oblong-fusiform, 4-12 \times 4-5 μ (mostly 8-10 \times 4-5 μ), more or less grayish, containing 20-30 small granules. (Drawn 20 days after material collected, on barks, 750 m., Hitoyoshi, Kumamoto Co.; do., 850 m., Mt. Ohira; do., 1400 m., Mt. Shiraga; *S. H.*)

Drepanolejeunea foliicola Horikawa (Pl. III, Figs. 24-27). Oil-bodies copious, 10-25 per cell, translucent, almost spherical, 3.2-5 μ (mostly 4 μ) in diameter, formed of many (10-20) indistinct globules protruding (of "grape-cluster" type) and fairly large (ca. 1 μ in diameter); or often several (no more than 10) oblong (\pm fusiform) oil-bodies in a cell, 6-11 \times 4-5 μ in size, formed of 30-40 globules, and segmented. Ocellus almost filled with a large compound oil-body, 40-45 \times 15 μ in size, grayish, segmented, composed of 25-30 large spherules (4-6 μ in diam.) admixed with smaller ones (2-3 μ in diam.) (From fresh material; on leaves of evergreens, ca. 300 m., Sakatani, Miyazaki Co.; *S. H.*)

Drepanolejeunea bidens (St.) Evs. (Pl. IX, Figs. 3-4). (1.) Cells thin-walled, 13-14 \times 16-18 μ , medially somewhat larger and elongate, to 15-17 \times 22-27 μ , thin-walled and lacking trigones. Cells of two types; chlorophyllose and chloroplast-free ocelli. Ocelli formed of cells not or only little larger than surrounding cells, present in most (but not all) leaves, 1-2, occasionally 3 per leaf, occurring in a single row (usually interrupted by vegetative cells), from somewhat above the base to slightly above the leaf-middle, rarely the 2-3 ocelli

juxtaposed and forming a short median vitta. Ocelli ca. $21-26 \times 14-17 \mu$, each containing a large homogeneous strongly refractive oil-body 13×18 to $16 \times 22 \mu$. Vegetative cells with 2-3, rarely 4 oil-bodies per cell: the oil-bodies spherical and $1.8-2 \mu$, occasionally 3μ , rarely ellipsoidal and $2.25 \times 5 \mu$, distinctly segmented (a few often more minute and homogeneous, perhaps formed by dissociation from larger segmented oil-bodies. (S 19240; from material dry 2-3 weeks; *R. M. S.*)

(2.) Median cells $13-15 \mu$ wide \times (20) $23-26 \mu$ long, the walls slightly thickened, with small or minute trigones and occasional vague intermediate thickenings. Cells each usually with 2-4 oil-bodies, varying from spherical and $2-3.5 \mu$ to ovoid and $2.5-3 \times 4-6 \mu$, very distinctly segmented (formed of strongly bulging globules, each ca. $0.7-0.9 \mu$). Ocelli in a broken vitta, on mature leaves usually 3-5 per leaf, rarely 1-2 per leaf; frequently with 2 ocelli at base, in a basal longitudinal row (rarely with a third present, situated lateral of the basal ocellus), the containing cells large ($18-19 \times 35 \mu$), but not perceptibly larger than surrounding cells; in addition to the 2-3 basal ocelli, with typically 2 ocelli (one near middle of leaf, one midway between middle and apex). Median ocellus in a cell ca. $33 \times 22 \mu$, the single oil-body homogeneous, glistening, ca. $16 \times 29 \mu$. Chloroplasts ca. $4-5 \mu$. (S 31461, Gold Head Branch State Park, Fla.; *R. M. S.*)

(3.) Leaves with oil-bodies as in 2, but with 5-8 ocelli per leaf; 4-5 of the ocelli in an interrupted line (vitta), the others scattered in distal portion of the leaf. (S 31927; Marion Co., Fla.; *R. M. S.*)

Drepanolejeunea bidens subsp. *appalachiana* Schuster, n. subsp. (Pl. IX, Figs. 5-6). (1.) Cells in distal one-half of leaf and in leaf-middle $13-16 \mu$ wide \times $16-20 \mu$ long, but near ocelli occasionally to $16 \times 25 \mu$; cell-walls somewhat thickened, often with vaguely defined intermediate thickenings, and small trigones. Ocelli almost invariably two per leaf, situated in a line parallel to anterior leaf-margin (in third row of cells from margin), median in position, from base to apex of leaf; ocelli ca. $13 \times 22 \mu$ to $16 \times 25 \mu$, lacking chloroplasts, each with a large, opaque, grayish oil-body, ca. 11×20 to $14 \times 22 \mu$, formed of numerous small globules, ca. $1-1.8 \mu$ in diam. Median cells with 3-4, rarely 5 oil-bodies per cell, varying from spherical and $2.5-4 \mu$ to ovoid and $3.5-4.5 \times 5-7 \mu$, very occasionally to $5 \times 6-7 \mu$. Each oil-body formed of innumerable fine, barely perceptible globules that do not distinctly protrude (the globules perceptible only as fine points at the limit of resolution of the microscope). (S 28894, bark of *Tsuga*, Linville Gorge, N. C.; *R. M. S.*)

(2.) Cells $14-16 \times 16-20 \mu$, rounded polygonal to rectangular, with distinct but concave-sided trigones, no or infrequent intermediate thickenings. Ocelli most often absent, but sometimes 1 (beyond leaf-middle), more rarely 2 (then one somewhat above base, the other above middle of leaf); when present ca. $15 \times 24 \mu$, with the oil-body finely granular, opaque, ca. $10 \times 21 \mu$, formed of numerous small spherules. Median cells with 2-4 oil-bodies per cell, if 2 usually 3.5×5 to $4 \times 6-7 \mu$ and ovoid or ellipsoidal, of 3-4 subspherical to spherical and $3-3.5 \mu$ to $3.5-4 \times 5 \mu$, formed of numerous finely protruding globules (ca. $0.6-$

1.0 μ), appearing very finely segmented or papillose in appearance. (S 28946, bark of *Nyssa*, Linville Gorge, N. C.; *R. M. S.*)

(3.) Ocelli usually absent or one suprmedian ocellus present; more rarely with second ocellus (subbasal, 1 cell above stem). Cells 13-16 \times 15-20 μ , rectangular, with distinct but rather small trigones and many small intermediate thickenings. Oil-bodies 3-7 per cell, usually spherical and ca. 2.8-4.5, occasionally 5 μ , a few ovoid and ca. 3 \times 4-5 μ , formed of numerous minute globules (appearing papillose or very finely segmented). (S 28950, bark of *Betula lenta*, Linville Gorge, N. C.; *R. M. S.*)

Although the cytological features of the North Carolina collections agree closely with those of the typical plant of the subtropics, the plants are quite different in some respects and probably form a different taxon. This problem will be dealt with by one of the authors in another connection, at which time the above trinomial will be properly validated.

Harpalejeunea ovata (Hook.) Schiffn. (Pl. IX, Figs. 9-10). (1.) Cells thin-walled, minute or no trigones and no intermediate thickenings; near leaf-margin isodiametric, ca. 16-18 μ ; the median cells strongly elongate, ca. 27 \times 15 μ to 12-16 \times 36 μ . The larger cells near (but not at) leaf-base occasionally with a single large oil-body (these then forming an ocellus, which differs only in contents, but scarcely in size from neighboring cells). Oil-bodies in lobes and base mostly 4-6 per cell, of the "grape-cluster" type; in median cells ellipsoidal to ovate, mostly 1.8-2.1 \times 3.6-6 μ , near margins averaging shorter and smaller (sometimes subspherical and only 1.8-3 μ) formed of relatively few (2-3) rows of strongly protuberant globules. Several cells above the base (usually 2-3, extending to leaf-middle, forming a broken vitta, but often 1-0) forming ocelli; these cells ca. 16 \times 36 μ , containing a single large oil-body, homogeneous and smooth, prominent and highly refractive, ca. 12 \times 25 μ . Chloroplasts ca. 3.2-4 μ , subequal in area to oil-bodies (West Virginia, S 18300; *R. M. S.*).

(2.) Marginal cells ca. 10-12 μ ; median cells ca. 13-15 \times 16-22 μ ; walls thin, trigones small but discrete; no intermediate thickenings. Ocelli 1-2 (3) per cell, 14-15 \times 21-25 μ . Cells of leaf-apex and leaf-middle with 1-4 oil-bodies, coarsely segmented, formed of 2-3 rows of globules (each ca. 1-1.5, rarely 2 μ in diameter); oil-bodies relatively large and prominent, ca. 3 \times 5 μ to 3.5 \times 7 μ , to a maximum of 4 \times 12 μ . Chloroplasts ca. 3-4 \times 2-2.5 μ . Marginal cells with oil-bodies smaller, usually 2.5-3 \times 4-6 μ . (S 19206, S 19207, near Van Cleave, Miss.; *R. M. S.*). (Plants with oil-bodies quite different from collection 1, cited above; probably genotypically discrete).

(3.) Ocelli subbasal, 1-2, ca. 12-15 \times 20 μ , sometimes absent (S A-120, Chunchulla, Ala.; *R. M. S.*).

(4.) Median cells ca. 16-18 (20) μ \times 18-21 μ , becoming to 32 μ long below middle, with slightly thickened walls, discrete but concave-sided trigones, occasional ill-defined intermediate thickenings; cells adjacent to ocelli at and near base, 15-18 \times 20-24 μ or somewhat narrower and more elongate (13-15 \times 25-30 μ), distinctly smaller than ocelli. Most (but not all) leaves with 1-2 basal or subbasal ocelli (if with one ocellus, this invariably one cell-row above leaf-base;

if with two ocelli, these in a row, involving a basal leaf cell and the cell immediately above); ocelli $18-20 \times 35 \mu$ to $22 \times 36-38 \mu$, occasionally to $23 \times 42 \mu$, each containing a single large oil-body, glistening and homogeneous (ca. $10-12 \times 24-26 \mu$, often to $23 \times 30 \mu$), which may break up with age into two-several irregular segments; ocelli with chloroplasts absent or vestigial. Median and subbasal cells each with ca. 5-6 (less often 3-4 or 7-8) oil-bodies. Each oil-body usually ellipsoidal to narrowly fusiform, from $2-2.5 \times 5-7 \mu$ to $2.5 \times 8 \mu$ to $4 \times 9 \mu$ to $3 \times 10 \mu$ in size; in some cells oil-bodies 7-8 per cell and then usually smaller and short-ovoid ($2.5-3 \times 3-4 \mu$ to $3.5 \times 5-6 \mu$). Oil-bodies formed of numerous fine spherules (each less than 0.8μ), which protrude moderately through the bounding membrane, the oil-body thus appearing papillose or very finely segmented. (European material: Inverness, Scotland, July 29, 1953, E. W. Jones; material dry only 5 days).

(5.) Cells $18-19 \mu$ and subisodiametric in leaf-middle and leaf-lobe, with obvious, large, bulging trigones and frequent intermediate thickenings. Ocelli 1-2 basally (if one, usually one cell from leaf-base; if 2, forming a row involving basal and next suprabasal cell), rarely with a third, usually a short distance from the basal row of two; ocelli $15-19 (20) \mu \times 30-32(36) \mu$, each bearing a homogeneous oil-body ca. $15-16 \times 22-25 \mu$. (Yellow Mt., near Highlands, N. C., Anderson 10385).

(6.) Cells of leaf-middle $16-19 \times 18-21 \mu$, below middle becoming somewhat elongate but no wider, with distinct but scarcely bulging trigones, and rare intermediate thickenings. Ocelli 1 in basal cell (or immediately above basal tier of cells), or 2 (then either in a row, involving basal cells, or occupying two basal cells, side-by-side), rarely 3 in a group (of which 1 or 2 may be basal); ocelli $16-20 \times 35-38 \mu$, averaging scarcely wider but much longer than surrounding normal cells, each containing a single glistening homogeneous, rarely 2-segmented, oil-body ($13-18 \times 18-24 \mu$). Oil-bodies of median cells 3-5, rather small, $1.5-2 \times 4-6 \mu$ in most cells, narrowly ellipsoidal to linear, of distinct protruding globules (ca. $0.8-1.2 \mu$), appearing segmented. (Linville Gorge, N. C., S 28894).

(7.) Ocelli 2-3, occasionally 4 (in two basal approximated rows of 2 ocelli) per leaf-base, conspicuous, mostly $22-25 \times 32-38 \mu$, each containing an oil-body ca. $20-22 \times 22-25$, occasionally 28μ long; oil-body homogeneous. Median cells with 3-5 oil-bodies, if 3-4 more or less narrowly fusiform ($2-2.5 \times 6-8 \mu$), of 4-5 usually short ovoid and subspherical ($2.5-3 \times 3-4 \mu$), formed of discrete, protuberant globules (each ca. 1μ ; the smaller oil-bodies often of few coarse globules, to 2μ in size). (Linville Caverns, N. C., S 29040; *R. M. S.*). Both the size and frequency of the ocelli in this collection are exceptional.

The ocelli of this species are described as occurring in a basal group (as in Frye and Clark, 1947, p. 863), and in Müller (1905-1916). However, in some nearctic material we have examined we find some, but not all, leaves with a single, often 2-3, somewhat larger cells, each with a large homogeneous oil-body within. These ocelli are usually separated from each other, forming a broken vitta, but may be aggregated to form a group. In either case, the position of

the ocelli is clearly some distance above the leaf-base, thus subbasal, rather than basal (as described in the literature).

It is to be noted that the plants from the Appalachian plateau (Nos. 1, 5, 6, 7) agree with the European plants in the large size of the ocelli, and in their basic position; these vary from $15-16 \times 30 \mu$ to $22-25 \times 38 \mu$. In the material from Coastal Mississippi and Alabama (from which the species had not heretofore been known), the ocelli are only $12-15 \times 20-25 \mu$. This suggests that the montane North American material is identical with the European, the Coastal Plain material distinct.

Harpalejeunea intermedia Evs. (Pl. II, Figs. 13-14). Oil-bodies very scarce, translucent, minute, 1 per cell, rotundate in outline, $2.5-3.5 \mu$ wide or $3-4 \times 2-3 \mu$, composed of mostly 5-6 (rarely of 12) spherules ($0.5-0.8 \mu$ in diam.), aggregated in a plane, flower-like in appearance. (From fresh material and herbarium specimens 25 days after collection; on barks of *Cryptomeria japonica*, ca. 30 m., Obi, Miyazaki Co.; on barks, ca. 150 m., Yamaye, Kumamoto Co.; S. H.)

Leptolejeunea subacuta St. (Pl. II, Figs. 15-16). Oil-bodies ca. 10 per cell, minute and dispersed, hyaline and shining, with appearance of an oil-droplet, homogeneous within, $1-2 \mu$ in diameter; occasionally with aggregation of several globules, rotundate in outline, ca. 2.5μ in diameter (than of "grape-cluster" type). Ocellus filled with a big oil-body, spherical or nearly so, $50 \times 33 \mu$ or $50 \times 38 \mu$, translucent and light, with numerous small protuberances (almost equal in size to oil-bodies in ordinary cell) on the surface, or entirely smooth, hyaline and shining, homogeneous within (possibly because of the protuberances being fused with mass of oil-body). Plants strongly aromatic in fresh condition. (From fresh material; on leaves of *Camellia*, ca. 30 m. alt., Obi, Miyazaki Co.; S. H.)

Leptolejeunea elliptica (Lehm. & Lindenb.) Schiffn. (Pl. IX, Figs. 7-8a).

(1.) Cell-walls thin, hyaline, even with age; walls with small but often bulging trigones, and with frequent intermediate thickenings. Oil-bodies distinct in only the youngest leaves (except in ocelli), exceedingly minute and inconspicuous, from ca. $0.5-0.7 \times 1-2 \mu$ and of 2-several distinct spherules (thus of "grape-cluster" type), occasional cells with 1-several oil-bodies formed of a single spherule, ca. 0.5μ or less in size; oil-bodies mostly 2-4 (5) per cell, apparently disappearing with maturity of the leaf, and almost always absent in cells of plants that have been dry for more than 3 days. Ocelli each with a single, very large, compound oil-body, which usually persists for some time after drying of the plant; the ocelli mostly 3-5 per leaf, forming an interrupted vitta lying in the longitudinal midline of the leaf; distal ocelli mostly with oil-bodies ca. $19-21 \times 22-24 \mu$, the lower oil-bodies (lying in more elongate cells) $28 \times 35 \mu$ or larger. Oil-bodies in ocelli formed of many globules of heterogeneous size, often clustered around a central homogeneous sphere $8-10 \mu$, in diameter or more, the oil-body thus irregular, with the individual globules strongly protuberant. Chloroplasts ca. $2.5-3 \mu$ in diameter, relatively conspicuous and much larger than oil-bodies of normal cells. (From material dry 5 days, Long Key Pineland,

Everglade Keys, from leaves of *Coccolobia laurifolia*, S 22010; *R. M. S.*)

(2.) Cells with trigones minute, intermediate thickenings infrequent. Ocelli varying from scarcely to somewhat larger than vegetative cells. Vegetative cells with 3-8 minute oil-bodies, the smaller 0.5-1.2 μ or less and homogeneous, the larger to 1.8-2.3 μ (rarely 3.6 μ), segmented, formed of 3-8 segments in surface view, the oil-bodies inconspicuous. Chloroplasts ca. 2.8-3.3 μ . Ocelli with oil-bodies homogeneous, glistening (surrounded by a thin mantle of fine spherules), ca. 22 μ and spherical to broadly ellipsoidal and $22 \times 27 \mu$, nearly filling the containing cell (*R. M. S.*).

(3.) Each leaf with 2-5 ocelli. Each vegetative cell with 2-10 minute, granule-like, refringent, homogeneous oil-bodies (which rapidly turn an intense violet-blue with quinoleine). (Martinique; fide *Jovet-Ast*).

It is possible that the description by *Jovet-Ast* is based on plants that had been dry for some time. Evidently the fresh oil-bodies are formed of globose minute segments, surrounded by an exceptionally delicate membrane, destroyed soon after the plants dry.

Lejeunea flava (Sw.) N. (Pl. II, Figs. 22-23; Pl. X, Figs. 1-2). (1.) Oil-bodies 3-15 per cell, rotundate to elliptical or mostly oblong-fusiform, $5-10 \times 5 \mu$, containing ca. 15 minute granules (less than 1 μ in diam.) (From fresh material; *S. H.*).

(2.) Median cells ca. $18-20 \times 23-29 \mu$, hexagonal, thin-walled, with rather large to slightly bulging trigones and 1, occasionally 2 intermediate thickenings on many longitudinal, and on a few oblique, walls. Oil-bodies mostly 4-7 per cell, usually ellipsoidal to fusiform and from $2 \times 3.5-7 \mu$, a few spherical and only 3 μ , formed of numerous small (less than 0.6 μ) globules that protrude only moderately, hence faintly papillose to obscurely segmented in appearance (S 22145, Florida; *R. M. S.*).

(3.) Median cells ca. $22-26 \times 26-32 \mu$, hexagonal to rectangular, with moderate trigones but no or rare intermediate thickenings. Oil-bodies mostly 7-12 per cell, mostly spherical to short-ovoid, weakly papillose (the small component spherules slightly protruding through the common bounding membrane; often nearly homogeneous in appearance), 2.8-3.2, a few to $3 \times 4 \mu$. Chloroplasts averaging slightly larger, ca. 3.2 μ to $3.5 \times 5 \mu$. (Simpson Co., Miss.; *R. M. S.*)

(4.) Oil-bodies colorless, small, segmented, 2-10 per cell, mostly oval (South African material; fide *S. A.*).

(5.) Median cells ca. $22-25 \mu$, hexagonal, nearly isodiametric, thin-walled with trigones and no intermediate thickenings. Oil-bodies ca. 6-10 per cell, obviously coarse-segmented (formed of at most 2-3 rows of coarse globules, each ca. 1.2-1.5 μ , each of which protrude individually); cells with fewer oil-bodies with them mostly short-ellipsoidal to ovate, ca. $3 \times 6 \mu$, in cells with more numerous oil-bodies with them mostly globular, 3.0-3.5 μ (then only of 5-8 globules in surface-view). Chloroplasts ca. 3 μ . (S 19229, Mississippi; *R. M. S.*). Plants somewhat different from typical *L. flava* in the smaller underleaves (ca. $2-3.5 \times$ the area of the lobules), only 230 μ long \times 225-255 μ wide, and in the more distinctly segmented oil-bodies. Possibly to be regarded as a discrete variety or

even species.¹⁴⁾

Lejeunea cladogyna Evs. (Pl. X, Fig. 3). (1.) Cells thin-walled, with small trigones, ca. $20 \times 27 \mu$. Oil-bodies ca. 4-9 per cell, and 3×5 to $3 \times 8 \mu$; sometimes smaller and more numerous; each oil-body composed of moderately discrete, individually protruding oil-globules, thus coarsely papillose to weakly segmented in appearance. (S 22601, Florida; *R. M. S.*)

(2.) Cells 18-20 μ , nearly isodiametric and hexagonal, thin-walled with concave-sided but discrete trigones. Oil-bodies mostly 4-8, occasionally 5-15 per cell, ca. 3-4 μ and spherical to $4 \times 7 \mu$, composed of relatively distinct, individually protruding globules (the oil-bodies varying from coarsely papillose to segmented in appearance). Chloroplasts ca. 3-3.5 μ . (S 22061, Long Key, Florida; *R. M. S.*)¹⁵⁾

(3.) Cells in normal leaves with 4-7 oil-bodies, these short to elongate-ellipsoidal, formed of numerous discrete spherules (1 μ or less in diameter), which protrude distinctly through the common bounding membrane, mostly $2.8-3 \times 4-8 \mu$; in many cells, however, with more numerous spherical oil-bodies only ca. 3 μ in diameter (these cells old and dying?). (From material dry 20 days, S 22603, Paradise Key, Dade Co., Florida; *R. M. S.*)¹⁶⁾

Lejeunea caroliniana Schuster (mss.) (Pl. X, Figs. 4-5). Median cells ca. $23-25 \mu \times 28-33 \mu$ with thin walls, no intermediate thickenings, and minute trigones. Oil-bodies (in younger leaves) mostly 4-6 per cell, ovoid to narrowly ellipsoidal, $5 \times 7-9 \mu$ to $4.5-5 \times 10-13 \mu$, rarely nearly linear and $4 \times 16 \mu$, formed of discrete globules (appearing coarsely papillose or very finely segmented; the individual globules less than 1 μ), the globules distinctly protruding. In older plants oil-bodies sometimes 7-15 (rarely 17-18) per cell, formed of coarser, more discrete globules (1-2 μ in size), more distinctly segmented, varying from spherical and 3.5-6 μ to, more often, ovoid to ellipsoidal, $5 \times 6-9 \mu$ to occasionally narrowly ellipsoidal and $4 \times 10 \mu$; subapical cells mostly with 5-8 oil-

14) This is the plant called by Buch (1934) *L. americana*. It differs from typical *L. flava* in the larger lobules (ca. 10-15% the area of the dorsal lobes) and smaller underleaves (ca. 3-6 \times the area of the lobules). The plants are probably only the xeric phase, of dry bark, of more typical *L. flava*.

15) Perhaps a discrete new species, with perianths rather strongly dilated above and somewhat compressed; lobules almost all reduced, but less so than in *L. minutiloba*. This collection to be discussed in detail elsewhere.

16) The plants of this collection somewhat doubtful. The lobules very small, mostly obsolete on fertile plants; underleaves small, suborbicular, ca. 150-160 μ in length and width, less than 1.8 as wide as the stem, separated from each other by about 2-3 times their length; perianths usually on short lateral branches, which again innovate, but occasionally on elongate or main branches; androecia invariably of 2-3 pairs of bracts, very short, wider than long, on very short lateral branches lacking normal leaves; female bracts and bracteole short, but nearly free from each other; bracts 385-450 μ long, or less, with the lobule ca. 225-250 μ long, extremely narrow, lanceolate to acuminate, separated by a deep sinus from the dorsal lobe. The form and position of the androecia, normal position of the perianth, which is 0.6-0.7 emergent, form and size of underleaves and lobules, are all characteristic of *L. cladogyna*; rarely is the perianth 3/4 emergent, when it approaches that of *L. glaucescens*. The nearly free bracteole and bracts, which are acute or subacute at their tips, also recall *L. glaucescens*; possibly a distinct species is involved.

bodies, and these smaller. Chloroplasts ca. $3 \times 4 \mu$, averaging much smaller than oil-bodies. (S 28667, Raven Rock Harnett Co., N. C.; *R. M. S.*)¹⁷⁾

Lejeunea floridana Evs. (Pl. X, Fig. 9) (1.) Median cells thin-walled, quite devoid of trigones and of intermediate thickenings, ca. $19-23 \times 20-26 \mu$. Oil-bodies 4-10 per cell, if few per cell, large and 5×7.5 to $4.5 \times 13 \mu$, if more numerous all or partly smaller, 3×5 to $4 \times 6 \mu$; formed of very numerous, not evidently protruding spherules, appearing at best faintly papillose or granulose. (S 22872, Hillsborough State Park, Fla.; *R. M. S.*)

(2.) Cells similar, but with minute trigones, ca. $18-25 \times 30-32 \mu$. Oil-bodies similarly formed, mostly 5-9 per cell, almost all narrowly ellipsoidal and varying from $3.5 \times 7 \mu$ to $4 \times 7.5 \mu$, to a maximum of $4.5 \times 13 \mu$ and $5 \times 14 \mu$, rarely sublinear and $3-3.6 \times 16-17 \mu$. Chloroplasts ca. 3μ , much smaller than oil-bodies. (S 22872a, same locality; *R. M. S.*)

Lejeunea patens Lindb. (Pl. X, Figs. 6-8, Pl. XI, Fig. 1). (1.) Median cells thin-walled, with small trigones, devoid of intermediate thickenings, ca. $22-26 \mu$. Oil-bodies 3-8 per cell, mostly $4-6 \mu$ and spherical, a few to 6×7 or $4 \times 8 \mu$ and ellipsoidal, of fine, slightly protuberant to scarcely protuberant globules, each ca. 0.6μ or less in diameter, colorless or brownish-gray with age. Chloroplasts ca. 4μ , averaging somewhat smaller than oil-bodies. (Balsam Gap, N. C.; S 19101; *R. M. S.*)

(2.) Median cells similar, with moderate trigones, $22-23 \mu$. Oil-bodies 3-4 per cell, spherical and 4.5μ to (more often) ellipsoidal to narrowly ovoid and 4×9 to $4.5 \times 10 \mu$, similarly finely papillose in appearance as in 1, above. Chloroplasts averaging much smaller than oil-bodies ($1/2-2/3$ their area). (Balsam Gap, N. C.; *R. M. S.*)

(3.) Median cells ca. $21-25 \mu \times 22-28 \mu$, with moderate trigones, occasional vague intermediate thickenings. Oil-bodies mostly subcircular to short-ovoid, $2.5-3 \mu$ to $3 \times 4 \mu$, in some cells larger and ellipsoidal and 3.2×8 to $3.6 \times 11 \mu$, mostly 3-5 (6) per cell, appearing granular, consisting of numerous minute spherules. (S 18301, near Seneca Rocks, West Va.; *R. M. S.*)

(4.) Median cells $19-24 \times 23-28$ (30) μ , with moderate, not or barely protruding trigones; no intermediate thickenings. Oil-bodies either few per cell (3-5, more rarely 2) and linear to narrowly fusiform (then $3-4 \times 10-15 \mu$), or more numerous (5-8 per cell) and short-ovoid to subspherical or spherical (then varying from $4 \times 10 \mu$ to $3.5-4 \times 6-7 \mu$, with some spherical ones ca. 4μ). Oil-bodies formed of distinct globules, individually protuberant, appearing finely segmented (the globules ca. $1-1.2 \mu$), but the largest, narrowest oil-bodies often of minute globules and appearing papillose (the globules ca. $0.6-0.8 \mu$). (Linville Gorge, N. C., S 2882; *R. M. S.*)

Lejeunea capensis Gottsche. Oil-bodies up to 6 per cell, small, compound (fide *S. A.*).

17) This species will be dealt with in detail in another connection. It belongs to the group of species with largely (but not uniformly) vestigial lobules, but with the female bracts large (as long as the leaves). Its closest relative appears to be the tropical *L. minutiloba* Evs.

Lejeunea convera S. Arnell. Marginal cells 16 μ , median cells 20-30 μ , walls rather thick, trigones large. Oil-bodies 8-10 \times 14-18 μ , rather coarsely segmented, 1-2 per cell (fide S. A.).

Judging from the large size of the trigones, and from the few and large oil-bodies, this species cannot belong in *Lejeunea* s. str. Similar oil-bodies, however, occur in *Rectolejeunea*, *Cheilolejeunea*, and *Euosmolejeunea species* (R. M. S.).

Lejeunea tabularis Sprengel. Marginal cells 10-14 μ , median cells 16 \times 20 μ ; walls thin, with small intermediate thickenings; trigones small to rather large. Oil-bodies 2-6 per cell, colorless, oval to spherical, 2-5 μ (S. A.). Very similar to *L. flava* (Sw.) Nees.

Lejeunea eckloniana Lindenb. (= *L. wilmsii* St.) Oil-bodies spherical-bacilliform, brownish, persisting for several years (indicated in Arnell's figure as occurring ca. 36 per cell; probably homogeneous) (fide S. A.). A species evidently belonging in the same complex with *L. cavifolia*.

Lejeunea helenae (Pears.) St. Marginal cells 12 (-18) μ , inner cells ca. 18 μ , walls with indistinct intermediate thickenings; trigones small to absent. Oil-bodies 2-3 per cell, composed of small segments (spherules), colorless. (fide S. A.).

Lejeunea caespitosa Lindenb. Marginal cells ca. 20 μ , inner cells 20-28 μ , trigones small and distinct, intermediate thickenings distinct. Oil-bodies 2-4 per cell, formed of rather coarse segments, colorless (fide S. A.).

Lejeunea microlobulata S. Arnell. Marginal cells 18-30 μ long, median cells ca. 30 \times 30-36 μ , walls very thin, trigones lacking or very small. Oil-bodies fusiform, composed of small colorless drops (fide S. A.).

The writers interpret this to mean that the oil-bodies are small and homogeneous, drop-like. If this interpretation is correct, the oil-bodies agree with those of *L. glaucescens* and *cavifolia*. The plant closely resembles *L. glaucescens* in the large cells and the reduced lobules.

Lejeunea mayebarae Hatt. (msc.) (Related to *L. compacta* St. and through it to *Euosmolejeunea auriculata* St.) Oil-bodies 3-10 (mostly 4-5) per cell, more or less grayish, rotundate (3-5 μ in diam.) to oblong-fusiform (10-12 \times 3-5 μ), formed of 10-30 granules (each ca. 1 μ in diam.). (From herbarium specimens 15 and 20 days after collection; on limestone, ca. 200 m. alt., Koonose, Kumamoto Co.; do., ca. 100 m., Isshoochi; S. H.)

Lejeunea vaginata St. (Allied to *L. nietneri* St.) (Pl. II, Figs. 19-21). Oil-bodies 7-24 (mostly 10-14) per cell, oblong-fusiform, 5-7.5 \times 3-3.5 μ , occasionally spherical, 3-4 μ in diameter, translucent, containing 15-30 indistinct granules, often appearing only to be glistening points. (From herbarium specimen, 35 days after collection; on barks, ca. 900 m. alt., Mt. Masugata, Kumamoto Co.; S. H.)

Lejeunea boninensis Horikawa (Pl. II, Figs. 17-18). Oil-bodies 5-15 (mostly 10) per cell, translucent, rotundate to elliptical to oblong-fusiform, 3-10 \times 3-4 μ , formed of 15-25 granules (each no more than 1 μ in diam.). (From fresh material; on branches and barks, Obi, ca. 30 m. alt., Miyazaki Co.; S. H.)

Lejeunea japonica Mitt. (Syn. *Rectolejeunea nankaiensis* St.; *Lejeunea to-sana* St.; *L. nipponica* Hatt.) (Pl. II, Fig. 24). Oil-bodies 20-40 per cell, rotundate (2-2.5 μ in diam.) or mostly elliptical (ca. $4 \times 2 \mu$) hyaline, homogeneous within. (From herbarium-specimens 25 and 35 days after collection; on rocks, 300 m. alt., Itsuki, Kumamoto Co.; do. 80m., Koonose; S. H.)

Lejeunea scalaris (St.) Hatt. (Closely related to *L. japonica* Mitt.) Oil-bodies 10-20 per cell, rotundate or mostly elliptical to oblong-fusiform, 3-5 \times 2-3 μ , homogeneous and hyaline. (From fresh material; on banks, ca. 30 m. alt., Obi, Miyazaki Co.; S. H.)

Lejeunea aquatica Horikawa (Pl. II, Figs. 25-26). Oil-bodies 10-25 (mostly 15-20) per cell, rotundate (3-4 μ in diam.) or mostly oblong, \pm fusiform (6-10 \times 3-4 μ), hyaline and homogeneous, but occasionally ca. 8 indistinct granules recognizable in larger oil-bodies as faint, shining points, when greatly magnified. (From fresh material and also from herbarium-specimen 30 days after collection; S. H.)

Lejeunea cavifolia (Ehrh.) Ldb. (Pl. XI, Flgs. 2-3). (1.) Median cells thin-walled, with rather distinct trigones and occasional shallow, ill-defined intermediate thickenings, ca. 25-28 μ . Oil-bodies minute, ca. $1/3$ - $1/2$ the area of the chloroplasts, only 1.8 μ and spherical to 1.8-2 \times 2.4-3.0 μ , homogeneous, highly refractive, colorless, mostly 40-52 per cell; chloroplasts ca. 3.6-5 μ in longer diameter (S 18300c, Seneca Rocks, West Va.; R. M. S.).

(2.) Cells each with 30-40, near leaf-base 50-60, in occasional cells over 70 oil-bodies, hyaline, spherical to shortly rod-shaped, only 1.5-2 $\mu \times$ 2-3 μ , with homogeneous contents. (European material; fide Müller, 1939).

(3.) Cells ca. 19-21 \times 26-30 μ medially, with barely thickened walls. Oil-bodies 30-40, occasionally 40-50 per median cell, minute (1.0-1.5 \times 2-3 μ), but conspicuous, because homogeneous, highly refractive and strongly glistening, usually ellipsoidal in shape. Chloroplasts much larger, 4-4.5 μ . (S 29548, Bluff Mt., Ashe Co., N. C.; R. M. S.)

(4.) Marginal cells 19-27 μ on leaves of main shoots. Each cell with 25-50 spherical to ellipsoidal oil-bodies, 1-2 μ long, simple, transparent, colorless or a clear brownish, persistent for decades in herbarium material. (Fide Buch, 1934; based on European material).

Lejeunea planiuscula (Lindb.) Buch.¹⁸⁾ (See Buch, 1934, Fig. 1:14 for illustration). Marginal cells 14-19 μ ; median cells with few, segmented oil-bodies. (Fide Buch, 1934; from European material.)

Lejeunea glaucescens Gottsche (Pl. XI, Figs. 4-5). Median cells ca. 30-32 μ wide \times 31-34 μ long, the walls thin but locally thickened (thus undulate), due to uneven development and poor definition of the frequent intermediate thickenings, and the obvious but poorly defined trigones. Oil-bodies 8-16 per cell, homogeneous, mostly narrowly ellipsoidal to fusiform, ca. 2.1 \times 5.5 μ to 2.5 \times 7 μ to 2.4 \times 9 μ , a few short-ellipsoidal and 2.4 \times 3.5 μ ; oil-bodies (with age) occasionally faintly transversely barred and obscurely 3-5 segmented. Chloroplasts

18) This species is evidently a synonym of *Lejeunea lamacerina* St.

to 3.6-4.5 μ long (S 22023, Florida; *R. M. S.*).¹⁹⁾

Lejeunea macvicarii Pears. Oil-bodies few, ca. 15 per cell, little evident among the chloroplasts, spherical, only 2 μ in diameter. (From material dry for 2 years; fide Müller, 1939.)

Microlejeunea rotundistipula St. Oil-bodies 3-10 (mostly 5) per cell, rotundate to oblong, 3.5-10 \times 3.5 μ , hyaline, containing 15-30 granules within. (From herbarium-specimens 45 and 50 days after collection; *S. H.*)

-var. *pallida* Hatt. (Pl. II, Figs. 27-28). Oil-bodies 2-5 or more (mostly 4), rotundate to oblong-fusiform, 4-11 \times 4 μ translucent or \pm grayish, formed of 10-20 granules (less than 1 μ in diam.). (From fresh material and herbarium-specimen 10 days after collection; on barks, ca. 20 m. alt., Obi, Miyazaki Co.; on large mosses, 150 m., Koonose, Kumamoto Co.; *S. H.*)

Microlejeunea punctiformis (Tayl.) Schiffn. (Pl. II, Fig. 29). Oil-bodies 2-4, rarely 5, per cell, rotundate to elliptical to oblong-fusiform, hyaline, 3-8 \times 3 μ , containing minute and indistinct granules recognizable when greatly magnified. (From fresh material and herbarium-specimens 25 and 35 days after collection; on barks, ca. 30 m. alt., Obi, Miyazaki Co.; ca. 400 m., Isshoochi, Kumamoto Co.; *S. H.*)

Microlejeunea laetevirens (N. & M.) Evs. (Pl. XII, Figs. 2-5). (1.) Cells thin-walled, with small, concave trigones, and rarely irregular, slight intermediate thickenings (never nodular and pronounced); median cells mostly 16-21 \times 21-24 μ , mostly hexagonal, the walls hyaline and colorless. Oil-bodies (3-4) 5-10 per cell, mostly ellipsoidal and 2 \times 4.5 to 2.2-2.5 \times 6-6.5 (7.5) μ , occasionally some subsphericals to spherical and smaller (2.5-3 \times 2.5-3.5 μ), formed of relatively numerous, fine (ca. 0.5 μ), scarcely protuberant, rather indistinct globules, persisting unchanged in dry plants for some weeks, obscuring ca. 1/5-1/4 of the cell-surface. Ocelli absent. Chloroplasts averaging fully as large, but rarely longer, than oil-bodies, ca. 4-4.5 μ in longer diameter. (From S 22592b, Paradise Key, Florida; material dry 15 days; *R. M. S.*)

(2.) Median cells 18-24 \times 25-30 μ , somewhat thick-walled, with occasional vague intermediate thickenings and rather distinct, occasionally barely bulging trigones. Oil-bodies mostly 7-10 per cell, mostly oval to ellipsoidal, 3 \times 4.5-5 μ , occasionally to 3 \times 7.5 μ , distinctly and rather coarsely segmented (globules individually protruding, the larger oil-bodies of only 2 rows of globules, in surface view; each segment ca. 1.5-1.8 μ). Chloroplasts somewhat smaller than oil-bodies or equal to them in size, 3-3.5 μ , occasionally 4 μ . (S 26153c, Collier-Seminole State Park, Fla.; *R. M. S.*)

(3.) Marginal cells ca. 14-17 μ , median ca. 19-21 \times 22-24 μ , mostly hexagonal, with walls moderately, equally thick-walled. Oil-bodies mostly 5-8, occasionally 9-10 per cell, mostly ellipsoidal and 3 \times 5-7.5 μ , a few to 3 \times 9 or 4 \times 7 μ , formed of numerous, barely protuberant fine globules (each ca. 0.5 μ). Chlo-

¹⁹⁾ In the homogeneous oil-bodies very similar to *L. cavifolia* (but with the oil-bodies many fewer, and individually much larger). On the basis of the larger cell-size, these plants are referred to *L. glaucescens*, while very similar plants, with smaller cells, but obviously segmented-papillose oil-bodies are referred to the confusingly similar *L. cladogyna*.

roplasts 4-5 μ long. Ocelli absent. (S 29015, Linville Gorge, N. C.; *R. M. S.*)

(4.) Median cells ca. 17-19 \times 18-20 μ , largely hexagonal, the walls rather slightly, but equally thick-walled. Oil-bodies 2-4, rarely 5, mostly 3 per cell, almost all spherical and 3 μ , occasionally to 4 μ in diameter, more or less equal in size to the chloroplasts, formed of many small, rather discrete, barely protuberant spherules (thus papillose, rather than segmented, in appearance). (S 29040, Linville Caverns, N. C.; *R. M. S.*)

The mountain forms of this species (Nos. 3, 4) differ from the coastal, tropical and subtropical phases (Nos. 1, 2) in the stronger tendency toward producing equally thick-walled cells, and the largely non-dentate sides of the underleaves. However, it is to be noted that Nos. 3 and 4 (from the montane region) have quite different oil-bodies, both as regards size and number, and that No. 3 agrees closely with No. 1 (from the tropics). The plants of No. 2 represent the most xeromorphic form of the species seen; in these plants the oil-bodies are distinctive in their coarsely segmented form, and the cells are larger than usual. Otherwise, these plants are typically developed.

Microlejeunea ruthii Evs. (Pl. XII, Fig. 6). (1.) Median cells thin-walled, with small to moderate, concave-sided trigones, 18-20 μ wide \times 21-24 μ ; no intermediate thickenings. Oil-bodies mostly 2-3 per cell, finely granular in appearance (formed of numerous very small, little protruding spherules), 3.5-4.5 (5) μ and spherical to 4.5 \times 6, occasionally 5 \times 7 μ and ellipsoidal. Chloroplasts ca. 3-3.5 μ , averaging somewhat smaller than oil-bodies (Balsam Gap, N. C.; *R. M. S.*).

(2.) Median cells 16-20 \times 18-22 μ , more or less equally thick-walled, with minute trigones; no ocelli. Oil-bodies 2-4 per cell, mostly ovoid and 3.5-4 \times 5-8 μ to 5 \times 6-8 μ , occasional ones spherical and 4-5 μ , formed of numerous minute (scarcely recognizable) globules, which barely protrude; the oil-bodies appearing finely papillose, but not segmented. Chloroplasts somewhat smaller than oil-bodies in average size, 3-4 μ . (John's Cr., n. of Marion, N. C., S 28820; *R. M. S.*)

(3.) Median cells 15-17 \times 17-19 μ , somewhat equally thick-walled; no ocelli. Oil-bodies 2-3 (4) per cell, each 3.5-4 \times 5 μ to 4-5 \times 7 μ and ovoid to ellipsoid, some spherical (particularly in marginal and submarginal cells) and 3-4 (5) μ . In marginal and submarginal cells frequently smaller and to 1.5-3 μ in diameter; oil-bodies formed of minute, barely perceptible globules (less than 0.6 μ in diam.), superficially appearing faintly warty externally. (Same data as above, S 28825; *R. M. S.*)

Microlejeunea ulicina (Tayl.) Evs. (Pl. XII, Figs. 7-9). (1.) Median cells 15 \times 20 μ , with moderate trigones but no intermediate thickenings. Oil-bodies 5-8 (9) per cell, formed of fine oil-globules, each slightly protuberant, appearing finely papillose, 3-4.5 μ and spherical to short-ellipsoidal and 4 \times 5 μ , rarely to 5 \times 6 μ . Chloroplasts ca. 3 μ , averaging subequal to oil-bodies or somewhat smaller. (Balsam Gap, N. C.; *R. M. S.*)

(2.) Cells with 3-8 oil-bodies, spherical to elongate ovate or shortly rod-shaped, occasionally weakly curved, 2 μ to 2 \times 4 μ (European material; fide Müller, 1939).

(3.) Median cells slightly thick-walled, with very small trigones, ca. 15-18 μ . Oil-bodies 2-4 per cell, spherical and 2.5-3 μ to 2 \times 4.5 μ , a few to 3 \times 6 μ , formed of discrete, relatively few, clearly protuberant globules, thus appearing finely segmented or coarsely papillose. Dorsal lobe, just below juncture of dorsal base and stem, typically with a single ocellus (the containing cell similar in size or slightly smaller than surrounding cells), the ocellus nearly filled by an ovoid to ellipsoidal homogeneous, highly refractive oil-body, ca. 10 \times 12-15 μ in size. (Cascades, near Hanging Rock State Park, Stokes Co., N. C.; *Schuster and Blomquist*, 28234).

(4.) Median cells 13-16 μ , thin-walled, with small trigones. Usually with one basal ocellus distinct (cell ca. 13-15 \times 20 μ ; oil-body homogeneous, 9-10-12 μ , spherical); more rarely two basal ocelli, occurring either side-by-side, or end-to-end in a short basal vitta. Median cells with 2-3, rarely only 1, oil-bodies per cell, these spherical and 2-2.5-4 μ to more often ovoid or ellipsoidal, 2.5-3 \times 4 μ , rarely sublinear and 2 \times 5-6 (7) μ ; oil-bodies formed of minute globules (less than 0.6 μ in diam.), appearing coarsely papillose. Oil-bodies of median, marginal and basal cells all virtually equal in size. (S 28821, John's Cr., n. of Marion, N. C.; *R. M. S.*) (plant unusually small and only 220 μ wide, with leaves approaching those of *M. bullata* in size, form and orientation).

(5.) Median, subapical and subbasal cells nearly equal in size, ca. 14-16 μ wide \times 16-20 μ long, walls rather thin, trigones small and concave; no intermediate thickenings. Ocelli usually 1-2 at base (usually in a short line, involving basal cell) occasionally in a group of 3; ocelli not or little wider than surrounding cells, usually slightly longer (14 \times 18 μ to 16 \times 25 μ), each with a single large oil-body (16 \times 17 μ to 18 \times 28 μ), homogeneous when fresh but dissociating into a grayish opaque body. Median and subapical and subbasal cells all with 2-4 oil-bodies, these mostly ovoid to ellipsoidal to fusiform, ca. 2.8-3.2 \times 5 μ to 3.5 \times 7 μ , a few spherical and 3-3.5 μ ; oil-bodies formed of numerous minute spherules (less than 0.6 μ), appearing nearly or quite smooth, the globules distinct merely as faint points. (S 28896, Linville Gorge, N. C.; *R. M. S.*)

(6.) Cells ca. 12-15 \times 14-18 μ in leaf-middle, with concave-sided but obvious trigones, the cells rounded-polygonal. Ocelli usually absent, but rarely a single basal one (13-14 \times 20-22 μ , containing a homogeneous oil-body ca. 10 \times 13-14 μ). Median cells with 2-3 oil-bodies, these finely granular (of minute, scarcely protruding globules, less than 0.5 μ in diam.), ca. 2.5-3 \times 4-5 μ and ovoid to subspherical and 2.5-3, occasionally 3.5 μ . Chloroplasts ca. 4 μ , subequal in size to oil-bodies. (S 28949, pp., among *Drepanolejeunea bidens*, Linville Gorge, N. C.; *R. M. S.*)

(7.) Cells ca. 14-16 μ wide, little or no longer medially, thin-walled, with moderate trigones and rarely an occasional intermediate thickening. Normal cells each with a single (quite rarely with 2) oil-bodies; these 2-2.5 \times 3-3.5 μ , occasionally 3 \times 4 μ , or spherical and 3-4 μ , appearing finely segmented-papillose, of slightly protuberant fine globules. Chloroplasts averaging equal to oil-bodies in size, 3-4 μ long. Ocelli very variable in number, almost always at least one present (this then basal), frequently 2 present (then in a short row, one basal,

one immediately above the basal one), but occasionally 4-5 present (then 3-4 forming a basal row, adjacent to the stem cells, with the final ocellus immediately above the uppermost basal ocellus, resulting in an inverted L-shaped grouping). Ocelli up to $15-16 \times 18-20 \mu$, each containing a single large, opaque, granular appearing oil-body up to $14 \times 16 \mu$, but often spherical and only $12-14 \mu$. (S 29436, Neddie Creek, Jackson Co., N. C.; *R. M. S.*)

(8.) Cells $15-16 \times 16-18 \mu$, thin-walled, with small trigones. Ocelli uniformly absent. Cells each with 2-3, occasionally 4 oil-bodies, these spherical and $2.5-3 \mu$ to 3×5 , occasionally $3 \times 7 \mu$ and elongate-oval, formed of fine globules (less than 0.6μ apparently) that barely protrude, thus finely granular in appearance. (On *Salix atrocinerea* in bog, Lyndhurst Hill, New Forest, England, E. W. Jones; *R. M. S.*)

(9.) Cells $12-14 \times 14-17 \mu$, walls barely thickened, trigones rather small; each cell with 2, rarely 3, oil-bodies, these spherical and $2-2.5 \mu$ to ovoid or oval and $2-2.5 \times 3-4 \mu$, occasionally singly per cell and then up to $2-3.2 \times 6-7 \mu$, finely granular, appearing papillose. Almost all leaves with one basal ocellus (cell ca. $15 \times 16 \mu$), containing a single granular opaque oil-body, ca. $10 \times 13 \mu$ to 12μ ; a few leaves exocellate. (S 29448, Cedar Cliff Mt., N. C.; an xeric extreme, from dry rock, with *Metzgeria crassipilis* and *Frullania inflata*; *R. M. S.*)

M. ulicina is a variable and taxonomically difficult taxon. At least some forms of the species, both in Europe and North America, possess 1-2 basal ocelli (Nos. 3-6, 9 above). Other forms never appear to possess ocelli (fide Evans, 1910); Nos. 1, 2 and 8 belong in this category. Finally, rarely do we find that up to 4-5 ocelli occur (No. 7, above). It deserves emphasis that non-ocellate forms (Nos. 1-2) have a large number of oil-bodies per cell (3-8 usually),²⁰⁾ while forms with 1-2 ocelli usually have 2-3 or 2-4 oil-bodies per cell (Nos. 3-6), while the exceptional forms with up to 4-5 ocelli have almost uniformly a single oil-body in the vegetative cells (No. 7). Evans (l. c.) noted that there appeared to be some variation in number of ocelli in the species. The present study indicates that there is also variation in number of oil-bodies per cell, with the number decreasing with an increase in number of ocelli. *M. ulicina* is not alone in the genus in being ocellate. The North American *M. cardoti* St. is also obscurely ocellate. No material of this species has been available for study.

As is noted above (5), occasional plants of *M. ulicina* bear mostly 2-3 ocelli per leaf base. It also deserves emphasis that all living North American plants studied by the writer (1951-53), of which Nos. 3-5 are only isolated examples, possess ocelli on at least some leaves of every mature plant. Since several dozen collections have been examined, all of which were studied while fresh, the conclusion has been reached that at least the North American material is normally ocellate. Since the ocelli disintegrate with time (and since the cells in which they are found are not or barely larger than surrounding cells), it is possible

20) However, the English specimen (which was received through the courtesy of Dr. E. W. Jones), has 2-3, more rarely 4, oil-bodies per cell, as in the 1-ocellate type, yet consistently lacks the ocellus. Both Dr. Jones and the senior author were quite unable to see any ocellus in this collection.

that the observations by Evans (1910, p. 35), to the effect that much European material "apparently" lack ocelli may be based on the inadequacy of the material he studied. Ocelli were still distinct in a specimen from Baden, Germany, collected by Müller in 1903 (Schiffner, Hep. Eur. Exsic. No. 1074).

One of the authors (*R. M. S.*) has studied a number of specimens of *M. bullata*, exceedingly closely related to *M. ulicina*. This species is essentially similar to *M. ulicina* in its oil-bodies, but never appears to be ocellate. The significance of the fact that the English *M. ulicina* is exocellate (and presumably the type material from Ireland), while the coastal *M. bullata*, of North America is exocellate, and the montane forms of "*M. ulicina*" of eastern North America are clearly ocellate, deserves emphasis. The borderline between *M. bullata* and *ulicina* is exceedingly vague, and no differentiation on the basis attempted by Frye and Clark (l. c.) in their key can be maintained. The above examples, selected at random, also show that the cells are often smaller than the "18 μ " often cited in the literature for *M. ulicina*, and are not appreciably larger than in many forms of *M. bullata* from tropical Florida.

Microlejeunea ocellifera S. Arnell. Marginal cells 10-16 μ , inner cells 14-16 μ , walls thin to slightly thickened, trigones small. Mostly with 1 ocellus in basal part of lobe, near insertion of leaf; near female organs sometimes with several ocelli (either in a basal group or scattered in the lobe and occasionally also in the lobule). Male bracts also sometimes with a few scattered ocelli. Cells with small colorless oil-bodies (indicated as 1-3 per cell in Arnell's figure). (South African material; fide *S. A.*)

The present species is extremely close to *M. ulicina* and *bullata*. The former (as is evident from the foregoing) may have 1-3 basal ocelli. Careful comparative study may show that all three of these entities represent a single species (*R. M. S.*).

Microlejeunea bullata (Tayl.) Evs. (1.) Median cells 15-17 μ wide \times 17-19 μ long, thin-walled, with small trigones. No ocelli. Oil-bodies 2-3 per cell, finely granulose in appearance (formed of very fine spherules, moderately protuberant), spherical and 3-4 μ to ovoid and ellipsoidal and 3 \times 4 to 2.5-3 \times 6-7 μ . Chloroplasts ca. 4 μ . (Nigger Mt., N. C., S 29607; *R. M. S.*). The plants of this collection quite small, somewhat xeromorphic, quite devoid of ocelli. On the basis of size and lack of ocelli placed here, but perhaps a reduced form of *M. ulicina*. As is indicated above, the distinction of the two species may be artificial.

(2) Cells 10-12 μ in middle of dorsal lobe, nearly equally thick-walled. Both antical base of lobe, and antical base of lobule, with a single, greyish, fine-segmented, opaque ocellus. Vegetative cells with 1 small oil-body per cell, rarely 2. (S 31416; Liberty Co., Georgia; *R. M. S.*)

(3) Cells isodiametric, hexagonal to hexagonal-quadrate, 10-11 μ in middle of dorsal lobe, somewhat equally thick-walled. Ocelli at bases of lobes and lobules quite lacking. Cells with a solitary oil-body, rather large in size (ovoid to fusiform or ellipsoidal, 2 \times 5 μ , to 2.5-3 \times 7 μ , formed of discrete, but small, somewhat bulging spherules. (S 31407, Clay Co., Fla.; *R. M. S.*)

(4) Cells with 1 oil-body per cell; with 1 ocellus at antical base of lobe, 1 at base of lobule (near anterior base). (S 31919 p. p., Marion Co., Fla.; *R. M. S.*)

(5) With 1 oil-body per cell, as above; ocelli usually absent, but rarely with 1 ocellus of antical base. (S 31933, Marion Co., Fla.; *R. M. S.*)

(6) One, very rarely 2, oil-bodies per cell; some leaves with a dorsal basal ocellus (others with no ocellus); never with an ocellus of postical base of leaf (lobule). (S 31932a; Marion Co., Fla.; *R. M. S.*)

M. bullata appears to bear the same relationship to *M. ulicina* as does *Cololejeunea myriocarpa* to *C. minutissima*. True *M. bullata* has 1, rarely 2 oil-bodies per cell (*M. ulicina* usually has at least 3 oil-bodies per cell). At one time it was believed that *M. bullata* lacked ocelli, but careful study of living material has revealed that most plants have a single basal ocellus of the lobes (more rarely also one of the base of the lobules). Only once was a plant found with 2-3 ocelli of the antical base.

Potamolejeunea holtii (Spruce) Greig-Smith (= *Lejeunea holtii* Spruce). Cells with 30-50 very small (only 2 μ large), spherical, glistening oil-bodies (from material dry for 2 years; sive Müller, 1939).

Greig-Smith (Trans. Br. Bryol. Soc. 1 (2): 108, 1948) has shown that this species should go into *Potamolejeunea*, if that genus is to be accepted at all (as distinct from *Lejeunea*, s. str.).

Ciliolejeunea capensis Arnell. Cells 16-26 μ marginally, 20 \times 20 to 26 \times 34 μ medially; walls thin, with small trigones, small intermediary thickenings. Oil-bodies numerous (Arnell figures ca. 38 per cell), small, bacilliform to spherical, colorless, appearing homogeneous. (*S. A.*)

Strepsilejeunea knysnana Arnell. Cells 10-16 μ marginally, ca. 16 \times 20 μ medially, trigones distinct to large. Oil-bodies singly per cell, large, composed of rather large segments (drops), colorless or sometimes brownish. (*S. A.*)

Strepsilejeunea georgensis Arnell. Marginal cells 8-14 μ , inner cells to 18 \times 20 μ , walls rather thick, somewhat rosy, trigones more or less distinct, mostly large. Oil-bodies large, 4-6 \times 6-8 μ , slightly brownish, 3-5 per cell (in Arnell's figure, but described as "to 15 per cell"), almost filling cell; (illustrated as being segmented). (*S. A.*)

Stylolejeunea spiniloba (Lindenb. & Gottsche) Evs. (Pl. XII, Fig. 1). Median cells 25-28 \times 22-24 μ , thin-walled, with distinct but never bulging trigones devoid of intermediate thickenings. Each cell with 5-6 elongate, often *Paramecium*-shaped or *Euglena*-shaped oil-bodies ca. 3 \times 12-15 μ , a few smaller and 3 \times 8-9 μ or even 3 \times 5 μ , formed of 4-5 rows of relatively small (less than 0.7 μ), but strongly protruding globules, thus fine-segmented to very coarsely papillose in appearance. Marginal cells with usually smaller, more ovoid to ellipsoid oil-bodies ca. 3 \times 5-7 μ or spherical and 3.0-3.6 μ , occurring 4-7 per cell. Chloroplasts ca. 3-3.3 μ , much smaller than oil-bodies. (S 22780, Hillsborough State Park, Fla.; *R. M. S.*)

Crossotolejeunea bermudiana Evs. (Pl. XI, Figs. 7-8). (1.) Median cells relatively large, mostly 20-23 μ \times 32 (rarely 37) μ . Cells all strongly convex, but with smooth cuticle; the marginal cells of both leaves and underleaves pro-

minently bulging on their free margins (the underleaves and leaves thus appearing erenulate); cell-walls thin, but (except in strongly leptodermous extremes) with distinct to somewhat bulging trigones, and occasional to frequent intermediate thickenings. Plants generally extremely hyaline and whitish green, due to the small chloroplasts. Oil-bodies mostly (3) 4-5 per median cell, relatively large, 4×9 or $5 \times 10 \mu$ to occasionally 5×15 or $7 \times 14 \mu$, narrowly elliptical to fusiform composed of very strongly bulging, protuberant, large spherules (ca. 1.5μ), thus very distinctly compound, of the "grape-cluster" type, colorless. Chloroplasts small, less than 3μ , the cells only slightly chlorophyllous. (*R. M. S.*)²¹⁾

(2.) Median cells 19-22 (rarely 22-27) μ wide \times 26-30 μ long, with walls thin, but with large, bulging trigones and often with intermediate thickenings (these absent on most short walls, but usually 1, sometimes 2 per longer cell-walls). Oil-bodies mostly 2-5 per cell, large, usually ovoid to narrowly ellipsoidal and $4 \times 7 \mu$ to $3.5-4.5 \times 10-15 \mu$, a few (especially near leaf bases) to $6 \times 20 \mu$; in some cells with some oil-bodies spherical and 5-6 μ in diameter. Older plants with cells sometimes almost filled with 5-12, occasionally 12-18 or more oil-bodies; these from 3×5 to $6 \times 9 \mu$ in most cases. Each oil-body formed of moderately discrete globules, each ca. 1-1.2 μ , occasionally 1.5 μ , these only slightly protuberant, the oil-bodies thus relatively faintly segmented. (S 29202, Lake Wacamaw, N. C.; *R. M. S.*)

Taxilejunea obtusangula (Spruce) Evs. (Pl. XI, Fig. 6). Cells with walls quite thin, but with distinct (often slightly bulging) trigones, and intermediate thickenings; walls quite colorless. The intermediate thickenings numerous and constant, one, or occasionally two, between each pair of trigones. Median cells $23-26 \times 21-23 \mu$. Oil-bodies minute, glistening, homogeneous, extraordinarily numerous, 40-55, often apparently to 60-65 per cell (and then almost impossi-

21) Sterile plants of this species are most easily confused with those of *Lejeunea*. The strongly erenulate leaf-margins (and margins of the small underleaves), the somewhat larger cell-size, and particularly the large and few oil-bodies will separate *C. bermudiana* from any nearctic *Lejeunea*. The larger oil-bodies ($5-7 \times 14-15 \mu$) are about twice as large as the larger oil-bodies in such superficially similar species as *Lejeunea flava* and *cladogyna*. A further point of difference lies in the tendency for sterile plants of *C. bermudiana* to develop more or less apiculate leaf-lobes—a characteristic, which, however, is not always observable; this never occurs in *Lejeunea*. The species agrees closely with *Lejeunea* in the 5-keeled perianth, in the pale color, in size, and in the autoecious inflorescences, as well as in the form of the lobule (hyaline papilla proximal; apical tooth small, not sharp). The very small underleaves, little or no wider than the stems, which attain a maximum width of 110-150 μ , eliminate most species of *Lejeunea* from consideration. The underleaves are almost always characterized by a sudden apiculum on each lobe, formed of 2 superimposed cells; this rarely occurs in any *Lejeunea* species. *C. bermudiana*, in the author's opinion, serves to connect *Lejeunea* and *Crossotolejeunea*. The perianths of this species have five keels rather strongly erenulate by means of protruding cells, occurring in two rows (thus each keel is faintly bidenticulate). This, and the larger oil-bodies, appear to be the only characters that serve to keep *C. bermudiana* from inclusion in *Lejeunea*. It would seem that, perhaps, *Crossotolejeunea* might well be considered merely a discrete subgenus of *Lejeunea*, differing in the more or less denticulate or dentate keels of the perianth.

ble to accurately count), mostly ovoid to ellipsoid to bacilliform, $1.4-1.6 \times 2-3.5 \mu$, forming almost a sheath of beads surrounding the central vacuole of the cell. Chloroplasts much larger, ca. $3.2-3.8 \mu$, moderately numerous (the cells rather opaque because of the numerous oil-bodies, combined with the very many chloroplasts). (S 22587, Paradise Key, Fla.; *R. M. S.*)²²⁾

Taxilejeunea conformis (N. et M.) St. Cells $14-20 \times 20-30 \mu$ on margins, trigones small or lacking. Oil-bodies up to 6 per cell, $4-6 \mu$, composed of small drops (segmented), colorless (South African material; fide *S. A.*).

Taxilejeunea vallis-gratiae St. Cells $18-24 \mu$ on margins, $20-40 \mu$ in leaf-middle, trigones small or lacking. Oil-bodies segmented, colorless, about $4-6 \times 6-10 \mu$, 3-15 per cell. (South African material; fide *S. A.*)²³⁾

Taxilejeunea eggersiana St. ? (perhaps a reduced form of the related *T. sulphurea* (L. et L.) Schiffn.). Cells ca. $30-31 \mu \times 40-50 \mu$ in and below leaf-middle, thin-walled, with small trigones and occasional faint intermediate thickenings. Oil-bodies homogeneous, strongly glistening, 10-20 per cell, varying from 3×4 to $3.5 \times 6 \mu$, up to $3.5-4 \times 7-8 \mu$, ovoid to ellipsoidal to fusiform. Chloroplasts ca. $3-4 \mu$, averaging smaller than oil-bodies. (El Yunque, Puerto Rico, among and growing over *Hymenophyllum*; *R. M. S.*)

The present plants are strongly apiculate-leaved, but rarely show a slight subapical tooth of the antical margin. The underleaves vary from approximate to somewhat imbricate, are crenulate, have a narrow to closed, slit-like sinus. The plants are dioecious, with ♀ inflorescences on short, lateral, spur-like shoots, without innovations.

Prionolejeunea aemula (Gottsche) Evs. Cells ca. $22-25 \times 26-29 \mu$, thin-walled, the walls colorless, with discrete but concave-sided trigones, no intermediate thickenings. No ocelli. Oil-bodies variable, (2) 3-7, rarely more per cell, spherical and $4-5$ ($6-7$) μ to ovoid and 4×5 to $5-6 \times 9 \mu$, rarely fusiform or sublinear and 5×11 or $4 \times 14 \mu$; oil-bodies much smaller and usually only 2-4 per cell near margins; each oil-body formed of discrete globules, ca. $0.5-1.0 \mu$ in diameter, protruding slightly, thus appearing papillose. Chloroplasts much smaller than oil-bodies, ca. 2μ . (On leaves of *Hymenophyllum*, El Yunque, Puerto Rico; *R. M. S.*)

Tuyamaella molischii (Schffn.) Hatt. (Pl. III, Figs. 1-2). In vitta (of

22) Sterile material of this species, when living can at once be placed on the basis of the extremely abundant, minute, homogeneous oil-bodies. Similarly numerous, and minute oil-bodies occur in a few species of *Lejeunea* (*L. cavifolia* etc.), but these differ from *Taxilejeunea* at once in that the underleaves are not clearly wider than long. The very wide underleaves of *Taxilejeunea* ($350-375 \mu$ wide on robust shoots) are one of the best recognition marks of sterile plants. Another excellent diagnostic character lies in the cell-walls, which bear abundant intermediate thickenings, which occur almost between every pair of trigones (occasionally even two occurring in a cell-wall). The underleaves of robust shoots are very generally broadly rounded and somewhat cordate at base.

23) As is readily evident on comparison of the above two African species, with *T. obtusangula*, very fundamental differences in size, form and number of the oil-bodies occur within *Taxilejeunea* as now constituted. Equally significant is that, in the only other American species studied, the oil-bodies are as in *T. obtusangula*, e. g., numerous and homogeneous. (*R. M. S.*)

elongate basal cells) oil-bodies copious, mostly 20 per cell, rotundate, (ca. $4\ \mu$ in diam.) or ovate (ca. $8 \times 5\ \mu$), or mostly oblong-fusiform (ca. $12 \times 4.5\ \mu$), grayish, compound, granules ca. $1\ \mu$ in diameter, numerous (25–35), dense. Near the limb, the rectangular hyaline cells at the leaf-margin have the oil-bodies few and minute, almost drop-like or disappearing. In leaf-middle, oil-bodies 3–6 (rarely 7–8) per cell, oblong-fusiform or occasionally ovate to rotundate, $3\text{--}6 \times 1.5\text{--}2.5\ \mu$, compound, granules 10–20, ca. $0.7\ \mu$ in diameter. Oil-bodies in the cell near vitta similar to those in vitta; that is, oil-bodies becoming more (up to 10 per cell) and larger (up to $10 \times 3.5\ \mu$), with included granules more distinct and numerous (ca. 25). (Fresh material; on leaves, ca. 500 m. alt., Nakago, Miyazaki Co.; *S. H.*)

-fo. *corticola* Hatt. (Syn. *Pycnolejeunea boninensis* Horikawa) In vitta oil-bodies 10–15 per cell, $10\text{--}16 \times 4.5\text{--}6\ \mu$ in size. In leaf-middle oil-bodies 4–10 per cell, $6\text{--}13 \times 3\text{--}4\ \mu$, or $3\text{--}4.5\ \mu$ in diameter. (From herbarium-specimen 15 days after collection; on tree-trunks, 750 m. alt., Hitoyoshi, Kumamoto Co.; *S. H.*)

C. Paradoxae

Diplasiolejeunea rudolphiana St. (Pl. XIII, Figs. 1–4). (1.) Median cells ca. $20\text{--}26\ \mu$ and subhexagonal, virtually isodiametric; walls colorless, nearly evenly thick-walled (but at times walls somewhat undulate due to uneven thickenings), lacking distinct trigones. Cells dimorphic, of the *Stictolejeunea* type, e. g., with differentiation into vegetative cells with chloroplasts (these with several small oil-bodies), and nearly chloroplast-free ocelli (these each with a single, large, homogeneous-appearing oil-body). Chlorophyllose cells with large chloroplasts (ca. $4.5\ \mu$) and 4–8 small oil-bodies (varying from spherical and $1.8\text{--}2.5\ \mu$ to sublinear and $1.5 \times 4.8\ \mu$ to $1.5 \times 6.5\ \mu$); oil-bodies polymorphic, the smaller ones either homogeneous or 2–3 segmented, the larger, sublinear ones formed of 1–2 rows of small spherules (each ca. $0.7\text{--}1.2\ \mu$), thus coarsely segmented. In most cells a combination of several small homogeneous or 2–3 segmented oil-bodies with 2–4 many segmented ones. Ocelli nearly or quite lacking chloroplasts, each with a large spherical to broadly ovoid oil-body ca. $16\ \mu$ to $18 \times 24\ \mu$. (S 22053, Dade Co., Fla; *R. M. S.*)

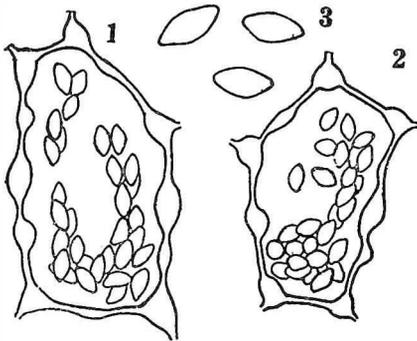


Fig. 1-3. *Colura meijeri* Jovet-Ast
1. Cell from leaf base, $\times 800$. 2. Cell from leaf middle, $\times 800$. 3. Three oil-bodies from leaf cell, $\times 1600$. The figures were drawn by S. Hattori from material collected at Mt. Asama, Mie County (Japan).

(2.) Median cells $23\text{--}26\ \mu$, equally thick-walled (the walls around the scattered ocelli usually thinner than those around normal cells). Median cells usually with 3–5 (rarely 6) oil-bodies, these mostly $2 \times 6\text{--}7.5$, occasionally $2.5 \times 7.5\text{--}9\ \mu$, formed of one, occasionally partly or entirely 2 rows of small globules, strong-

ly individually protruding, thus sharply segmented; in some cells oil-bodies are more linear and longer, $2.5-3 \times 9-12 \mu$, formed of 2 (rarely partly 3) rows of globules. Chloroplasts ca. 4.5μ . Scattered throughout the leaf additional cells (ocelli) with homogeneous, glistening oil-body per cell, nearly filling cell ($17-20 \mu$ in diameter), the surrounding cytoplasm with a few small inconspicuous chloroplasts, or with chloroplasts virtually absent. (S 26001, Timms Hammock, Fla., on twig of live oak). It should be noted that Frye and Clark (l.c.) state, incorrectly, (p. 920, 921) that ocelli are lacking in this species.

Colura meijeri Jovet-Ast²⁴⁾ Syn. *C. inuii* (non Horikawa) Auct. quoad pl. Japon. (Fig. 1-3). (1.) Oil-bodies about 30 per cell, hyaline and homogeneous within, oblong — fusiform, $5-6 \times 2.5-3 \mu$, occasionally ovate to rotundate. Median cells $30-45 \times 25 \mu$. (From herbarium-specimen 12 days after collection; on barks, Isl. Yakushima, Kagoshima Co.; *S. H.*)

(2) Oil-bodies 30-40 per cell, ovate to fusiform, rarely roundish, $5.5 \times 2.5 \mu$, $5.2 \times 2.7 \mu$, $4.2 \times 2.8 \mu$, or 2.8μ (diameter), hyaline and homogeneous within, soon disintegrating into minute droplets and finally disappearing after the cell died. Chloroplasts about 4μ in diameter. (From specimen 5 days after collection; on tree bases, 530 m. alt., Mt. Asama, Mie Co.; *S. H.*)

Cololejeunea denticulata (Horikawa) Hatt. Oil-bodies hyaline, 10-20 per middle cell, 30-40 per basal elongate cell, less than 10 (or almost disappearing) per marginal cell; ovate to oblong-fusiform, small, $5-8 \times 3-3.5 \mu$, containing ca. 10 (or in larger oil-bodies 15) granules, granules so minute that recognizable as

24) The present species was recently proposed by Jovet-Ast in her monographic work "Le genre *Colura*" (in Rev. Bryol. et Lichenol. 22 (3/4):206-312. 1953), basing on Meijer's collection from Java (type) and Mayehara's from Japan. She described in her work oil-bodies of five species of *Colura*, *C. herzogii*, *C. sp.* from Madagascar, *C. obesa*, *C. calyptrifolia*, and *C. tenuicornis*, and remarked, "Dans les spécimens secs des différentes espèces de *Colura*, je n'ai trouvé aucune trace d'oléocorps même lorsque la récolte datait seulement de quelques mois. Cependant les cellules des spécimens de *C. lyrata* récoltés à la Guadeloupe en 1936 (donc il y a 17 ans!) sont encore bourrées d'oléocorps malheureusement déformés; à l'état frais ils doivent occuper la plus grande partie de la cellule. Les oléocorps existent donc chez les *Colura*. Ils apparaissent, le plus souvent, en forme de petits "grains" homogènes, sphériques ou ±ovoïdes, de très petite taille (quelques μ), ± nombreux dans chaque cellule, libres, non groupés en corps de forme définie. Ils ne sont probablement pas identiques dans les différentes sections." (Jovet-Ast, l.c. 217-218, fig. 12). (*S. H.*)

The following descriptions are based on Jovet-Ast (1953):

Colura herzogii Jovet-Ast Oil-bodies 20-40 per cell, drop-like or a little elongated, hyaline and homogeneous within. (From living material; Tjibodas, Java; fide Jovet-Ast).

Colura sp. Oil-bodies about 40 per cell, ovoid, $3 \times 2 \mu$, obtuse or acute at both ends, hyaline and homogeneous within, much comparable to *C. herzogii*. (From specimen 10 days after collection; Madagascar; fide Jovet-Ast).

Colura obesa Jovet-Ast Oil-bodies about 40 per cell, having much resemblance to those of *C. herzogii*. (From specimen 11 days after collection; Madagascar; fide Jovet-Ast).

Colura calyptrifolia (Hook.) Dum. Oil-bodies dispersed, rather few, drop-like, about 2μ in diameter. (From specimen 10 days after collection; fide Jovet-Ast).

Colura tenuicornis (Evs.) St. syn. *C. pseudocalyptrifolia* Horikawa. Oil-bodies having a resemblance to those of *C. calyptrifolia*. (From living material; Madagascar; fide Jovet-Ast). (*S. H.*)

a shining point when greatly magnified. (From fresh material; on leaves, ca. 500 m. alt., Nakago, Miyazaki Co.; *S. H.*)

Cololejeunea minuta (Mitt.) St. (Pl. III, Fig. 3). Oil-bodies hyaline, 6-12 per middle cell, 10-15 per basal cell, ovate to oblong-fusiform, small, $5-8 \times 3-3.5 \mu$, or occasionally rotundate, $3-4 \mu$ in diameter, the surface view formed of ca. 10 (but in rotundate oil-body only 3-4) minute and indistinct granules. (From fresh material and herbarium-specimen 30 days after collection; on leaves, ca. 500 m. alt., Nakago, Miyazaki Co.; on rocks, ca. 100 m., Hitoyoshi, Kumamoto Co.; *S. H.*)

Cololejeunea orbiculata (Herz.) Hatt. (Allied to *C. minutissima* closely). Oil-bodies hyaline, 3-7 per cell, rotundate to elliptical (rarely \pm fusiform), small $3-8 \times 3-3.5 \mu$ containing 10-20 minute and indistinct granules within. (From fresh material; on branches of *Rhododendron* ca. 20 m., Obi, Miyazaki Co.; *S. H.*)

Cololejeunea minutissima (Sm.) Schiffn. (Pl. XIII, Figs. 5-7; XIV, Figs. 1-2). Two types of plants occur in southeastern United States, bearing somewhat different morphological features, and differing in their cytology. It is possible two distinct species are at hand, though further evidence must be forthcoming before this can be decided. For the time being, the hammock plant of tropical Florida, which is rather close to the tropical *C. myriocarpa*, will be treated as the plants of the "*Myriocarpa* type," the more widespread and not exclusively tropical plants with larger lobules, will be referred to as "*Minutissima* type."

Myriocarpa type: (1.) Marginal cells of dorsal lobe, near middle with cells thin-walled, with minute trigones, and no intermediate thickenings, ca. $16-18 \mu$ and nearly isodiametric. Median cells ca. $16-19 \times 18-22 \mu$, their walls like those of marginal cells. Oil-bodies almost constantly 1-2 per cell, even in marginal cells, when 2 per cell, subspherical to short-ellipsoidal and 3.6μ to 3.5×5 to 6μ ; when 1 per cell, notably larger and to $4-4.5 \times 10-12 \mu$, fusiform to sublinear. Oil-bodies distinctly, but not coarsely segmented, the individual globules strongly protuberant, the oil-bodies 4-5 rows of segments wide (the segments ca. $0.5-0.8 \mu$). Chloroplasts ca. 3μ . (S 22029b; *R. M. S.*)

(2.) Median cells similar to those above, ca. $18-22 \mu$. Oil-bodies 1-3, rarely 4 per cell, segmented as above; when 1 oil-body per cell ca. $4.5 \times 11 \mu$; when 2-4 per cell, ca. $4.5 \times 7-9 \mu$ or even smaller. (S 22558, Paradise Key, Fla.; *R. M. S.*)

Minutissima type: (1.) Median cells thin-walled with slight trigones and no intermediate thickenings, ca. $16 \times 18 \mu$ to $17-19 \times 20-22 \mu$, quadrate to subhexagonal, nearly isodiametric. Oil-bodies 4-6 per cell, formed of coarse globules (each oil-body of only 2-3 rows medially, in surface view; the globules ca. $1-1.3 \mu$ in diameter); oil-bodies in surface view of ca. 5-13, rarely 20 segments); oil-bodies from short ellipsoidal and $3 \times 5-7 \mu$ to sublinear and a maximum of $2-2.5 \times 7-9 \mu$. (Oil-bodies of this type differing from the *Myriocarpa* type in being more numerous, smaller, and composed of coarser spherules; never occurring singly per cell, as is very common in the *Myriocarpa*-type). (Ocean Springs, Miss.; *R. M. S.*)

(2.) Oil-bodies mostly 4-6 (3-8, rarely 10) per cell, spherical to ovate to

oblong-fusiform, more or less smaller than those of the preceding species, *C. orbiculata*. (From herbarium specimen, 20 days after collection; on barks, ca. 300 m. alt., Hitoyoshi, Kumamoto Co.; *S. H.*)

Cololejeunea myriantha (Herzog) Arnell. Marginal cells 18–20 μ , inner cells to 30 μ , thin-walled, no trigones, no ocelli. Oil-bodies up to 16 per cell, 2–6 μ , composed of rather large drops, colorless. (South African material; fide *S. A.*)²⁵⁾

Cololejeunea rupicola (St.) St. (Pl. III, Fig. 4). Oil-bodies 3–7 per outer cell, spherical (1.5–2 μ in diam.) or rarely elliptical; 4–10 per inner cell, spherical (2–3 μ in diam.) or mostly oblong-fusiform (3–5 \times 2–3 μ), containing minute and indistinct granules within. (From fresh material; on ferns, ca. 500 m., Nakago, Miyazaki Co.; *S. H.*)

Cololejeunea shikokiana (Horikawa) Hatt. (Pl. III, Fig. 5). Oil-bodies hyaline, 3–4 per cell, spherical to ovate (often grain-like in shape), very small, 1.5–2 \times 1.5 μ , containing minute and indistinct granules within. In ocellus, oil-bodies copious, large, grayish, containing numerous, distinct granules, sooner or later dissociating and disappearing. (From herbarium-specimen 45 days after collection; on barks, 150 m. alt., Fukada, Kumamoto Co.; *S. H.*)

Cololejeunea yamanakana Kamimura. Oil-bodies hyaline, 2–5 per cell, spherical, occasionally ovate to rice-grain-like in shape, less than 5 μ long, containing minute and indistinct granules within. In basal elongate cell (ocellus-like) oil-bodies large but soon dissociating into numerous droplets. (From herbarium-specimen 15 days after collection; on ferns, Mt. Funakoshi, Okayama Co.; *S. H.*)

Cololejeunea spinosa (Horikawa) Pande et Misra (Pl. III, Figs. 6–8). Oil-bodies hyaline, 3–9 per cell, spherical to ovate, 2–4 \times 2–2.5 μ , almost homogeneous within; in basal cell near ocellus oil-bodies becoming larger and more or less similar to oil-bodies in ocellus, and often with recognizable minute granules within. In ocellus oil-bodies copious, grayish, 20–30 per cell, spherical to ovate, 3.5–4 μ long, with included 10–30 granules. (From fresh material and herbarium-specimen 45 days after collection; on ferns, ca. 20 m., Obi, Miyazaki Co.; Hitoyoshi, Kumamoto Co.; *S. H.*)

Cololejeunea biddlecomiae (Aust.) Underw. (Pl. XIII, Fig. 8; XIV, Figs. 6–8). (1.) Cells thin-walled, with small, concave-sided trigones and no intermediate thickenings, ca. 18–21 μ in leaf-middle. No ocelli. Oil-bodies ca. 7–12, occasionally 12–15 per cell, mostly subspherical and 2.2–2.5 μ , some broadly ellipsoidal and 2.2–5 μ , formed of numerous, scarcely perceptible, minute, scarcely protuberant spherules, thus faintly papillose in appearance under the highest powers (usually appearing nearly smooth and almost homogeneous) but not

25) Exceedingly similar to *C. minutissima*. As is evident from the descriptions of the oil-bodies of the latter, that species has segmented, relatively large oil-bodies, occurring few per cell. If the oil-bodies of *C. myriantha*, as figured and described by Arnell (1953), are those of living plants, the two species are quite different. However, it is very probable that the material from which the figure was drawn was derived from plants in which the oil-bodies had started to disintegrate.

segmented. Chloroplasts subequal to oil-bodies in size. (S 18325, Turkey Run State Park, Ind.; *R. M. S.*)

(2.) Cells of leaf-middle $16-18 \times 22-23 \mu$, extremely thin-walled, with no intermediate thickenings, with only minute trigones. Oil-bodies of median cells 4-8 (mostly 5-6), mostly ellipsoidal or ovoid to fusiform, ca. $2 \times 6 \mu$ to $2.5 \times 5 \mu$, or $3 \times 4.5 \mu$, occasional ones spherical and $2-3 \mu$, appearing nearly homogeneous (the included globules minute, near limit of visibility under oil, lying apparently in a matrix of nearly equal refractive index), at best very obscurely papillose in appearance. Chloroplasts $4-4.5 \mu$, more or less equal in size to the oil-bodies. (Hemlock Bluff, Wake Co., N. C.; *R. M. S.*)

(3.) Cells thin-walled, with minute trigones, $13-15 \times 15-20 \mu$ in leaf-middle. Each cell with (5) 7-12 (15-17) oil-bodies, these minute, appearing almost homogeneous but formed of obscurely visible globules, which do not protrude externally (the oil-bodies thus essentially smooth); oil-bodies short-ovoid to subspherical, and $2-2.5 \times 3 \mu$ to $3 \times 3.5 \mu$ to ellipsoidal and sublinear, and $1.8-2.2 \times 4-5 \mu$. Chloroplasts ca. 4μ long, averaging about equal in size to oil-bodies. (Lake Waccamaw, N. C., S 30021; *R. M. S.*)

Cololejeunea calcarca. Every cell with 7-17 glistening oil-bodies, pellucid, spherical to oval or rod-shaped, 2μ , with homogeneous contents. (Fide Müller, 1939; based on European material).²⁶⁾

Cololejeunea contractiloba Evs. (Pl. XIV, Figs. 3-5). (1.) Median cells thin-walled, with evident but concave-sided trigones; each cell with external (antical) face armed with a salient conical elevation; median cells ca. $14-15 \times 16-18 \mu$; intermediate thickenings absent; walls colorless. Ocelli absent. Oil-bodies rather small, mostly 3-4 per cell, varying from spherical and $2-3 \mu$ to ellipsoidal and $2.8-3 \times 5-5.5 \mu$. Each oil-body formed of numerous very small, rather difficultly evident, not distinctly protuberant spherules (thus not segmented), appearing at best faintly papillose because of the slight or vestigial protrusion of the individual oil-globules. Chloroplasts ca. $3-3.5 \mu$ long. (Juniper Springs, Fla., Dec. 22, 1951; *R. M. S.*)

(2.) Median cells $15-16 \mu$ wide $\times 20-23 \mu$ long, thin-walled, with obvious, but non-bulging, trigones. Ocelli absent. Oil-bodies typically 3-5 per cell, varying from short-ovoid and $2-2.5 \times 3-4 \mu$ to ellipsoidal or fusiform and $2 \times 5-9 \mu$, occasionally *Euglena*-like in shape. Each oil-body formed of numerous, very fine (less than 0.5μ), difficultly perceptible globules, appearing nearly smooth and nearly homogeneous under oil-immersion. Chloroplasts obviously smaller than oil-bodies. (Highlands Hammock, Fla., S 26004b; *R. M. S.*)

(3.) Median cells $15 \times 19-21 \mu$, thin-walled, with small trigones. Oil-bodies 3-7 per cell, occasionally only 2 per cell, mostly fusiform or narrowly ellipsoidal to sublinear, $1.8 \times 4 \mu$ to $1.8-2 \times 6 \mu$. Each oil-body coarsely segmented, formed

26) It seems probable to us that in this species, which is very closely related to *C. biddeco-miae* and is to be regarded as a sibling species more careful study would reveal that the oil-bodies are not homogeneous, but are formed of minute spherules. At any rate, the smaller oil-body size suggests that the differentiation of the two species has proceeded to the specific level. (*R. M. S.*)

either of a row of (2-3) 4-7 segments, or partially formed of 2 rows of segments. Chloroplasts $2.5-3 \mu$, smaller than oil-bodies usually. (Van Cleave, Miss., S 19230; *R. M. S.*)

Previously unknown north of Florida. The Mississippi plants quite typical, except for the coarsely segmented oil-bodies.

Cololejeunea diaphana Evs. (Pl. XV, Figs. 1-2). (1.) Median cells elongate-hexagonal, ca. $16-17 \mu$ wide \times $25-30 \mu$ long, very thin-walled, with minute trigones (often absent), and no intermediate thickenings; walls colorless. Oil-bodies broadly to narrowly ellipsoidal to fusiform, the larger $2.8 \times 3.6 \mu$ to $2.5 \times 6 \mu$, to a maximum of $2.8 \times 7 \mu$, composed of many small, rather inconspicuous, little protruding minute spherules (thus not segmented), occurring usually 4-9 per cell. Some cells with short-ellipsoidal to subspherical oil-bodies, 3μ to $2.8 \times 3.6 \mu$ in size. Chloroplasts ca. 3μ , averaging somewhat smaller than oil-bodies in size. (S 22692, Mathesson Hammock, Dade Co., Fla.; *R. M. S.*)

(2.) Median cells more or less elongate polygonal, $15-19 \mu$ wide \times $24-26 \mu$ long, very thin-walled, with vestigial trigones. Oil-bodies broadly to narrowly ellipsoidal to fusiform, from $2 \times 2.3 \mu$ to $2-3 \times 6 \mu$, composed of minute, scarcely protuberant, barely perceptible (under oil-immersion) spherules, appearing nearly homogeneous and slightly glistening, mostly 4-6 (8-9) per cell, short to elongate-ovate to fusiform. (S 26011, Highlands Hammock, Fla., *R. M. S.*)

Cololejeunea subdiaphana Jovet-Ast. Cells $14-16 \times 15-20 \mu$, with moderate to somewhat bulging trigones (and occasional, weakly defined, intermediate thickenings); cells of marginal row of free lobe, and of keelar region strongly conically elevated. Oil-bodies 4-8 per cell (10-14 in some elongate median cells), composed of minute, not protuberant globules, appearing faintly papillose, mostly ovoid to fusiform (ca. $2 \times 4-7 \mu$), but in some cells spherical (ca. $2-3 \mu$). (S 31407a; Clay Co., Florida; *R. M. S.*)

These plants are identical in all respects with *C. subdiaphana* Jovet-Ast (known only from the type, from the French Antilles). In another connection the senior author will attempt to show that this "species" probably represents only the xeromorphic extreme of *C. diaphana* Evs.

Cololejeunea subcristata Evs. (Pl. XIV, Figs. 9-10; XV, Figs. 3-4). (1.) Cells thin-walled, pellucid, the walls with distinct, but concave-sided trigones, and with very occasional to rare intermediate thickenings, ca. $17-19 \mu$, nearly isodiametric. Oil-bodies mostly 3-7 per cell, of the "grape-cluster" type, and moderate in size, very variable from one cell to the next, even within the same leaf. In some cells formed of 3-8 minute globules (less than 0.5μ in diameter) and then only $1.5-2 \mu$ in size, at most to 3μ long; in other (especially the larger) cells from $2 \times 4 \mu$ to a maximum of ca. $1.8-2 \times 6.5 \mu$, formed (in surface-view) of 8-16 globules; in other cells with nearly spherical oil-bodies, of larger globules to 1μ in diameter, the oil-bodies $1.8-2.2 \mu$, of 3-6 spherules; oil-bodies highly refractive, pellucid, colorless, the individual spherules strongly protuberant. Chloroplasts averaging nearly or quite as large as oil-bodies, mostly 2μ in diameter. Ocelli absent. (From material dry 4 days; S 22010, p. p., Long Key pineland, Florida, on leaves of *Coccolobis laurifolia*; *R. M. S.*)

(2.) Cells slightly thick-walled, with small trigones and no intermediate thickenings, 15–18 μ wide \times 18–23 μ long, little elongate. Oil-bodies 3–6 per cell, formed of 2–8 very coarse globules (each 1.5–2.5 μ in diameter), from 4 μ and nearly spherical (and of 2 globules) to 3 \times 7.5 or 4.5 \times 9 μ , and of 6–8 globules. (Long Key pineland, S 22032; *R. M. S.*)

(3.) Oil-bodies 3–7 per cell, formed of very large protuberant globules (thus appearing segmented), from 3.5 μ (then of 2 segments) to 3 \times 6 μ (of 3 segments), to 2 \times 12 μ (of 10–12 segments). In some cells consistently larger and up to 3 \times 15 μ (then linear, of a row of 10 globules or segments), or of fewer globules (then as little as 2.3 \times 6 μ). (From S 22590, Paradise Key, bark of Gumbolimbo; *R. M. S.*)

The oil-bodies of this species are extremely polymorphic, and thus cannot readily be used for its diagnosis, unless a series of plants are examined. Preliminary work indicates that variation from epiphyllous to corticolous types exists. The size, as is indicated, is extremely variable; therefore the only truly diagnostic features lie in the number (3–7, occasionally 10) and in the constantly segmented nature. Except for the epiphyllous material (S 22010), all plants examined showed coarsely segmented oil-bodies, with the segments or globules from 1.5–3 μ , occasionally greater, in diameter.

Aphanolejeunea sicaefolia (Gottsche) Evans (Pl. XV, Fig. 11). Median cells rectangular, strongly elongate, their external faces conically protuberant (the surface of the cone often thick-walled), ca. 12–14 μ wide \times 40–46 μ long; marginal cells of about the same width, only ca. one-half as long as median cells; cell-walls thin, with trigones absent or vestigial; no clear intermediate thickenings. Oil-bodies of the elongate median cells 10–15 (18) per cell, usually spherical and 2–3.2 μ , a very few cells with some ovoid or ellipsoidal, to 3 \times 5 μ ; oil-bodies formed of a limited number of ill-defined, faintly discernible globules (less than 0.8 μ), which scarcely protrude through the external membrane — thus appearing superficially homogeneous. Chloroplasts averaging subequal to oil-bodies, 2–2.6 μ in diameter. (On leaves of *Hymenophyllum*, El Yunque, Puerto Rico; *R. M. S.*)

Aphanolejeunea evansii Schuster (The Bryologist, 1954). (Pl. XV, Fig. 5). Cells extremely leptodermous, without discrete trigones or any trace of intermediate thickenings, the walls colorless; median cells elongate, ca. 14–16 \times 25–35 μ ; cells near margins irregularly quadrate-polygonal, 16–18 \times 18–20 μ . Median elongate cells with 5–12 oil-bodies per cell, near and in margins 4–6 (10) per cell. Oil-bodies minute, mostly spherical (and ca. 1.6–2 μ) to short-ovoid (and 1.7 \times 3 μ), a few to ellipsoidal and 2 \times 4.5 μ to 1.8 \times 5 μ , appearing nearly smooth, but under high power composed of a discrete number of approximately equal, small spherules (at or near the limit of visibility at 950 \times), which do not distinctly protrude through the common membrane; the oil-body therefore appears to be virtually smooth. Chloroplasts relatively small, but as large or larger than oil-bodies. (Long Key pineland, Fla.; S 22029a; *R. M. S.*)

Aphanolejeunea ephemerooides Schuster (MS). (1.) Cells pellucid, extremely leptodermous, devoid of trigones, 10–15 \times 15–20 μ medially. Oil-bodies vir-

tually homogeneous in appearance (under oil-immersion evidently formed of exceedingly fine globules, less than $0.5-0.7 \mu$ in diameter, which do not protrude through the extremely delicate bounding membrane); 4-9 oil-bodies per marginal cell, (4) 6-12 per median cells, spherical and $2-2.5 \mu$ to (more often) ovoid to fusiform and $1.5 \times 2-2.5$ to $2 \times 4 \mu$. Chloroplasts subequal in size to oil-bodies, ca. $3 \times 2.5 \mu$. (S 31405, Clay Co., Fla.; *R. M. S.*)

(2.) Cells all conically armed on mature lobes, $10-14 \times 14-17 \mu$ medially; each cell with 2-4 oil-bodies per cell, the oil-bodies glistening and smooth (virtually homogeneous), $1.5-2 \times 2-3 \mu$ and ovoid, some fusiform to sublinear and $1.2-1.5 \times 4-5 \mu$. (S 31407, Clay Co., Fla.; *R. M. S.*)

This new species is being described in another connection. It is closely related to *A. gracilis* Jovet-Ast and *A. verrucosa* Jovet-Ast, from the French Antilles.

Leptocolea goebelii (G.) Evs. Oil-bodies hyaline, 5-10 per marginal cell, ovate or mostly spherical, 8-14 per middle cell, ovate or mostly oblong-fusiform, 12-22 per basal cell, oblong-fusiform; $3-8 \times 3 \mu$ in size, containing several to 15 minute and indistinct granules within (or almost unrecognizable in small, spherical oil-bodies.). (From fresh material and herbarium-specimens 70 days after collection; on leaves, ca. 500 m. alt., Nakago, Miyazaki Co.; on barks, 600 m., Hitoyoshi, Kumamoto Co.; *S. H.*)

Leptocolea dolichostyla Herz. Oil-bodies hyaline, 10-15 per cell, spherical to oblong to oblong-fusiform, $3-8 \times 3 \mu$, with included 10-15 granules, but in small, spherical oil-bodies, granules indistinct or not recognizable. (From fresh material; on ferns, ca. 20 m., Obi, Miyazaki Co.; *S. H.*)

Leptocolea horikawana Hatt. Oil-bodies mostly dissociated to minute droplets, but seemingly same as those of *L. dolichostyla* Herz., the preceding species. (From herbarium-specimen ca. 150 days after collection; on rocks, Mt. Kaimon, Kagoshima Co.; *S. H.*)

Leptocolea japonica Schffn. Oil-bodies hyaline, 10-20 or occasionally 30 per cell, spherical to oblong-ovate, $4-7 \times 3.5-4.5 \mu$, with included 15-20 granules. (From herbarium-specimens 30 and 35 days after collection; on limestone, ca. 100 m. alt., Koonose, Kumamoto Co.; on barks, ca. 600 m., Hitoyoshi; *S. H.*)

Leptocolea longilobula Horikawa (Very closely related to the preceding *L. japonica*). Oil-bodies 10-20 per cell, same as those of *L. japonica*. (From herbarium-specimen 25 days after collection; on barks, ca. 200 m., Koonose, Kumamoto Co.; *S. H.*)

Leptocolea miyajimensis Horikawa var. *microdonta* Hatt. (This species closely related to *L. tonkinensis* St.) (Pl. III, Figs. 10-12). Oil-bodies hyaline, 6-14, mostly ca. 10, per median cell, ovate to oblong, rarely rotundate, 10-25 (mostly ca. 15) per basal elongate cell, oblong to oblong-fusiform, 4-6 per marginal cell adjacent to limb (composed of rectangular, hyaline and vacuous cells), smaller, spherical to ovate, often dissolving into droplets; mostly $6-10 \times 3.5-4 \mu$ (with included ± 20 granules), or ca. 4μ in diameter, in spherical oil-bodies (with included 3-4 indistinct granules). (From fresh material; on leaves, ca. 500 m., Nakago, Miyazaki Co.; do. ca. 300 m., Sakatani; *S. H.*)

Leptocolea nakaii Horikawa (Allied to *L. lanciloba* St.). Oil-bodies hyaline, copiously present, 6–20 per cell, or 20–30 per basal elongated cell, spherical or ovate or oblong-fusiform, or 6–8 per outer cell adjacent to limb; 4–12 × 4–5 μ in size, compound, with 5–20 granules (ca. 1.5 μ in diam.). (From herbarium-specimen 60 days after collection; on barks, ca. 10 m. alt., Isl. Biro, Kagoshima Co.; *S. H.*)

Leptocolea aoshimensis Horikawa (Pl. III, Fig. 9). Oil-bodies mostly 5–10 (3–17) per cell, hyaline, spherical or mostly ovate-oblong (\pm of grain-like shape), 4–10 × 4 μ , with 10–20 granules (each 1 μ or less in diam.). (From herbarium-specimen 5 days after collection; on limestone and barks, ca. 50 m., near sea-shore, Inasa, Kochi Co.; *S. H.*)

Leptocolea ciliatlobula Horikawa (Pl. III, Figs. 13–14). Oil-bodies 20–30 per middle cell, to ca. 50 per basal cell, but almost disappearing in marginal cells, hyaline, mostly ovate, 2.5–3.5 × 1.8 μ , or in marginal cells often rotundate, 1.3–2 μ in diameter; granules indistinct (less than ca. 10). (From fresh material; on leaves, ca. 30 m. alt., Obi, Miyazaki Co.; *S. H.*)

Leptocolea scabrifolia (Gottsche) Evs. Cells with (5) 6–7 (8) oil-bodies, 7–9 μ long, formed of 6–8 spherical globules (thus distinctly segmented). (West Indies; fide *Jovet-Ast*).

Leptocolea cardiocarpa (Mont.) Evs. (Pl. XV, Figs. 6–10). (1.) Cells rather translucent, with colorless, thin walls lacking discrete intermediate thickenings (but often with portions of the walls slightly unevenly thicker-walled), and with small (concave) trigones. Oil-bodies quite variable. Mostly 12–18 oil-bodies per cell, and these often spherical to short-ovoid, 2–3 μ to 2.5–3 × 4 μ , formed mostly of many small, moderately protuberant oil-globules (in a few cases the smallest homogeneous, or formed of only 2–5 globules, and then distinctly segmented in appearance); the largest oil-bodies (which are much in the minority), of many smaller globules, each somewhat protuberant, up to 2 × 6, rarely 2.2 × 7 μ . (S 22010a, Long Key, Everglades, Fla.; *R. M. S.*)

(2.) In material from near Ocean Springs, Mississippi (on bark of *Quercus virginiana*), cells more uniform, 15–17 μ wide × 18–23 μ long; all oil-bodies formed of nearly similar, small, moderately protuberant globules, the oil-bodies thus of the “grape-cluster” type, none homogeneous; in some cells 6–8 oil-bodies, then 2–2.5 × 3–4.5 μ ; in other cells only 3–6 oil-bodies, all or some of which then 2.8 × 6 to 3 × 7 μ , elliptical to bacilliform. Chloroplasts moderately numerous, not making the cells notably opaque, mostly 3–3.5 μ . (*R. M. S.*)

(3.) Median cells ca. 20 × 24 μ , thin-walled with minute trigones. Oil-bodies ca. 7 per cell, narrowly fusiform to sublinear, ca. 1.8 × 6 to 2 × 7 μ , formed of 2–3 rows of globules 0.8–0.9 μ in diameter or less; individual globules relatively coarse (compared to oil-body size), strongly protruding, the oil-body thus of the segmented type). (S 22680, Loveland Hammock, Fla.; *R. M. S.*)

(4.) Median cells 16–17 × 19–22 μ , thin-walled but with distinct, concave-sided trigones and occasional intermediate thickenings. Oil-bodies mostly 3–5 per cell, linear to narrowly fusiform, formed of 1–2 rows of coarse, protruding globules 0.8–1.5 μ in diameter, thus segmented; oil-bodies ca. 1.5 × 6 μ to 1.8 ×

8 μ . Chloroplasts scarcely or not greater in area than oil-bodies, ca. 3–3.5 μ in longer diameter. (S 22590, Florida; *R. M. S.*)

(5.) Median cells ca. 16–20 \times 26–30 μ , thin-walled with small trigones but frequent intermediate thickenings (the longitudinal walls sometimes somewhat wavy). Oil-bodies very variable; up to 12–15 per cell, distinctly segmented, the globules usually less than 0.6 μ . Smaller oil-bodies ca. 2–3 μ and spherical, larger to 2 \times 6–7 μ and ellipsoidal. Some cells with several, spherical, 2–5 segmented oil-bodies and several ellipsoidal, elongate, many-segmented oil-bodies within the same cell. Chloroplasts ca. 3–3.5 μ . (Paradise Key, Fla.; *R. M. S.*)

(6.) Cells with oil-bodies as in *L. scabrifolia* (Martinique; fide *Jovet-Ast*).

The strong tendency for the formation of segmented oil-bodies composed of a very large number of small, usually less than 0.8 μ , oil-globules, often apparently over 40–50 of these globules visible in surface view, will separate *Lep- tocolea cardiocarpa* from all of the nearctic and neotropical species of *Cololeje- unea* known to the writer. In the material from leaves of *Coccolobis* (S 22010a) the antical margin of some (but never all) leaves is provided with a hyaline border of dead, empty, transparent cells, 1, occasionally 2 cells wide; this border (unlike the somewhat similar West Indian *L. planifolia* Evs.) is never continuous but ends before the leaf-apex. In this collection (clearly autoecious), the distal finger-like hyaline cells of the apices of the dorsal lobe are also exceedingly well-developed. It would appear that the development of a large group of dead distal cells (and the more rare development of a border of dead hyaline cells of the antical margin) is correlated largely with epiphyllous occurrence, while in corticolous material (as from Ocean Springs, Miss.), the antical border is quite lacking, while the distal group of finger-like hyaline cells is quite rare, absent on most leaves, often reduced to 1–2 cells, only occasionally with 3–4 such cells differentiated.

Taeniolejeunea oshimensis (Horikawa) Hatt. (Pl. III, Figs. 15–19). In middle of leaf, oil-bodies 2–3 per cell, hyaline, narrowly oblong-fusiform, ca. 6 \times 2.5 μ (rarely 9 μ long), formed of 10–15 granules (1 μ in diam.), or occasionally several granules aggregated to form an almost spherical body (2–3.8 \times 2–3 μ in size). Towards the basal cell, adjacent to ocellus, oil-bodies larger, often 3 or more, oblong-fusiform 11 \times 3 μ or more in size, formed of 20–25 granules. Towards the marginal cell adjacent to limb, oil-bodies smaller, droplet-like or disappearing. In ocellus, oil-bodies \pm grayish, ca. 10 or often 20–30 per cell, 8–10 \times 4–5 μ , segmented (of “grape-cluster” type), formed of ca. 10 large granules (ca. 2 μ in diam.); or of \pm smaller but numerous granules; or often rotundate in outline, ca. 5 μ in diameter, formed of several granules; soon dissociating and disappearing. (From fresh material; on leaves, ca. 300 m., Sakatani, Miyazaki Co.; *S. H.*)

Taeniolejeunea pseudofloccosa (Horikawa) Hatt. (Pl. III, Figs. 23–24). In ocellus, oil-bodies 10–15, \pm grayish, ovate (grain-like in shape), ca. 7 \times 4 μ or rotundate, 4–5 μ in diameter; compound, \pm segmented, globules small and numerous. In median, ordinary cell, oil-bodies few, minute, hyaline; towards the cell adjacent to ocellus oil-bodies more or less similar to those of ocellus; on

the other hand, towards the marginal cells, oil-bodies becoming minute, droplet-like or almost disappearing. This species has two distinct ocelli in a row at the base of the leaf, although nothing was said about the presence of ocelli in the description of the present species. (From herbarium-specimen 50 days after collection; on barks, 750 m. alt., Mt. Ichifusa, Kumamoto Co.; *S. H.*)

Taeniolejeunea ocelloides (Horikawa) Hatt. (Pl. III, Figs. 21-22). Oil-bodies in ocellus 8-12, elliptical, $10-13 \times 6 \mu$, grayish, compound, granules numerous and dense, ca. 1μ in diameter. Oil-bodies in median cells minute and hyaline. (From specimens 50 and 80 days after collection; on barks, ca. 1000 m. alt., Mt. Ohira, Kumamoto Co.; do., ca. 600 m., Hitoyoshi; *S. H.*)

Taeniolejeunea peraffinis (Schiffn.) Zwick. Oil-bodies ca. 10 per cell, hyaline, minute, droplet-like, $1-2 \mu$ in diameter; but towards ocellus more or less larger and similar to those in ocellus. In ocellus oil-bodies very copious, 10-15 filling ocellus, grayish, compound, $5-8 \times 5 \mu$, or occasionally smaller, granules minute and indistinct. (From fresh material; on barks of *Cryptomeria japonica*, ca. 30 m. alt., Obi, Miyazaki Co.; *S. H.*)

Taeniolejeunea appressa (Evs.) Zwick. (Pl. III, Fig. 20). Ocellus almost filled with 2-3, rarely 5, grayish oil-bodies; oil-bodies large, $20-30 \times 12-15 \mu$, or often aggregated into one large mass ca. $30-40 \times 20 \mu$, compound, globules numerous and dense, ca. 1μ in diameter. In ordinary cell, oil-bodies 1-10 (or rarely invisible) per cell, hyaline, mostly spherical to ovate, minute, $2-4 \times 2-3 \mu$; towards the basal cells adjacent to ocellus, oil-bodies becoming larger and recognizable, with minute granules within. (From fresh material and specimens 15 and 45 days respectively after collection; on barks, ca. 400 m. alt., Sakatani, Miyazaki Co.; ca. 700 m., Hitoyoshi, Kumamoto Co.; *S. H.*)

Taeniolejeunea floccosa (L. et L.) Zwick. Ocellus almost filled with 6-10 or occasionally more oil-bodies; oil-bodies of ocellus gray, ovate to oblong (\pm fusiform), large, $15-20 \times 7-8 \mu$, or rarely rotundate; compound, globules numerous and coarse. In ordinary cell of lamina oil-bodies few, minute, hyaline, nearly spherical, ca. $0.5-2 \mu$ in diameter, but towards the basal cells adjacent to ocellus, oil-bodies larger ($6 \times 3 \mu$) and \pm similar to those of ocellus. The present species has 4 distinct ocelli in a row, each ocellus elongate, $40 \times 20 \mu$. (From specimens 60 days after collection; on bases of trees, ca. 200 m. alt., Mt. Kasuga, Nara Co.; on leaves, 150 m., Ichibu, Kumamoto Co.; *S. H.*)

Taeniolejeunea verdoornii Hatt. Ocellus almost filled with large, compound oil-bodies; oil-bodies of ocellus grayish, 10-20 per cell, ovate to oblong, $7-10 \times 4-5 \mu$, rarely rotundate, $4-5 \mu$ in diameter, globules numerous and dense. In median cell, oil-bodies hyaline, 4-7 per cell, less than $5.5 \times 3 \mu$ in size, oblong (\pm fusiform) or occasionally rotundate-ovate, containing 10-20 minute globules (1μ or less in diam.); towards marginal cells, oil-bodies becoming scarce, minute, drop-like, ca. 1μ in diameter, but in the other direction, oil-bodies in basal cells near ocellus \pm similar to those of ocellus. (From specimens 50 days after collection; on barks, ca. 600 m. alt., Mt. Ichifusa, Kumamoto Co.; *S. H.*)

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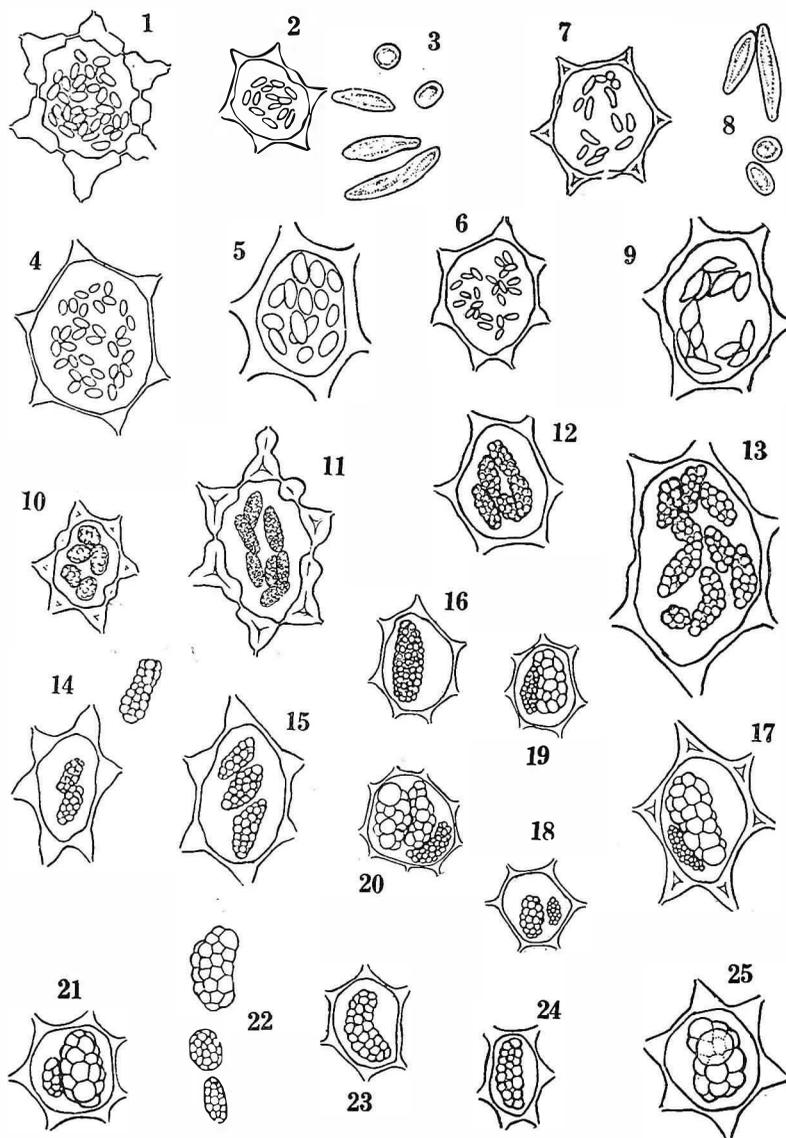


Plate I. *Spruceanthus semirepandus*, 1 ($\times 550$). *Spruceanthus polymorphus*, 2 ($\times 550$), 3 ($\times 1430$). *Brachiolejeunea sandvicensis*, 4 ($\times 550$). *Archilejeunea kiushiana*, 5 ($\times 1170$). *Ptychocoleus nipponicus*, 6 ($\times 550$). *Lopholejeunea formosana*, 7 ($\times 550$), 8 ($\times 1430$). *Lopholejeunea nipponica*, 9 ($\times 950$). *Ptychanthus striatus* var. *perrottetii*, 10, 11 ($\times 550$). *Tuzibeanthus porelloides*, 12 ($\times 550$), 13 ($\times 950$). *Mastigolejeunea liukuensis* var. *mayebarae*, 14–15 ($\times 550$). *Leucolejeunea xanthocarpa*, 16 ($\times 550$). *Pycnolejeunea tosana*, 17–18 ($\times 550$). *Pycnolejeunea obtusilobula*, 19–20 ($\times 550$). *Euosmolejeunea osumiensis*, 21–23 ($\times 550$). *Euosmolejeunea ontakensis*, 24 ($\times 550$), 25 ($\times 730$).

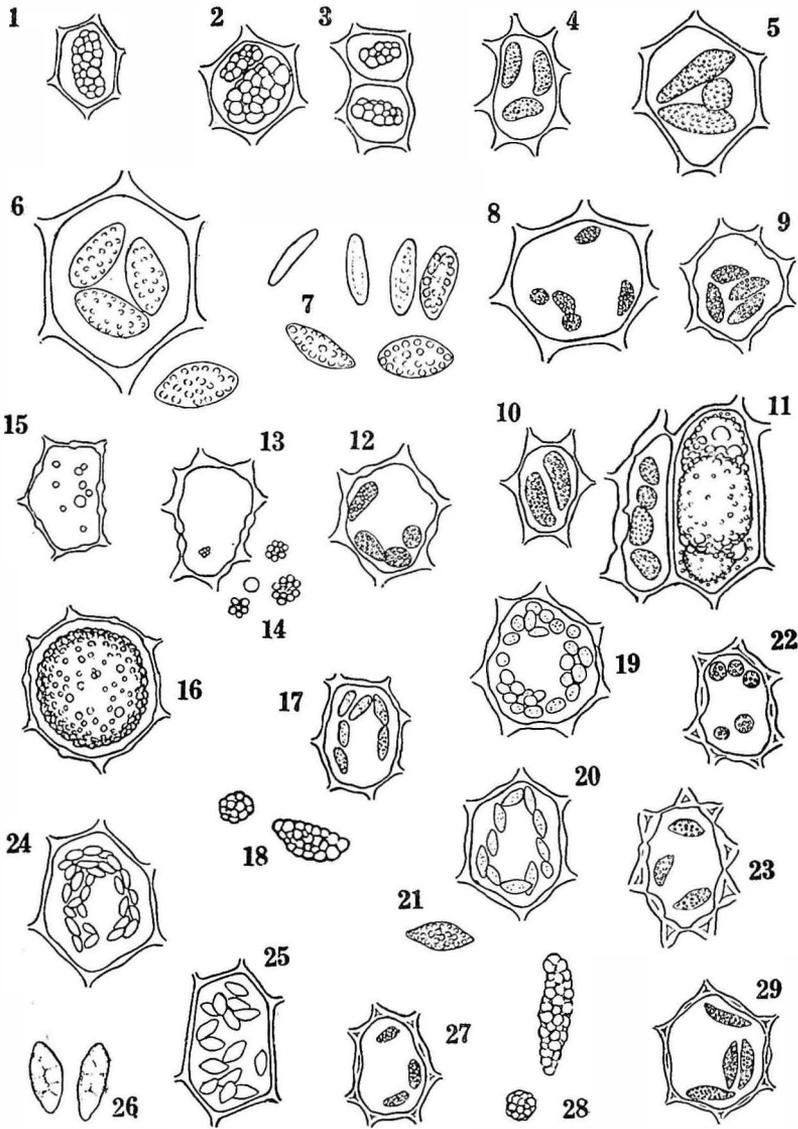


Plate II. *Euosmolejeunea nipponica*, 1 ($\times 550$). -Var. *calcicola*, 2-3 ($\times 550$).
Euosmolejeunea obtusifolia, 4 ($\times 550$), 5 ($\times 900$). *Nipponolejeunea pilifera*, 6-7 ($\times 1170$).
Nipponolejeunea subalpina, 8 ($\times 900$). *Drepanolejeunea japonica*, 9-10 ($\times 550$), 11 (ocellus
and its adjacent cell, $\times 550$). *Drepanolejeunea tenuis*, 12 ($\times 550$). *Harpalejeunea*
intermedia, 13 ($\times 550$), 14 ($\times 1170$). *Leptolejeunea subacuta*, 15 ($\times 550$), 16 (ocellus, \times
550). *Lejeunea boninensis*, 17 ($\times 550$), 18 ($\times 1430$). *Lejeunea vaginata*, 19-20 (\times
550), 21 ($\times 1170$). *Lejeunea flava*, 22-23 ($\times 550$). *Lejeunea japonica*, 24 ($\times 550$).
Lejeunea aquatica, 25 ($\times 550$), 26 ($\times 1170$). *Microlejeunea rotundistipula* var. *pallida*,
27 ($\times 550$), 28 ($\times 1430$). *Microlejeunea punctiformis*, 29 ($\times 550$).

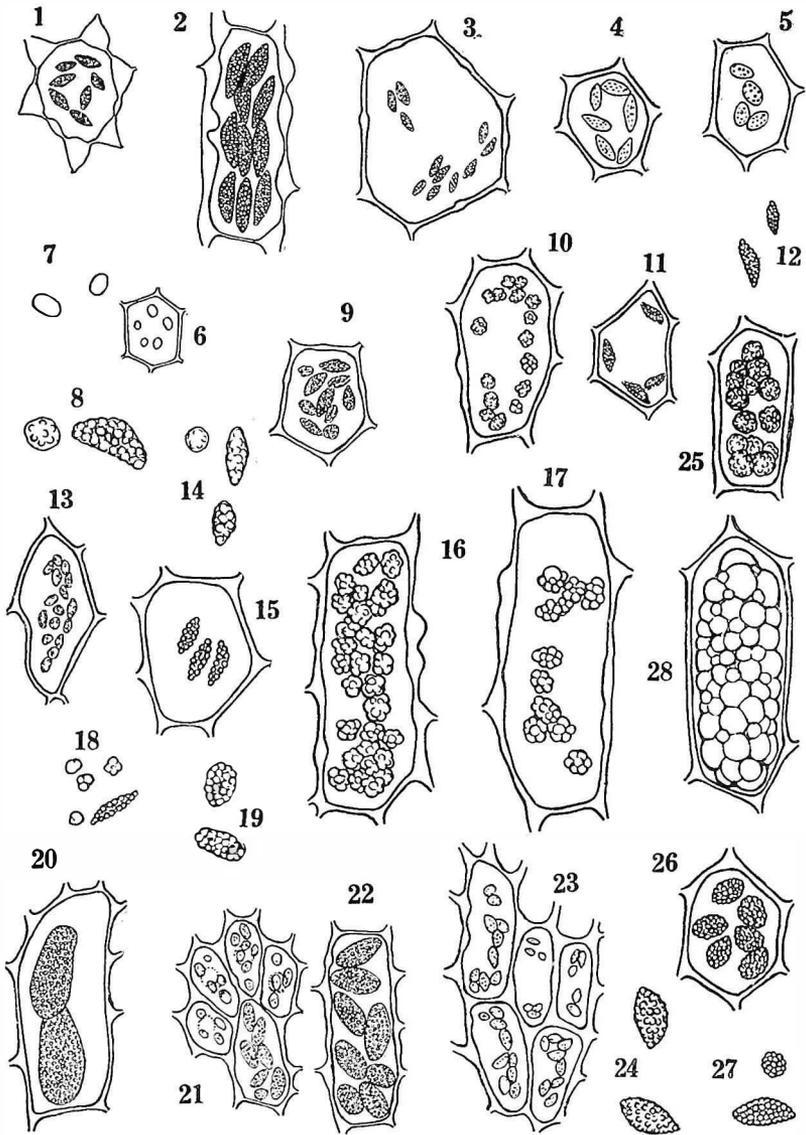


Plate III. *Tuyamaella molischii*, 1 ($\times 550$), 2 (elongated basal cell, $\times 550$). *Cololejeunea minuta*, 3 ($\times 550$). *Cololejeunea rupicola*, 4 ($\times 730$). *Cololejeunea shikokiana*, 5 ($\times 1430$). *Cololejeunea spinosa*, 6 ($\times 550$), 7 ($\times 1170$), 8 (oil-bodies from ocellus, $\times 1170$). *Leptocolea aoshimensis*, 9 ($\times 550$). *Leptocolea miyajimensis* var. *microdonta*, 10-12 ($\times 550$). *Leptocolea ciliatlobula*, 13 ($\times 550$), 14 ($\times 1430$). *Taeniolejeunea oshimensis*, 15 ($\times 1170$), 16 (ocellus, $\times 550$), 17 (ocellus, $\times 730$), 18 ($\times 1180$), 19 (oil-bodies from ocellus, $\times 730$). *Taeniolejeunea appressa*, 20 (ocellus, $\times 730$). *Taeniolejeunea ocelloides*, 21 ($\times 550$), 22 (ocellus, $\times 550$). *Taeniolejeunea pseudofloccosa*, 23 (two indistinct ocelli and three adjacent cells, $\times 550$), 24 (two oil-bodies from ocellus in fig. 23, $\times 1430$). *Drepanolejeunea foliicola*, 25-27 ($\times 730$), 28 (ocellus, $\times 730$).

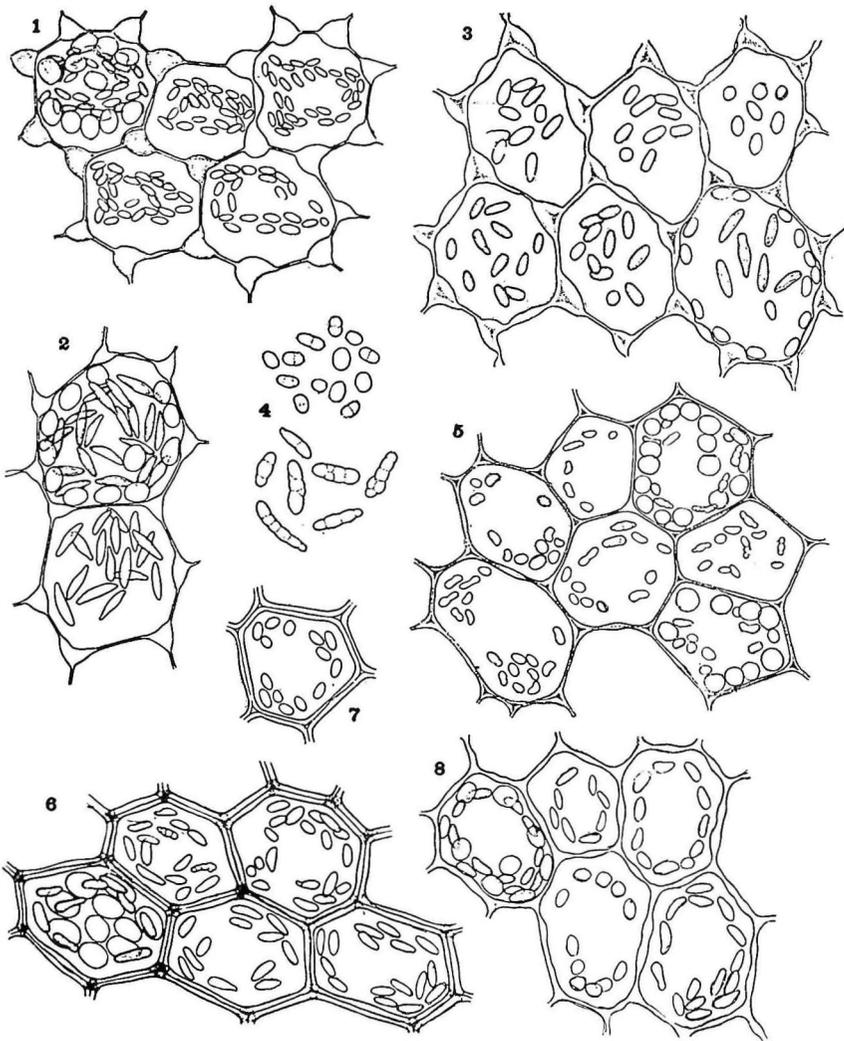


Plate IV. *Brachiolejeunea bahamensis*, 1 ($\times 551$), 2 ($\times 754$). *Ptychocoleus heterophyllus*, 3 ($\times 660$). *Lopholejeunea muelleriana*, 4 (individual oil-bodies, $\times 1285$), 5 ($\times 500$), 6 ($\times 791$), 7 ($\times 791$). *Lopholejeunea subfusca*, 8 ($\times 633$).

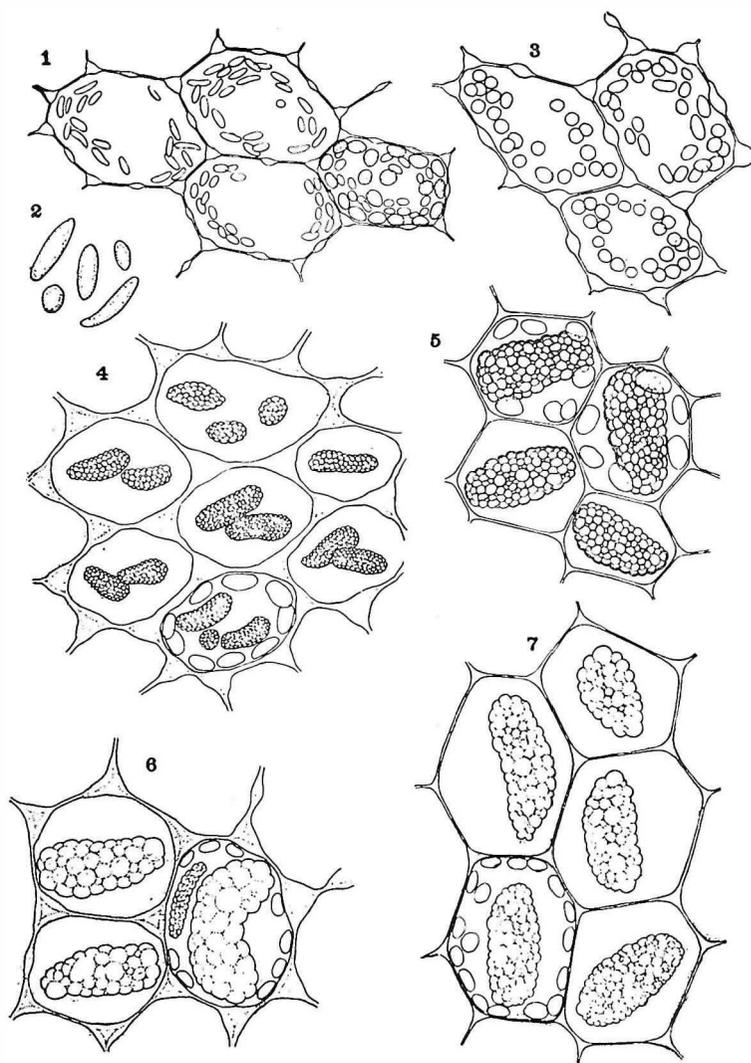


Plate V. *Caudalejeunea lehmanniana*, 1 ($\times 680$), 2 (individual oil-bodies, $\times 1428$), 3 ($\times 702$). *Mastigolejeunea auriculata*, 4 ($\times 1047$). *Leucolejeunea clypeata*, 5 ($\times 725$). *Leucolejeunea xanthocarpa*, 6 ($\times 822$). *Leucolejeunea conchifolia*, 7 ($\times 876$).

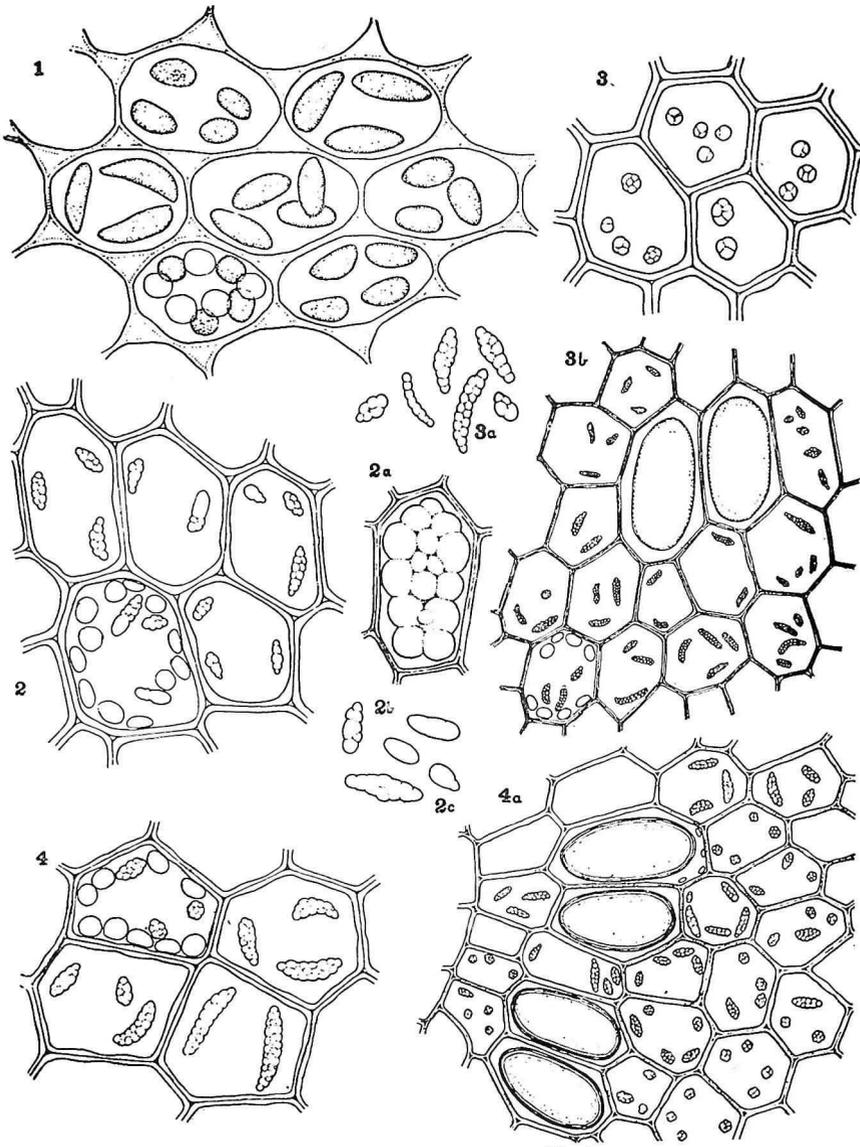


Plate VI. *Neurolejeunea breutelii*, 1 ($\times 969$). *Ceratolejeunea guianensis*, 2 ($\times 977$), 2a (ocellus, $\times 977$), 2b, 2c (oil-bodies from 2 adjacent cells, $\times 1600$), 3 (median cells, $\times 844$), 3a (individual oil-bodies, $\times 1416$), 3b (basal cells, $\times 579$). *Ceratolejeunea cubensis*, 4 (median cells, $\times 866$), 4a (basal cells, $\times 413$).

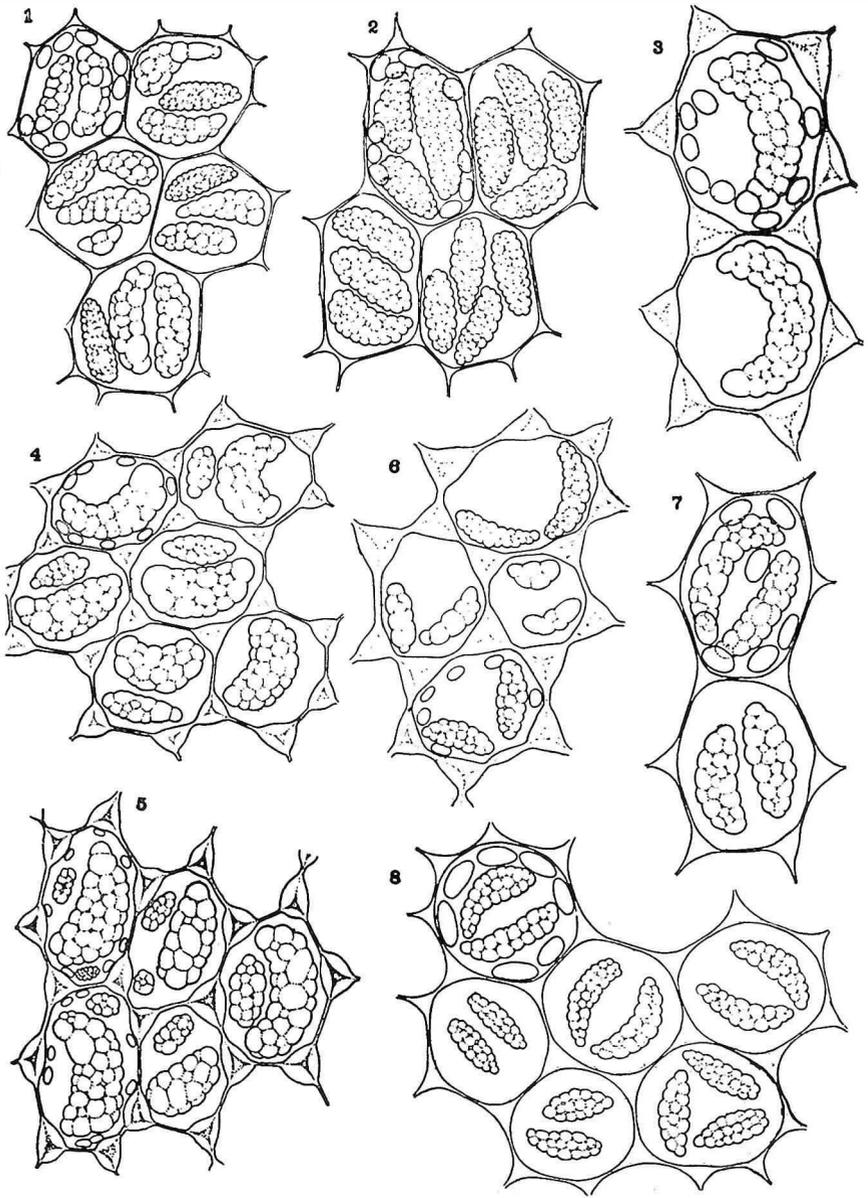


Plate VII. *Euosmolejeunea polyantha*, 1 ($\times 713$), 2 ($\times 833$). *Euosmolejeunea clausa*, 3 (same collection as in Fig. 7, $\times 1120$), 4 ($\times 637$), 5 ($\times 682$). *Euosmolejeunea rigidula*, 6 (xeromorphic, microphyllous form, $\times 941$), 7 (same collection as Fig. 3, $\times 1120$), 8 ($\times 1100$).

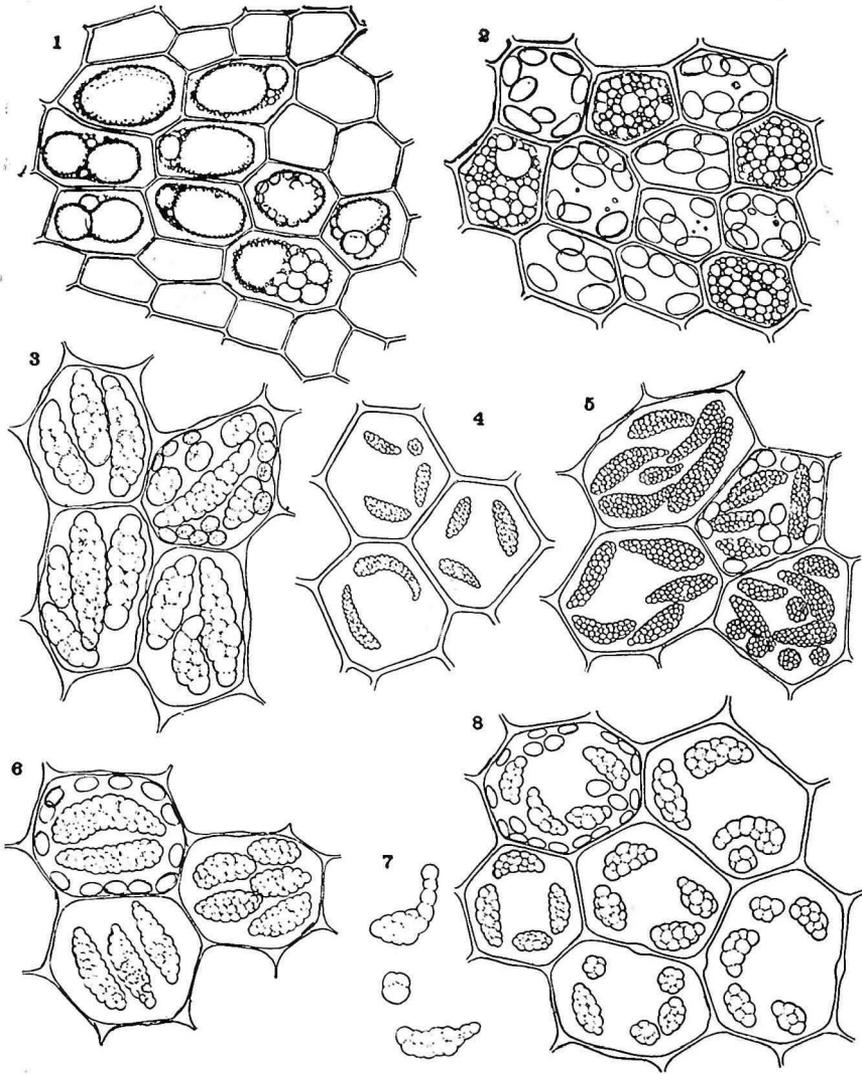


Plate VIII. *Rectolejeunea berteriana*, 1 (basal cells, $\times 552$), 2 (median cells, $\times 839$).
Cheilolejeunea decida, 3 ($\times 843$). *Rectolejeunea maxonii*, 4 (xeric phase, $\times 739$), 5 (shade
 form, $\times 860$). *Rectolejeunea brittoniae*, 6 (typical plants, $\times 1000$), 7 (individual oil-
 bodies, $\times 750$), 8 ($\times 714$).

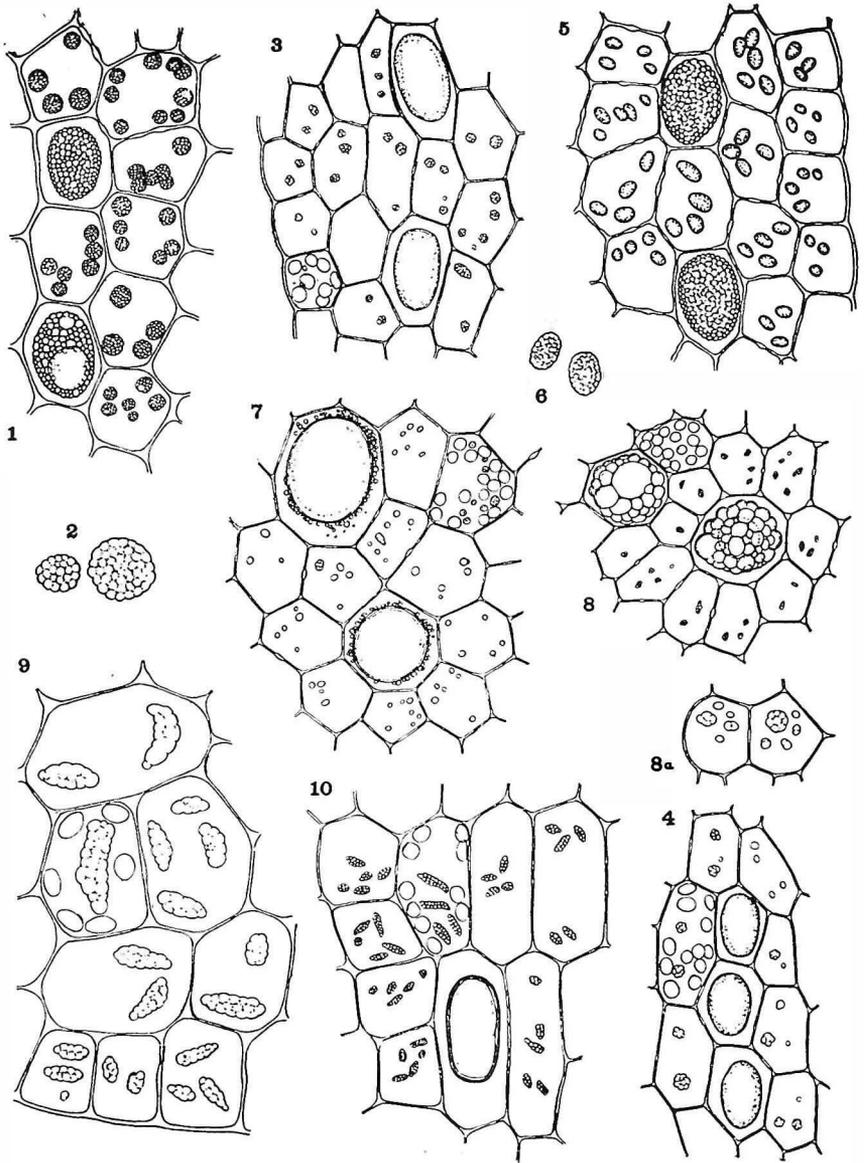


Plate IX. *Drepanolejeunea hamatifolia* (leg. E. W. Jones), 1 ($\times 509$), 2 (oil-bodies, $\times 1454$). *Drepanolejeunea bidens* (S 19240), 3 ($\times 540$), 4 ($\times 682$). *Drepanolejeunea bidens* ssp. *appalachiana* (S 28894), 5 ($\times 507$), 6 (two oil-bodies, $\times 1050$). *Leptolejeunea elliptica* (S 22010), 7 (median cells, $\times 666$), 8 (cells from upper half of young leaf, $\times 507$), 8a (two marginal cells, $\times 507$). *Harpalejeunea ovata*, 9 (cells, with margin of leaf below, $\times 1000$), 10 (cells just above base, $\times 619$).

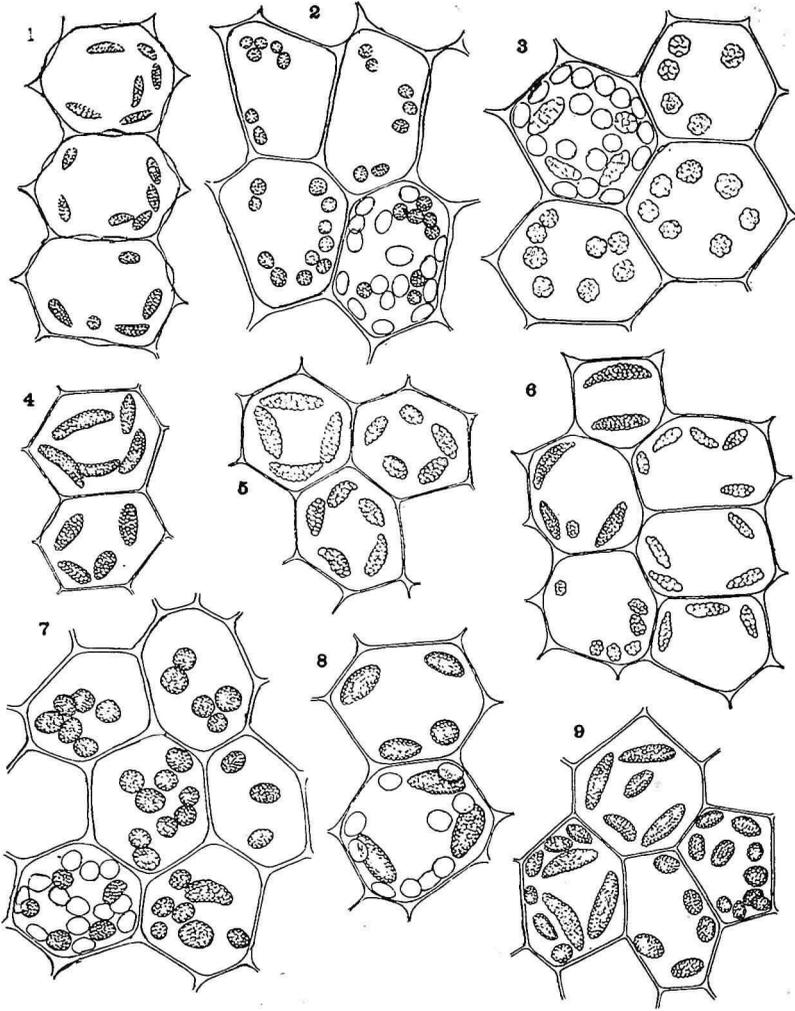


Plate X. *Lejeunea flava*, 1 ($\times 781$), 2 ($\times 672$). *Lejeunea cladogyna* (S 22061), 3 ($\times 868$). *Lejeunea caroliniana* (Type), 4 ($\times 520$), 5 ($\times 516$). *Lejeunea patens*, 6 ($\times 533$), 7 ($\times 686$), 8 ($\times 795$). *Lejeunea floridana*, 9 ($\times 600$).

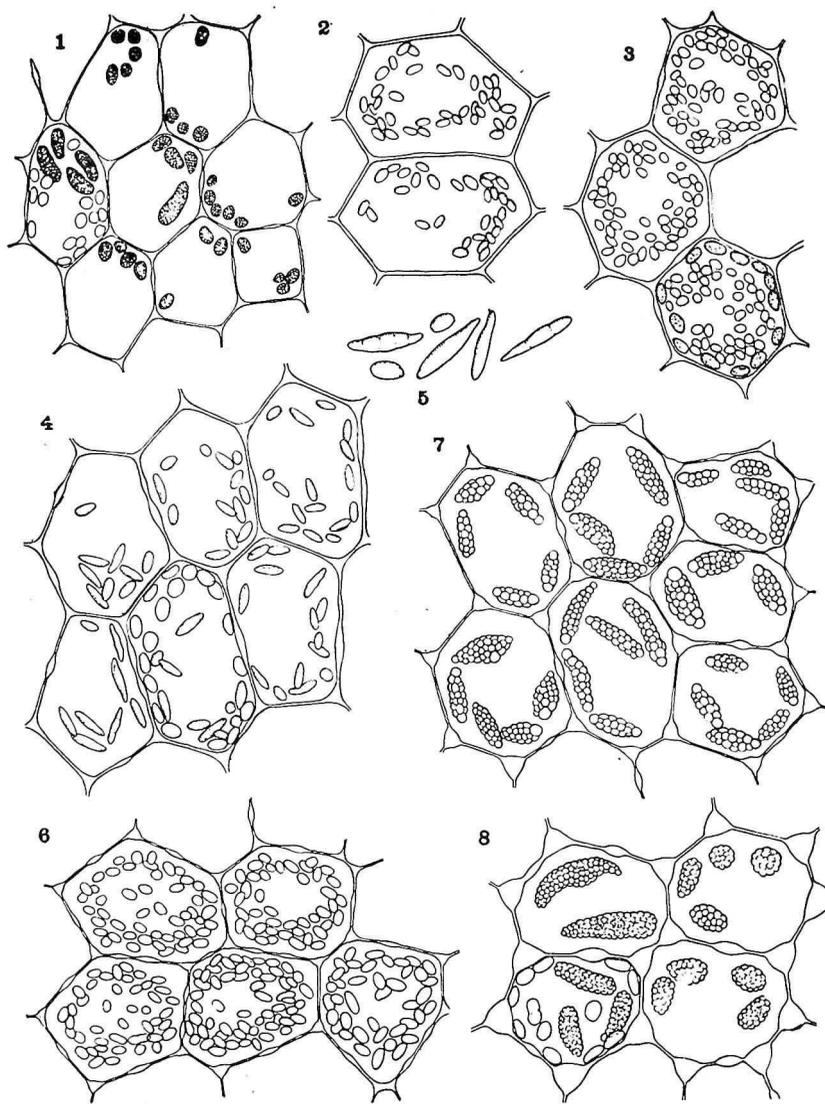


Plate XI. *Lejeunea patens*, 1 ($\times 500$). *Lejeunea cavifolia*, 2 ($\times 794$), 3 ($\times 603$).
Lejeunea glaucescens, 4 ($\times 692$), 5 (individual oil-bodies, $\times 1333$). *Taxilejeunea obtus-*
angula, 6 ($\times 815$). *Crossotolejeunea bermudiana*, 7 ($\times 587$), 8 ($\times 750$).

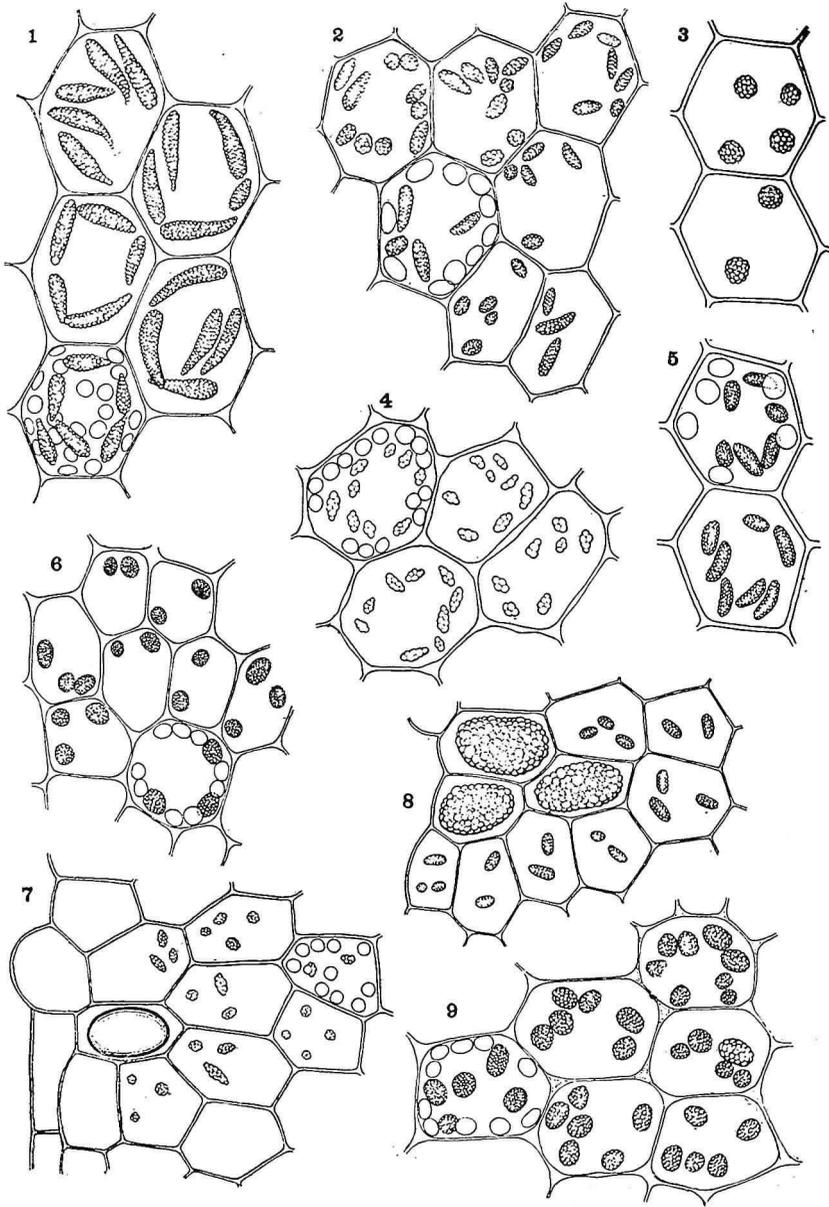


Plate XII. *Stylolejeunea spiniloba*, 1 ($\times 710$). *Microlejeunea lactevirens*, 2 ($\times 823$), 3 ($\times 1000$), 4 ($\times 566$), 5 ($\times 760$). *Microlejeunea ruthii*, 6 ($\times 466$). *Microlejeunea ulicina*, 7 (basal cells with one ocellus, at asterisk the free dorsal base, $\times 644$), 8 (same, with 3 ocelli, at asterisk the free dorsal base, $\times 625$), 9 (median cells, $\times 783$).

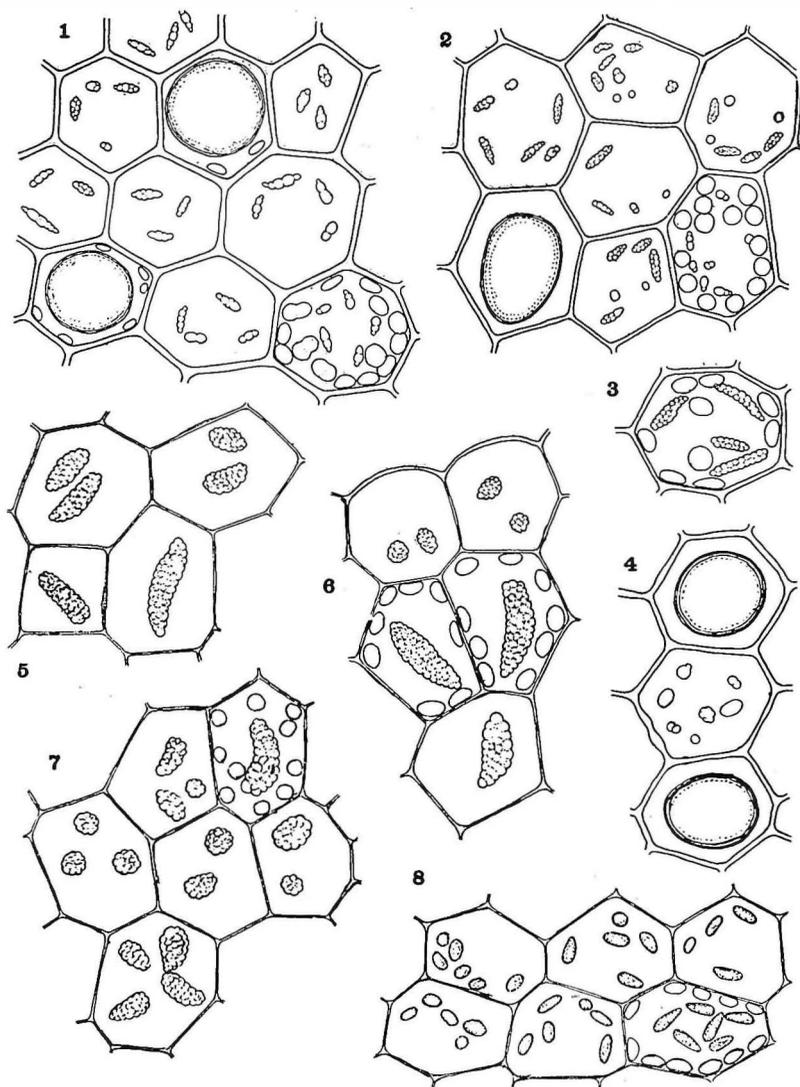


Plate XIII. *Diplasiolejeunea rudolphiana*, 1 ($\times 653$), 2 ($\times 666$), 3 ($\times 653$), 4 ($\times 666$).
Cololejeunea minutissima, 5 (Myriocarpa-type, median cells, $\times 800$), 6 (same, antical cells
near leaf-middle, $\times 843$), 7 ($\times 703$). *Cololejeunea biddlecomiae*, 8 ($\times 671$).

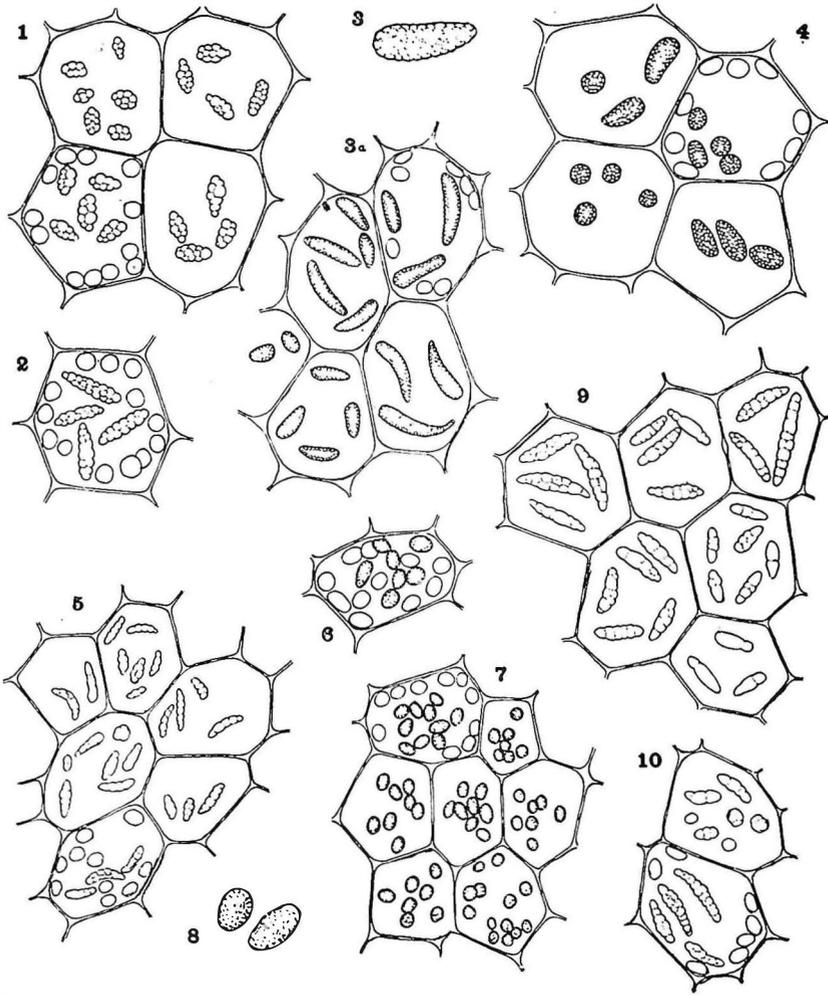


Plate XIV. *Cololejeunea minutissima*, 1 (*minutissima*-type, $\times 833$), 2 (same, $\times 1027$).
Cololejeunea contractiloba, 3 (single oil-body, $\times 2000$), 3a (median cells, $\times 911$), 4 ($\times 1206$),
 5 ($\times 833$). *Cololejeunea biddlecomiae*, 6 ($\times 799$), 7 ($\times 666$), 8 (two oil-bodies from Fig.
 7, $\times 2000$). *Cololejeunea subcristata*, 9 ($\times 770$), 10 ($\times 770$).

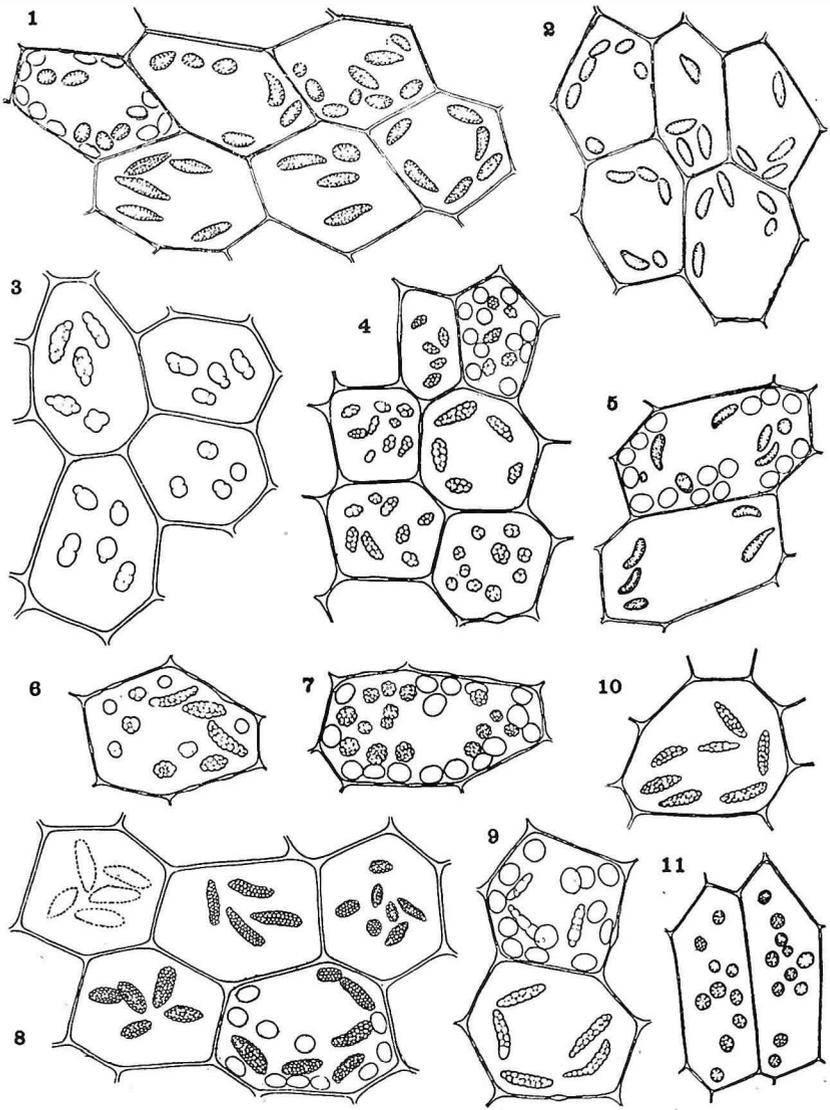


Plate XV. *Cololejeunea diaphana*, 1 ($\times 800$), 2 ($\times 720$). *Cololejeunea subcristata*, 3 ($\times 1000$), 4 ($\times 678$). *Aphanolejeunea evansii* (S 22029a), 5 ($\times 1000$). *Leptocolea cardiocarpa*, 6 ($\times 884$), 7 ($\times 967$), 8 ($\times 1000$), 9 ($\times 1062$), 10 ($\times 916$). *Aphanolejeunea sicaefolia* (El Yunque, Puerto Rico), 11 ($\times 675$).

GENERAL ASPECT OF VERTICAL DISTRIBUTION
OF MOSSES OF MT. FUJI (JAPAN)

BY NORIWO TAKAKI

高木典雄：富士山蘚類の垂直分布概観

The volcano of Mt. Fuji, the highest mountain in Japan, attains the elevation of 3776 m. above the sea level. Its gigantic and symmetrical "Konide" rising from the Pacific coast is one of the most graceful landscapes in Japan. Because of the simple and gentle slope of the Konide, it has a regular zonation of vegetation. Among many investigations of the vegetation of Mt. Fuji, Dr. Hayata's work²⁾ was the earliest and representative one. They are, however, mostly the works concerning with vascular plants, and very few with bryophytes. In 1951, the present author³⁾ reported on the moss flora of the summit of this mountain, without touching that of the flank. It is interesting how the moss flora changes according to the height, especially in relation to the changes of the vascular plant vegetation. The author has visited this mountain several times. The present paper is the result of the observations during the visits.

Touring courses for research

The dates and the courses of visiting the mountain are as follows:

North-east flank (Yoshidaguchi), August, 1937.

North-west flank (Shōjiguchi), July, 1950.

South-east flank (Gotembaguchi), May, 1940, (the lower portion only).

South-west flank (Ōmiyaguchi), July, 1950.

General aspect of vertical zonation of vascular plants

Distribution of mosses is closely related to that of vascular plants. Therefore, we must, first of all, know the zonation of the latter. The vegetation of Mt. Fuji has been divided by Dr. Hayata to the following six regions according to the altitude.

- a) Prairie region (Basal region)
- b) Deciduous broad-leaved tree region
- c) Evergreen conifer region
- d) *Larix* region
- e) *Salix-Alnus* region
- f) Higher grass region

Above the region (f), we find broader bare region which reaches up the su-

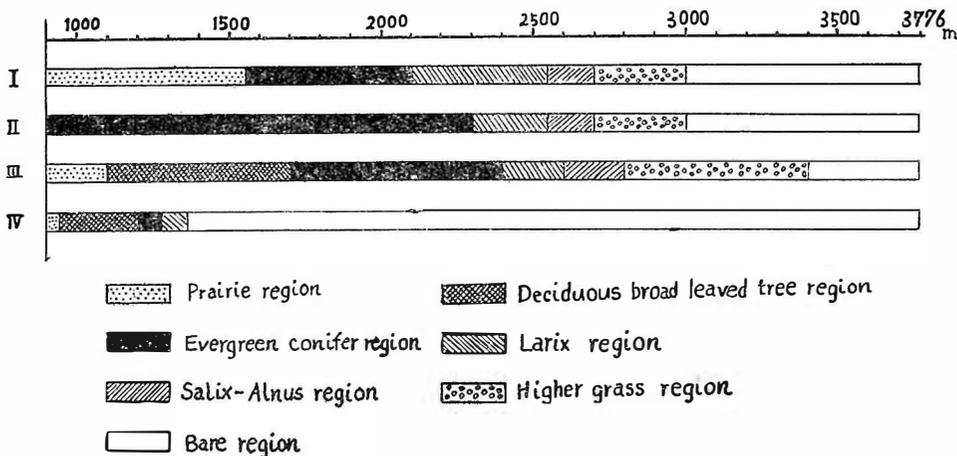
1) Biological Institute, Faculty of Culture, Nagoya University, Mizuho, Nagoya.

2) Hayata, B.: The vegetation of Mt. Fuji (Japan). Tokyo, 1911.

3) Takaki, N.: Muscinées des hauts sommets de la mte. Fuji (Japan). Journ. Hattori Bot. Lab. 6: 1-5 (1951).

mmitt. There, we see no vascular plants, but a few mosses, hepatics and lichens. The author considers it necessary to add one more (g) Bare region to the six regions (a) (e) mentioned above.

The vertical extent of each region has differences in each flank of the mountain, as is shown in the Figure. On the south-west flank, we can observe the deciduous broad-leaved forest predominating. While, on the north-west flank, an evergreen conifer forest shows its maximum development and comes down almost to the foot portion of the mountain. On the north-east flank, it is characteristic that the deciduous broad-leaved forest is thinly found. On the south-east, we see vast bare slope which comes down far below, caused by the eruption in 1709.



Zonation of the plant-regions in each flank of Mt. Fuji.

I. North-east flank (Yoshidaguchi). II. North-west flank (Shōjiguchi). III. South-west flank (Ōmiyaguchi). IV. South-east flank (Gotembaguchi). Based on Dr. Hayata's "Botanical Map of Mt. Fuji."

Moss flora of each region

a) Prairie region

It extends broadly around the base of this mountain, except a portion of north-west flank. This region remains in the state of grassy plain, without any forest. For this, several reasons are considered: it might be caused by the natural or artificial action. In the region, red pine woods are, here and there, seen, where the moss flora is comparatively poor, especially in epiphytic ones. Mosses found in this region are common with those of lowland districts in Japan. They are as follows:

Fissidens cristatus, *F. japonicus*, *Ditrichum pallidum*, *Ceratodon purpureus*, *Dicranella heteromalla*, *Thysanomitrium richardi*, *Oncophorus crispifolius*, *Dicranum japonicum*, *D. nipponense*, *D. scoparium*, *Weisia viridula*, *Barbula unguiculata*, *Grimmia apocarpa*, *G. pilifera*, *Rhacomitrium canescens*, *Physcomitrium eurystomum*, *Funaria hygrometrica*, *Pohlia scabridens*, *Bryum argen-*

teum, *Mnium microphyllum*, *M. trichomanes*, *Rhizogonium dozyanum*, *Macromitrium incurvum*, *Hedwigia albicans*, *Forsstroemia trichomitra*, *Barbella asperifolia*, *Schwetschkeopsis japonica*, *Herpetineuron toccocae*, *Entodon chalcengeri*, *Plagiothecium turgescens*, *Pylaisia brotheri*, *Hypnum plumaeforme*, *Isopterygium textori*, *Hylacomium cavifolium*, *Diphyscium fulvifolium*, *Catharinaea undulata*, *Pogonatum inflexum*, *P. spinulosum*, *Polytrichum attenuatum*, etc.

b) Deciduous broad-leaved tree region

As we have seen, this forest attains its most luxuriant growing at the southern slope of the mountain. This fact results mainly from its climatic condition: here it is drier in the winter, and is moist in the summer. This condition also gives the abundant growth of mosses, especially of epiphytic ones. Indeed, splendid growth of epiphytic mosses is a most characteristic in this region. They are as follows:

Anomodon giraldii, *Bissetia lingulata*, *Barbella asperifolia*, *Brachymenium nordenskiordii*, *Chrysocladium retrorsum*, *Dozya japonica*, *Dolichomitra cymbifolia*, *Forsstroemia japonica*, *Fissidens gymnogynus*, *Holomitrium japonicum*, *Homalothecium tokiodense*, *Macrosporiella scabriseta*, *M. dozyoides*, *Miyabea fruticella*, *Neckera yezoana*, *Okamuraea hakoniensis* and its fo. *multiflagellifera*, *Pterobryum arbuscula*, *Pilotrichopsis dentata*, *Schlotheimia japonica*.

In addition to the above, many terrestrial mosses are seen, they are:

Brachythecium wichurae, *Claopodium pugionifolium*, *Catharinaea undulata*, *Climacium japonicum*, *Dicranum scoparium*, *Dicranella heteromalla*, *Diphyscium fulvifolium*, *Entodon ramulosus*, *Funaria hygrometrica*, *Hylacomium cavifolium* and its fo. *angustifolium*, *Hypopterygium fauriei*, *Hypnum plumaeforme*, *Myuroclada concinna*, *Orthodicranum flagellare*, *Polytrichum attenuatum*, *Pogonatum spinulosum*, *P. contortum*, *Plagiothecium aomoriense*, *Rhizogonium dozyanum*, *Rhodobryum giganteum*, *Rh. roseum*, *Thuidium glaucinum*, *Th. yezoanum*, *Tetracladium molkenboerii*.

c) Evergreen conifer region

As we have previously stated, its most abundant growth is observed at the north side, especially north-west flank of the mountain. For this, some reasons, climatic and edaphic, are considered. We can find several lava-streams running down to every direction from the crater. Among these streams, north-west one which is called as Aokigahara lava, is most porous, and we see such character is capable of holding sufficient water and fitted for the growth of conifers. Here, it is rather humid in the winter, but rather dry in the spring and summer. Thus, surprising dense and wide conifer forest is formed.

These conditions also are favourable for the growth of mosses. Here, the wonderful growth of terrestrial mosses is characteristic. It is beautiful and mysterious indeed to see luxurious moss carpets covering all over the lava rocks in the conifer forest. They are:

Bartramia deciduaefolia, *B. pomiformis*, *Bartramiopsis lesqurii*, *Dicranum undulatum*, *Ditrichum divaricatum*, *Drepanocladus uncinatus*, *Diphyscium fulvifolium*, *D. foliosum*, *Hylocomium proliferum*, *H. triquetrum*, *H. calvescens*, *H. himalayanum*, *Hypnum fujiyamae*, *H. tristo-viride*, *Mnium hornum*, *M. punctatum*, *M. flagellare*, *M. undulatum*, *M. speciosum*, *M. immarginatum*, *Oncophorus wahlenbergii*, *Orthodicranum flagellare*, *Pogonatum contortum*, *P. grandifolium*, *P. urnigerum*, *Polytrichum alpinum*, *P. juniperinum*, *Pleuroziopsis ruthenica*, *Pohlia elongata*, *Ptilium crista-castrensis*, *Pleurozium schreberii*, *Philonotis fontana*.

As the epiphytic species: *Anomodon abbreviatus*, *A. giraldii*, *Boulaya mitteni*, *Dolichomitra cymbifolia*, *Forsstroemia japonica*, *Lesquereuxia robusta*, *Macrosporiella dozyoides*, *Neckera yezoana*, *Pilotrichopsis dentata*, *Schlotheimia japonica*.

In the Aokigahara lava-stream, here and there, lava-caves and lava-tunnels are found beneath the coniferous woods. At these places the temperature is much lower than that of the outside, and at the innermost part everything may often be frozen over even in the midsummer, and cold wind is constantly blowing from inner part towards outside. In a place as this, few kinds of mosses, such as *Heterophyllum haldanianum*, *Pohlia elongata*, *Rhacomitrium laetum*, *Rhabdo-weisia fugax* var. *subdenticulata*, are seen at the entrance, and no mosses, of course, at the dark inner part.

Here also we see some hollows formed on the surface of the lava-stream, and each of them looks like a bowl or a basin in shape and reaches about 20–30 m. in diameter, about 8–12 m. in depth. The bowl or the basin is completely covered with mosses which look like a dense carpet or like an abundant food on the dish. This carpet mainly consists of the following species. Here we can find rather few kinds of mosses, which, however, are growing abundantly.

Fissidens cristatus, *Hylocomium himalayanum*, *H. proliferum*, *Mnium speciosum*, *M. immarginatum*, *M. flagellare*, *Pleurozium schreberii*, *Pleuroziopsis ruthenica*, *Thamnum sandei*, *Thuidium yezoanum*, etc.

On the south side also the conifer forest is found above the deciduous forest, but its density and extension are far inferior to that in the north side, and poorer moss carpet develops here.

d) *Larix* region

With the decreasing of conifer forest upwards, *Larix* vegetation gradually begins to attract our attention. Here is a constant blowing of cold and strong wind. Under this condition, the epiphytic mosses almost disappear, except one species *Ulota crispa*. Yet, on the floor we can find the following several species:

Andreaea rupestris var. *fauriei*,⁴⁾ *Bartramia ithyphylla*, *Catharinaea undulata*, *Ditrichum divaricatum*, *Dicranum scoparium*, *Entodon ramulosus*, *Hylocomium triquetrum*, *H. proliferum*, *Mnium immarginatum*, *M. hornum*,

4) *Andreaea rupestris* Hedw. var. *fauriei* (Besch.) Takaki, comb. nov. Syn. *A. fauriei* Besch. in Ann. Sci. Nat. Ser. 7, Bot., 17: 392 (1893); *A. petrophila* Ehrh. var. *fauriei* Takaki in Journ. Hattori Bot. Lab. 10: 32 (1953). Hab. Japan, Formosa, Corea.

M. flagellare, *Oncophorus wahlenbergii*, *Pohlia elongata*, *Pogonatum contortum*, *P. grandifolium*, *P. urnigerum*, *Polytrichum juniperinum*, *P. attenuatum*, *Pleurozium schreberii*, *Ptilium crista-castrensis*, *Rhacomitrium hypnoides*, *Saelania glaucescens*.

e) *Salix-Alnus* region

Coming to this region, the forest-inhabitants mentioned above, almost disappear and they give way to bare-region-inhabitants. Here, no epiphytic mosses occur at all, and we see the following species:

Andreaea rupestris var. *fauriei*, *Bryum argenteum*, *Brachythecium populeum*, *Ditrichum divaricatum*, *Entodon ramulosus*, *Hylocomium proliferum*, *Pogonatum contortum*, *P. urnigerum*, *P. grandifolium*, *Polytrichum piliferum*, *Pohlia elongata*, *Ptilium crista-castrensis*, *Rhacomitrium hypnoides*, *Rh. canescens* var. *ericoides*.

f) Higher grass region

In this region, a few clusters of grass are seen here and there, and the remaining areas are almost bare, so the moss flora is the same as in the next region.

g) Bare region

Dr. Hayata has already reported some observations of the mosses found in this region. He stated, "From 3220 m. upwards, there is no vegetation except a few mosses such as *Rhacomitrium canescens* Brid., *Stereodon brachycarpus* Mitt., *S. plicatulus* Lindb., and a few lichens. On the south, this grass region extends as high as 3220 m.; but on the north, it is limited under 3000 m. From this elevation upwards, the mountain is entirely barren and there is nothing to represent vegetation except a few lichens and mosses."

Indeed, it is a desolate scene as far as we can see. Searching carefully, however, we can find some species only on the sheltered gaps of the lava which is stable.

At the south-east flank, this region stretches down about 1200 m. in altitude, and mostly consists of scoriae or volcanic ashes. This situation was derived from the eruption which took place in 1707. In this flank, we can observe the bare-region-inhabitants also come down, but they become very poor.

On the whole, the bare region, of course, has the poorest moss flora of all the regions of the mountain, but the summit area of this region has comparatively richer moss flora than the rest, on which the present author already stated. Speaking briefly, two causes are considered: one is the stableness of the rock as the substratum, and the other is the moisture of this rock brought by humid wind, clouds or snow remaining in the crater even in the summer. At the flank, however, the substratum is not so stable and moist as in the summit area, and the poorest flora of the whole mountain is found here. Mosses found in the bare region are:

Arctoa fulvella* var. *longisetacea*, **Andreaea rupestris* var. *fauriei*, *Anomobryum fuji-alpinum*, *Bartramia ithyphylla*, **Bryum argenteum*, **Dicrano-*

weisia crispula, **Grimmia decalvata*, **G. ovalis*, ***G. cratericola*, **Polytrichum sphaerothercium*, **P. piliferum*, **Pogonatum urnigerum*, ***Pohlia bulbifera*, **Rhacomitrium hypnoides*, *Rh. canescens* var. *ericoides*, *Rh. fauriei*, *Brachythecium populeum*?, *Drepanocladus aduncus*. An asterisk (*) marks the species found at the summit and the flank; two asterisks (**) mark those found only at the summit.

Lastly, we can say that Mt. Fuji has never a rich flora of mosses in spite of its high elevation. It is generally known that the volcano has comparatively poor flora of mosses than the other mountains. However, the dormant volcano which had ceased its activity in the old age has fairly a rich flora, such as Mt. Yatsugatake which stands in the Fuji volcanic range. On the other hand, the active volcano, such as Mt. Asama, has rather a poor flora.

Now, Mt. Fuji is in a dormant stage, but erupted several times even in the historical age, most recently in 1707. This is the very reason for the poorness of the flora of this mountain. There are no streams and marshes except at the foot of the mountain. Consequently we can find no hygrophytic and hydrophytic mosses at all.

On the endemism of the moss flora of Mt. Fuji, at present, we have no endemic species to this mountain. In 1951 the author reported two new species, *Anomobryum fuji-alpinum* Takaki and *Grimmia cratericola* Sakurai et Takaki from the summit area of this mountain. However, both species have recently been collected elsewhere.⁵⁾

5) *Anomobryum fuji-alpinum* Takaki in Journ. Hattori Bot. Lab. 6: 1 (1951). Mr. H. Ochi reported this from Mt. Yatsugatake for the second known station (Ochi in Journ. Jap. Bot. 28: 341. 1953).

Grimmia cratericola Sakurai et Takaki; Takaki, l. c. 6: 2 (1951). Prov. Kai, Mt. Akaishi, at the summit, 3100 m. alt. (Coll. N. Takaki, no. 6823, July 17, 1949). -This is the second locality for the present species.

モミ樹幹の着生蘚苔類について

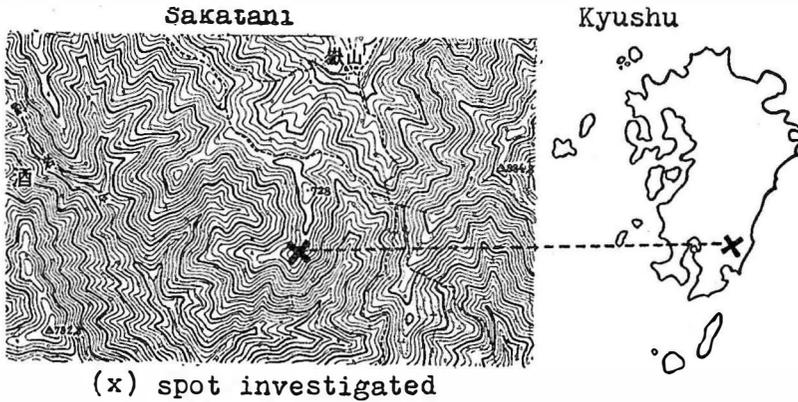
服部新佐¹⁾・野口 彰²⁾

Sinske HATTORI and Akira NOGUCHI: On the bryophyte community of an *Abies firma* bole

筆者の一人(服部)は最近屋久島より熱帯系の *Anastrophyllum mayebarae* を記載したが、本種は昭和26年前原勘次郎氏が屋久杉の地上5, 6米以上の樹皮に群生して居るのを発見されたものである。植物研究者が多数渡る屋久島にかゝる顕著な苔類が取残されて居たのは言う迄もなく樹幹上部の着生蘚苔類迄手が届かなかつたに外ならない。このように着生蘚苔類が樹幹の上・下部で相当変化があることは今迄野外に於て屢々観察する機会があつた。

恰かも当研究所より数里山へ入つた宮崎県南那珂郡酒谷村割岩河内の官有林伐採が20年計画とかで実施中であり、伐倒したばかりのモミ、ツガがあると云うので、昨年7月19日筆者の一人(服部)は清水大典、日高俊彦、安藤新喜等諸氏の協力と仮肥営林署各位の後援を得てモミ幹の着生蘚苔類の現地調査に出掛けることが出来た。

伐倒現場(附図参照)は海拔700米の山稜である。優占樹種はイスで大きい株は目通り直

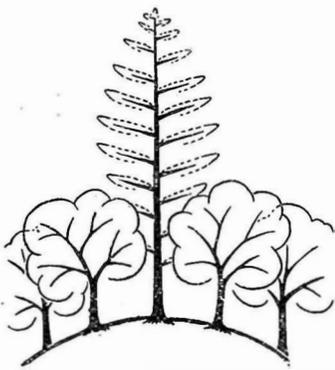


径1米に近い。灌木層はミヤマシキミが優占し、株床は浅く落葉が堆積してわづかにヤブコウジその他が散生する外には殆ど見る可きものがない。モミ、ツガはこの山稜部のみならず下方迄点々とそびえているが山稜部より少くなる。中腹あたりはイスは著しく減じ、イチイガシ等のカシ類が多く、クロマツ、シイ、タブ等も見られるが、先づ典型的なカシ帯である。

往復に時間がかゝり、小雨下でブヨが多く調査は思うように進まなかつた。結局調査したのは27米の樹高を有するモミ1本で、短時間附近のツガ、イスなどを比較出来た程度であつた。このような貧弱な調査を取敢て発表するのは、従来この種の研究が余り為されて居らぬこと、このデータには可成り面白い問題が萌芽の形ではあるが含まれていること、そしてこの報告が刺戟となつて今後精密な研究が各地より発表されること等を考慮し且つ

希望するからである。

附図に模式的に表現した如く、現地はイヌを主とする常緑潤葉樹林でその樹冠は地上10～15米に達し、樹高30米内外のモミ、ツガがこの樹冠から点々超出している。従つて調査したモミ幹の上半と下半では日光や風当りなど気象的条件に相当の差異が認められる筈であり、事実之は着生植物に強く反映している。以下に樹幹を高さによつて若干に区分して記述するが、この点を念頭において読まれるよう希望する(附表参照)。³⁾



An *Abies firma* bole (27 m. height) above the canopy of *Distylium racemosum*

幹基部。モミ幹の基部(地上より凡そ2米以下)には岩上、地上などに却つてよく見られる種が多い。Microclimate も林床の倒腐木、岩上の浅腐植などに近い。即ちこの部分では多いが上部へと急に減する種は純粋な着生蘚苔類と云えないものである。基部或は木の根もとはこの意味ではつきり区別しなければならぬ。

この部分は微気候的に最も湿度高く、蘚苔類の繁茂に適し、殆ど限なく大形蘚類に覆われて居る。目立つて優勢な種は *Isotheceum subdiversiforme* (幹基部の優占種)である。遙かに劣るが次いで *Hypnum oldhamii* 以下 *Bazzania japonica*, *Homaliodendron scalpellifolium* となる。この4種は殆ど樹高3米以下にのみ認められるもので、*Homaliodendron* 以外は着生蘚苔とは断じ難い。*Homaliodendron* が何故上部に减小消失するかと云うと、それは主として他の大形蘚 *Pterobryum arbuscula* との競争に負けるからである。⁴⁾

- 3) 蘚苔の水分摂取には(1)植物体の全面(全面と言つても勿論、葉或は葉状体がその殆どであるが)から水分を摂取するもの、(2)植物体の一部(と云つても、仮根であり、まれに体下部の地下茎状の部分)から摂取するもの、(3)程度に差はあるが前述二法併用するものとの三型がある。着生蘚苔類は多く(1)、及び(3)に属するものであるが、この型のみで割切することも困難である。結局は細胞プラズマの本質進行かねばならないのであるが、現在未だそこ迄研究が達していない。

然し(1)及び(3)の型に属し、且つ乾燥、特に間歇的に来る乾燥に対する抵抗力が強いことは確実である。更に見逃すことの出来ない特性は光条件に鋭敏なもの、即ち余り強い日光下にも余り弱い日光下にも生育困難で、要求する光の強さの範囲が狭く限定されたものが少くないことである。例えばモミ幹下半の優占種、*Pterobryum arbuscula* がそうであるが、モミ幹上半の優占種たるヤセドケケ属はこの点前者程ではない。

又、湿度の高い熱帯の原生林中では樹幹に着生する蘚苔が、分布北限の我国では岩上(特に石灰岩に見出される場合があるが、陰地の石灰岩～岩隙は他岩石より樹幹に近い habitat と思はれる)に着生する例がある。之もその microclimate に依るものであろう。一般に気象条件などの変化に従い蘚苔の着生基物が異つてくるものが少くない。近い所では屋久島と九州本島で、同じ種の着生基物にずれが認められる場合が容易に観察される。ごく大ざつばに云つて光が強くなり、且つ乾燥に傾けば着生蘚苔類は次第に樹幹→根も→林床と下つて行かざるを得ない。然し地上迄降つて生き伸びることも仲々困難である。そこには本来地上生の植物との生存競争と云ふ。試鋸が控え、且つ edaphic factor も多くの場合不利である。

- 4) 蘚苔類の分布(特に“microdistribution”)を研究する際にはこの生存競争と云ふ生物的要因の考慮が極めて重要である。或る蘚苔類が例えば石灰岩に好んで着生する乃至は石灰岩上に限られると思はれる場合、実は他の基物上では容易に他の植物に圧倒されるため、石灰岩上にしか見出されぬと云ふことが主な原因となつている場合が極めて多いのである。

従来かゝる考え方は余り強調されなかつたが、Aなる南方系の蘚苔類が日本を北限として石灰岩上に生存し、一方Bなる北方系の蘚苔類が我国を南限として同じく石灰岩上にのみ見出される如き現象を矛盾することなく説明するには前述の考え方を重視せざるを得ない。筆者の一人(野口)は昨年の日本植物学会に於いて好石灰蘚類に関して報告したが、更に本問題点を詳細に追求している。

他の筆者(服部)は清水大典氏と協力して我国のゼニゴケ類に就いて研究を進めて居るが、我国高地に極めて稀れに見出される *Athalamia*, *Scuteria*, *Peltolepis* その他の稀産ゼニゴケ類の分布についても生物的要因が強く支配していることを認めた。

幹基部には表示した如く更に若干の蘚苔類が認められるが、之等は僅か混入して居る程度で大形の優占者の間隙に辛うじて生育している有様である。只一言しておき度いのは *Microlejeunea rotundistipula* である。本種は極めて小形の苔であるが、他の大形蘚苔上に着生することが多く、敢えて樹上、岩上を問わない。従つてこのような小形種は群生する大型蘚苔中に在つても充分生存することが出来る。

幹下半部。樹高 3~10米の部分に移る。こゝでは大形着生蘚の *Pterobryum arbuscula* が極めて顕著で優占種となつている。下方(3~5米)には *Brotherella* sp. が部分的にやゝ顕著であるが、6米以上では殆ど認められない。従つて 3~10米の部分では *Leucoloma okamurae*, 更に僅か乍ら *Hypnum tristo-viride* の外、表に示した如く微量の *Saccogyna curiosissima*, *Spruceanthus semirepandus*, 前述 *Microlejeunea rotundistipula* などの苔類が見出されるに過ぎない。⁵⁾

即ちこの部分は *Pterobryum* の發生の爲、他蘚苔は充分に繁茂することが出来ないと考えられる。尙 8米あたりに *Diphyscium fulvifolium* が認められたが、之は土手や崖上などに着生する種で、この場合はカタヒバ基部に溜つた humus 上に生じ偶発的侵入と考えられる。

幹上半部。樹高11米以上の部分に移る。この部分はマメヅタランが一面に蔓延し、之と苔類のヤスデゴケ属の諸種 (*Frullania moniliata* subsp. *obscura*, *Fr. valida*, *Fr. motoyana*, *Fr. densiloba*, *Fr. diversitexta*) が顕著である。即ちこの部分は下半部に較べて急に乾燥に傾き明るさを増す為、前述 *Pterobryum* の如き大形蘚は生育し難くなり、却つてマメヅタランやヤスデゴケ属の諸種にとつて好条件となる。他にも若干の苔類が検出されたがごく僅かであつた。

この外 *Macromitrium gymnostomum*, *Dozya japonica*, *Myuriopsis sinica* などの蘚類が樹高 5米あたりから点々と現われ、24米内外迄認められる。約 17米より上方に *Sematophyllum japonicum*, *Macromitrium incurvum* (本種は陽地の岩上などに多く見られる), *Okamuraea hakoniensis*, *Chrysoladium retrorsum* などの蘚類が散生する。又 5~13米あたりに *Fauriella tenuis* が僅かに認められた。以上の如く蘚類に於いては 20米附近を境として上下の種類が異なるが、概して上方に着生する種が、より日光と乾燥に耐えるものと言うことが出来る。

高等植物では 5~10米間にマメヅタラン以外にはウチワホラゴケとカタヒバが見出されたが量的には僅かである。10米以上になれば前述の如くマメヅタランが蔓延する外、やゝ重視す可きものは 20米以上に散生するヒメノキシノブであろう。⁶⁾

地衣類は幹の上半部に限られ且つ量的にも蘚苔類に較べて遙かに劣る。10~15米に *Lobaria adscripta* (エビラゴケ), 15米以上、特に梢部に *Parmelia laevior*, *P. cirrhata* (ツノマタゴケモドキ), *P. marmorata*, *Sticta yatabeana* (ヤタベヨロイゴケ), *Usnea roscola* などが着生する。このうち *Sticta* が頻度が高い。

枝。枝上の着生植物は幹に較べて少ない。特に下方の枝に乏しい。然し枝上の着生植物は幹とは多少異つた所がある。先づ *Frullania kagoshimensis* が梢部の枝にやゝ多いが、幹では 25米あたりから上に僅かに認められるに過ぎない。*Usnea* sp. (アオヒゲゴケ) は上部の枝上に認められる。然しマメヅタラン、ヒメノキシノブ、次いで *Frullania* の若干種が主であつて、枝の着生植物は大体に於いて幹上部から梢部に一致する。⁷⁾

次に附近の他樹種に於ける着生蘚苔を簡単に述べる。

5) 5米あたりから上方 24—27米にかけて *Macromitrium gymnostomum*, *Dozya japonica*, *Myuriopsis sinica*, *Fauriella tenuis* (但し本種は凡そ 13米迄), *Frullania* spp. などが生ずるが、之等は大抵 10米以上に多く見られるものであるから後段に述べる。

6) 10米以上にはマツグミの寄生が認められた。

7) マツグミの寄生も幹に較べると著しい。

Epiphytes on an *Abies firma* bole (27m. height)

	(base)	Height (m.)	(top)
	0	10	20 27
(HEPATICAE)			
Bazzania japonica	—		
Plagiochila trabeculata	—		
Odontoschisma grosseverrucosum	—		
Microlejeunea rotundistipula	—		
Saccogyna curiosissima	—		
Frullania moniliata ssp. obscura	—		
Microlejeunea punctiformis	—		
Pycnolejeunea imbricata	—		
Spruceanthus semirepandus	—		
Lejeunea vaginata	—		
Euosmolejeunea ontakensis	—		
Drepanolejeunea tenuis	—		
Radula cavifolia	—		
Tuyamaella molischi	—		
Frullania valida	—		
Frullania motoyana	—		
Frullania diversitexta	—		
Frullania densiloba	—		
Frullania kagoshimensis	—		
(MUSCI)			
Isothecium subdiversiforme	▲		
Hypnum oldhamii	▲		
Homaliodendron scalpellifolium	—		
Brotherella sp.	—		
Pterobryum arbuscula	—		
Leucoloma okamurae	—		
Hypnum tristo-viride	—		
Mnium microphyllum	—		
Fauriella tenuis	—		
Diphyscium fulvifolium	—		
Macromitrium gymnostomum	—		
Myuriopsis sinica	—		
Dozya japonica	—		
Sematophyllum japonicum	—		
Macromitrium incurvum	—		
Okamuraea hakoniensis	—		
Chrysocladium retrorsum	—		
(LICHENES)			
Lobaria adscripta	—		
Parmelia laevior	—		
Sticta yatabeana	—		
Parmelia marmorata	—		
Parmelia cirrhata	—		
Usnea roseola	—		
Usnea sp.	—		
(PTERIDOPHYTA)			
Trichomanes parvulum	—		
Selaginella pachystachys	—		
Davallia mariesii	—		
Lepisorus onsei	—		
(PHANEROGAMAE - ORCHIDACEAE)			
Bulbophyllum drymoglossum	—		

ツガ。ツガの着生蘚苔は大体前記モミと同様である。勿論細かく見ればモミに見出さなかつた種も若干ある。例えば *Dicranodontium denudatum*, *Radula oyamensis*, *Plagiochila semidecurrrens* var. *grossidens*, *Otenidium* sp. の如きものが僅かに見出されたが、一方前記のモミ幹にあり、ツガに見られなかつた種もある。然し幹10米あたり迄大形蘚 *Pterobryum arbuscula* が優占する等、大綱に於いては一致するものと判断される。

クロマツ。クロマツは尾根よりやや下にあるが、樹皮のはげ易いことと乾燥し易いことのためにモミ、ツガ幹下半部の如き *Pterobryum* の発達は見られず、モミ幹上半部に多い *Frullania motoyana*, *Fr. valida*, *Fr. densiloba* の類が著しい。

イス。前記のモミに接するイスを調べたが非常に著しい差が見られた。第1にモミ下半部の如く大形蘚の旺盛な発生が認められない。樹高約3米以下では *Isotheceum subdiversiforme*, *Pterobryum arbuscula*, *Homaliodendron scalpellifolium*, *Dicranodontium denudatum*, *Neckera tosaensis*, *Haplohymenium microphyllum* 等の蘚類が認められる。苔類では *Lejeunea vaginata*, *Frullania moniliata* subsp. *obscura*, *Pyenolejeunea imbricata* が主で、*Radula oyamensis*, *Spruceanthus semirepandus*, *Microlejeunea rotundistipula*, *Bazzania fauriana* (但し根もと)が見出される。

イス幹4~5米になると大形蘚 *Pterobryum* は更に少くなり、蘚類では他に前記 *Homaliodendron*, *Neckera*, *Haplohymenium* が顕著な位である。苔類では *Radula japonica* が著しい。前出 *R. oyamensis* は認められず、その他 *Spruceanthus*, *Bazzania* が無くなる一方、*Brachiolejeunea sandwicensis*, *Lejeunea pallide-virens*, *Metzgeria* sp., *Taeniolejeunea ocelloides*, *T. appressa* (微量), *Aphanolejeunea unguistiloba* (微量) が検出された。5米より上部も大体同様である。

蘚苔類以外ではマメヅタを認めただのみである。

上述のモミとイスの着生植物の差は互いに隣接しているにも拘わらず誠に著しいものがある。先づモミ幹は樹高10米あたりを境としてはつきり上下の着生植物相が異なるが、イスでは之が無い。このことは最初注意しておいた如く、モミ幹上半部はイスの樹冠上に超出することに依り説明出来る。

モミ幹下半部とイス幹を較べると、イス幹には陰湿の環境を好む大形蘚の着生が遙かに劣つてゐる。之は言う迄もなくイスの樹冠が比較的光線を通し易く、且つその樹皮が乾燥に傾き易い為である。大形蘚の発生がよくない為、適度の湿度と光線とを要求する小形蘚や苔類が多種着生することとなる。然し之等の小形蘚苔の多くはモミ幹上部の如き所では生育が困難となつて来る。之は恐らくモミ幹が点々イス樹冠上に超出していて気象の激変をまともに受け、簡明した樹冠下と異つて環境が苛烈となるからと考えられる。⁸⁾

然し乍らモミ幹上半部にはマメヅタランが多生しているのに、イス幹では殆ど認められず、替つて少量乍らマメヅタが這うなど、僅か一日の調査では資料不十分で説明困難な場合が多く、今後の研究に俟つ。尚中腹のタブ、イチイ、ヤブニツケイなどを観察したが、ほゞイスと同様であつた。但し着生蘚苔類は種・量共に比較的貧弱であつたが、之はイス

8) 若しイスが散生乃至孤立樹であればモミ幹上部の条件に近くなる。かゝる場合には *Frullania* spp. など苛烈な気象の変化に耐える種が残り、大体モミ上部の蘚苔相に似て来る。又イス林が無くモミが孤立的に生じて居るならば、モミ幹下半部の大形蘚は無くなり大体上半部の着生蘚苔相と一致し、その間の境界は無くなつてしまふであらう。

9) タブ幹上部には *Macromitrium brachycarpum*, *Frullania diversitexta*, *Fr. motoyana*, *Spruceanthus semirepandus* の外、微量乍ら稀産 *Leucolejeunea xanthocarpa* が見出された。イチイ幹(10米内外)には *Haplohymenium microphyllum*, *Frullania moniliata* subsp. *obscura* などの外、極少いが *Neckera tosaensis*, *Pterobryum arbuscula* が着生して居た。ヤブニツケイの枝には *Frullania diversitexta* が多く、*Fr. kagoshimensis* もよく見られた。後者は当地域のみならず南九州の原生林では樹梢部の枝等に好んで着生する特徴がある。

が山稜上にあり、後者はその斜面(中腹)に位置するからであらう。²⁾ 更に溪谷迄下れば又着生蘚苔相は変つて来る。

以上を要約すれば、調査モミ幹の着生植物群は基部、下半部、上半部に分けることが出来、基部では *Isothecium subdiversiforme* が、下半部では *Pterobryum arbuscula* が、上半部ではマメヅタランとヤスデゴケ属が夫々優占すること、基部の蘚苔類は真の epiphyte と認められず、却つて同地域の林床、倒木、切株、岩上などの蘚苔群落と同一であること、更に幹上半部でも梢部や枝の着生植物相は異つた点があることを述べ、その原因を主に気象条件(特に microclimate)に求め、且つ生物的要因も重視すべき場合の多いことを指適した。次いで近接するツガ、イス、マツなどの着生植物と簡単に比較し、その異同は樹皮の違い、樹冠の厚薄などに影響されると考えた。

終りに臨み、地衣類の同定を引受けられた佐藤正己博士、現地調査に協力し且つ図表を作成された清水大典氏に深く感謝する。又調査を許可し且つ種々便宜を計られた斎藤菅林署長以下佻肥菅林署の各位に謝意を表する。

Résumé

The Wariwa wood is in a primitive condition, and is situated on a mountain ridge reaching 700 m. above sea level, at Sakatani, Miyazaki County, southern Kyushu, Lat. 31°41' N., Long. 131°20' E. (see Map). It consists of broad-leaved evergreens, among which *Distylium racemosum* is the dominant. Three coniferous species, *Abies firma*, *Tsuga sieboldii* and *Pinus thunbergii*, stand scattered, rising about 15 m. above dense canopies of broad-leaved evergreens (see Figure).

The epiphyte community of an *Abies firma* bole (27 m. height) was examined to prove that it comprises 19 species of Hepaticae, 17 species of Musci, 7 species of Lichens, 4 species of ferns and fern-allies and a species of epiphytic orchid.

We recognized the following three climax associules on the *Abies* bole (see Table):

- 1) Base (up to 2 m. height). Unlike the other epiphytic associules, the community on the base consists of those species which are abundantly found also (and, except *Homaliodendron scalpellifolium*, generally growing) on decaying logs, wood floor and shallow humus on boulders. The dominant is *Isothecium subdiversiforme* (Closed *Isothecium* associule). *Hypnum oldhamii* is conspicuous.
- 2) Lower portion of the trunk (2-10 m. height). The microclimate differs here from the higher portion of the trunk, as it does not rise above the canopy of broad-leaved evergreens (*Distylium racemosum*, mostly). The climax associule is decidedly dominated by *Pterobryum arbuscula* (*Pterobryum* associule). Here, competition is of great importance in delimiting the microdistribution of smaller bryophytes. They can not survive, overgrown by such a large mosses as *Pterobryum*. *Leucoloma okamurai* and *Macromitrium gymnostomum* are conspicuous. The uppermost limit of the present associule is no doubt determined by atmospheric factors.
- 3) Upper portion of the trunk (11-27 m. height). The epiphyte community consists chiefly of such species as can withstand exposure to strong wind, illumination and desiccation. Thus, *Pterobryum arbuscula* disappears, and *Bulbophyllum drymoglossum* (epiphytic orchid) is the dominant and *Frullania* spp.

(*Fr. moniliata* subsp. *obscura*, *Fr. valida*, *Fr. diversitexta*, *Fr. densiloba*) are the subdominant (*Bulbophyllum-Frullania* associate). *Dozya japonica*, *Macromitrium gymnostomum*, *M. incurvum*, *Sematophyllum japonicum*, *Okamuraea hakoniensis* are conspicuous. *Usnea* spp. and other lichens, *Lepisorus onoei* and *Frullania kagoshimensis* are localized to the uppermost part of the fir bole, where it is most illuminated and open to wind and hence least constantly humid; they can withstand such severe condition.

The epiphyte communities on *Tsuga sieboldii*, *Pinus thunbergii*, *Distylium racemosum*, and few others were observed in reference. The epiphyte community of *Tsuga sieboldii* is quite the same as that of *Abies firma*. But those of *Distylium racemosum* and other broad-leaved evergreens are strongly different, influenced possibly by the inclination of barks, its roughness and other factors together with moisture and light. The epiphyte community of *Pinus thunbergii* is very poor compared with the other conifers, influenced chiefly by the roughness and exfoliation of its barks.

ON A NEW LIVERWORT OF FAM. TREUBIACEAE

By Sinske HATTORI and Hiroshi INOUE

服部新佐, 井上 浩: トロイブゴケ科の一新種について

Treubia nana Hattori et Inoue, spec. nov. (Fig. A-O)

Sterilis; pseudofoliosa, minor, ± carnosae, intense viridis, prostrata, ad rupes, in muscis consociata. Frons ca. 20 mm. longa, ca. 5 mm. lata, simplex vel parum ramosa, radice pallidis, longis (1-1.5 mm.), ± fasciculatis. Costa lata, basi angusta et subteres, antice plana vel parum convexa, postice rotundato-convexa, crassa, utrinque sensim in alas attenuata; cellulae internae corticalibus multo minores. Alae fere unistratae, usque ad costam regulariter inciso-lobatae, lobis (vel pseudofoliis) majusculis, contiguus vel leviter imbricatis, late ovatis, apice rotundatis, 2 mm. longis, basi 2-2.8 mm. latis. Loborum cellulae usque fere subaequimagnae, 35-55 × 25-40 μ, basales parum longiores (45-75 × 35 μ), parietibus tenuibus, trigonis nullis, cuticula levi. Amphigastria (vel squamae posticae) nulla. Lobuli antici biseriati, sinuatim inserti, basi antica longe decurrentes, oblique trigono-ovati, 1.2 mm. longi, basi 1-1.5 mm. lati, apice obtusi vel ligulati, cauli ± appressi, lamellis nullis; cellulae ut in lobi. Cellulae oleiferae ubique dispersae, vicinis cellulis aequimagnae vel parum majores (raro 90 × 80 μ); corpora oleifera unica per cellula, maxima, subglobosa, (20)-35-45 × (20)-30-40 μ, pullato-brunneola, dense granulata, granulis minoribus.

Japanese name: Hime-treubgoke (nov.)

Hab. Moist rocks, among other bryophytes, beneath dense coniferous forest, ca. 2000 m. alt., the Karisaka pass in Chichibu Mts., Saitama Co., M. Japan, July 9, 1953, Coll. H. Inoue, type in Herb. Hattori Bot. Laboratory and Tokyo Uni-

versity of Education.

The present species was discovered by one of the authors in Chichibu Mts., M. Japan, roughly Long. 139° E., Lat. 36° N., at the altitude of ca. 2000 m. It occurs with *Hylacomium proliferum*, *Plagiochila* sp., *Hypnum* sp. and others, covering rocks beneath coniferous forest. *Pogonatum grandifolium*, *Bazzania ovifolia*, *Mylia verrucosa*, *Macrodiplophyllum plicatum*, *Diptophyllum albicans*, *Scapania* sp., *Lepidozia* sp. and *Nipponolejeunea pilifera* also grow nearby. The rocks are generally sandstones and clayslates which belong to Jurassic ~ Triassic.

Unfortunately the collection is sterile, and the systematic disposition is impossible to determine exactly. Thus, it is proposed here tentatively under the genus *Treubia*. However, the presence of scale-like lobules in two rows on the dorsal side of the midrib, equal in number to the larger lateral lobes (pseudo-leaves) is a remarkable feature of the genus, and the oil-cells and -bodies are quite the same as those of *Treubia insignis* which K. Müller* described in 1939.

The oil-bodies of the present liverwort are so remarkable that the authors wish to describe them from the original material (herbarium specimen *about 70 days after collection*) in the following:

Oil-cells scattered in leaves and stem (excl. central vein), containing chloroplasts which, however, are hardly seen, hidden by a big, dark grayish brown oil-body. Oil-cells almost equal to or rarely larger than the ordinary cells, but easily distinguished by its big oil-body. Oil-bodies one per cell, very large, almost filling the cell, 40–45 × 30–35 μ (or sometimes smaller) in middle of the lobe, 20–35 × 20–30 μ along margin of the lobe, rotundate or rarely subquadrate, composed of numerous spherules which are dense, but in water gradually dispersed after the cell died.

Treubiaceae comprises only the genus *Treubia*. Stephani, in his "Species Hepaticarum", listed only two species, *Treubia insignis* and *T. bracteata*. The former species (genotype) was discovered by Goebel in Java. Afterwards, S. Iwamasa reported the occurrence of *T. insignis* in Formosa (Mt. Tsugitaka, 3300–3345 m. alt.) at the 13th General Meeting of the Botanical Society of Japan (April, 1949). Hitherto many studies have been published on this interesting liverwort by excellent botanists, such as Goebel (in *Ann. Jard. Bot. Buitenzorg* 9: 1–10, pl. 1, 1930; in *Flora* 94: 99, 1906), Stephani (in *Hedwigia* 30: 190, 1891), Schiffner (Hepaticae in *Fl. Buitenzorg* 1: 70, 1900), Gruen (in *Flora* 106: 331, 1914), Campbell (in *Proc. Nat. Acad. Sci.* 2: 30, 1916; *Amer. Journ. Bot.* 3: 261–273, 1916), Wijk (in *Ann. Bryol.* 1: 147, 1928).

The second species, *Treubia bracteata* was collected by Reineck in Samoa.

* Ölkörperzellen reichlich in der Epidermis der blattartigen Lappen und der Blattohren auf deren Ober- und Unterseite, Oberfläche dadurch punctiert, vereinzelt in der Aussensicht des Stamms. Ölkörperzellen von gleicher Grösse wie die der Umgebung, einzelne viel grösser. Um diese gruppieren sich die übrigen Zellen rosettenartig. Ölkörper von Chloroplasten umgeben, braun, gelappt, 40–45 × 65 μ, mit kleinen Tröpfchen im Innern. In toten Zellen sind mitunter die Ölkörper ausgelaufen, und der ganze Zellinhalt besteht dann aus einer grauen Masse verschieden grosser Öltröpfchen. Die frische Pflanze ist geruchlos. (K. Müller in *Ber. Deut. Bot. Gesell.*, Bd. 57, Heft 8, S. 352, 1939).

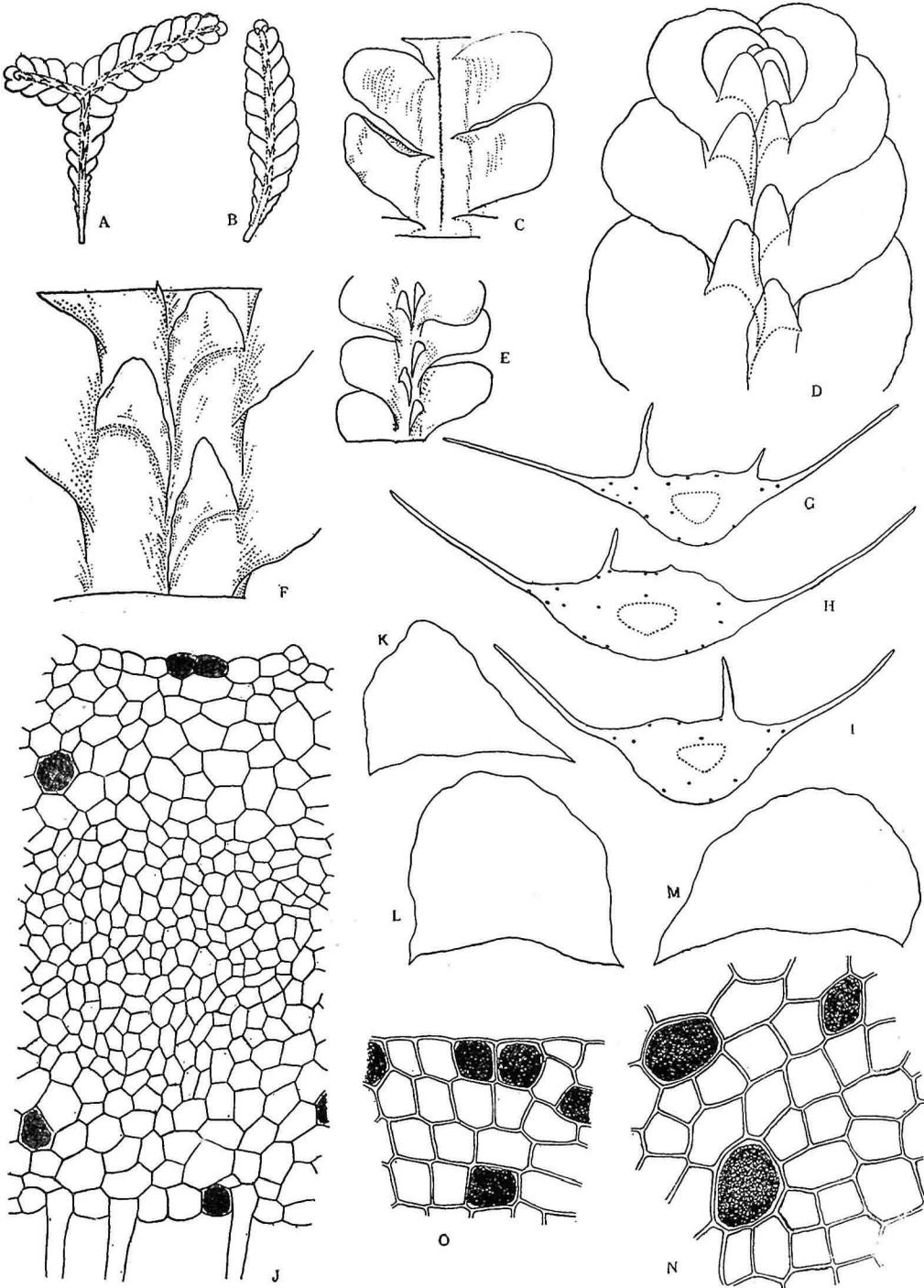


Fig. A-O. *Treubia nana* Hattori et Inoue

A-B. Two thalli, dorsal view, $\times 1.5$. C. Part of thallus, ventral view, $\times 15$. D. Apex of thallus, dorsal view, $\times 20$. E-I. Cross sections of thallus, $\times 25$. J. Middle part of cross section of thallus, $\times 140$. K. Dorsal lobule of thallus, $\times 25$. L-M. Lateral lobes of thallus (pseudoleaves), $\times 15$. N. Cells from middle of lateral lobe, $\times 250$. O. Cells along margin of lateral lobe, $\times 250$. The figures were all drawn from the type specimen by H. Inoue.

The authors do not know the literature concerning this species other than the original description of Stephani (Spec. Hepat. 1: 378, 1900).

Treubia insignis and *T. bracteata* will possibly belong to the largest hepaticae, they reach about 150 mm. in length and about 15 mm. in width. The present species, *T. nana*, however, is far smaller, it is about 20 mm. long and up to 5 mm. wide.

This report is a preliminary one. The authors will collect this year more material with sexual organs and sporophytes, and publish a detailed study of this remarkable liverwort. They wish to acknowledge of the kindness of Dr. H. Ito, Professor of the Tokyo University of Education, who encouraged and helped them.

トロイブゴケ科は2種を含むトロイブゴケ属のみに依つて代表され、ウロコゼニゴケ目とウロコゴケ目との中間的な形態を持つ著名な苔類である。ジャバに1種、サモア島に1種が知られているが、何れも苔類として最も大形に属する点でも名高い。基本種トロイブゴケは戦後岩政定治氏に依つて台湾の次高山にも産することが報告された。

我々の発見した第3種ヒメトロイブゴケは秩父雁坂峠より秩父側に寄つた高度約2000米の地点に成育していたもので、分布上注目には値するが、植物体が他の2種に較べて遙かに小さい点も顕著である。惜しい哉 sterileであつたので類縁関係の詳細は確められないが、トロイブゴケ科に属することは間違ひないと信ずる。

先づ葉状体中肋部背面に側葉(正しくは裂片)と1対1に2列に並ぶ小葉(正しくは小裂片)は他の苔類に全く見られぬ所である。次に油体であるが、之は K. Müller がトロイブゴケに就いて記載したものに全く一致する。即ち植物体全面に油細胞が散布、各油細胞には1個の大形油体が充満し、そのため葉緑粒など普通細胞同様含まれてはいるけれども殆ど認め難い(乾燥標本では数回水につけると油体が分解するので、はじめに葉緑粒が確認出来る位である)。油体は褐灰色で無数の小粒より成り類円形である。このような油体型は他に殆ど無い(只1、2種之に近い油体型を持つものがある)。

尚、原産地はコメツガを主とし、アオモリトドマツ、トウヒ、シラベ、ダケカンバ、カエデ属などより成る針葉樹林下で、附近に岩石の露出が多い。この附近の地層は藤本氏等の調査(與秩父の地質学的研究。秩父自然科学博物館研究報告第1号。昭和25年刊)に依ると主に砂岩で粘板岩の薄い層を挟有しており、ジュラ系三畳系の由である。樹林下にはシラネウラボ、シノブカグマ、ホソバトウゲシバ、メシダ、ミヤマカタバミ、イトスゲ、マイヅルサウ、オサバグサなどが生じ、林床、岩上には蘚苔類(種名は英文欄に挙げた)の発生が旺んである。ヒメトロイブゴケはこれ等の蘚苔類に混じて岩上に這ひ深緑色である。

最後に本研究について御援助を賜つた東京教育大学の伊藤洋教授に深謝する。筆者の1人、井上は同教授の教室にあつて研究指導を仰いでいるもので、この機会にその御厚情を記して感謝の意を表する。

351. *Andreaea nivalis* Hook. (*Andreaeaceae*) ガッサンクロゴケ 長野県水曾御嶽八合目小屋附近, 高山帯, 溪流中の岩上に水に浸りつゝ群生. 352. *Anisothecium rufescens* (Dicks.) Lindb. (*Dicranaceae*) アカススキゴケ 熊本県人吉市, 湿岩上. 353. *Brachythecium eustegium* Besch. (*Brachytheciaceae*) オニヒツジゴケ 北海道石狩, 空知郡東山村, 西達布, 林下の倒木.
354. *Burchia microspora* Nog. (*Dicranaceae*) ヒトヨシゴケ 熊本県球磨郡木上, 泥土上. 355. *Cynodontium polycarpum* Schpr. イヌノハゴケ 長野県御嶽, 五ノ沢附近, ハイマツ群落の土崖面, 半陰地. 356. *Dicranella tosaensis* Broth. トサノススキゴケ 宮崎県日南市植原, 神社境内の粘土質地上. 357. *Dicranodontium denudatum* (Brid.) Hag. ユミゴケ 宮崎県北諸県郡飯野, 腐木上. 358. *Dieranum perindutum* Card. エゾノシッポゴケ 長野県八ヶ岳, 旭岳, シラベ林下. 359. *D. undulatum* Ehrh. ナミシッポゴケ 長野県八ヶ岳, 旭岳, シラベ林下.
360. *Distichophyllum maibarae* Besch. (*Hookeriaceae*) ツガゴケ 熊本県人吉市, 湿岩上. 361. *Ditrichum pallidum* (Schreb.) Hampe (*Ditrichaceae*) キンシゴケ 熊本県人吉市, 堤土上.
362. *Dozya japonica* Lac. (*Leucodontaceae*) リスゴケ 愛知県額田郡本宮山, 老樹々幹上.
363. *Drepanocladus exannulatus* (Gumb.) Warnst. (*Amblystegiaceae*) ミヤマカギハイゴケ 福島県南会津郡檜枝岐村, 尾瀬ヶ原, 湿原の水中に浮遊する大盆座をなす. 364. *Entodon chloroticus* Besch. (*Entodontaceae*) アオツヤゴケ 熊本県人吉市, 岩上. 365. *Fissidens nagasakius* Besch. (*Fissidaceae*) ナガサキホウワウゴケ 熊本県人吉市, 湿岩上. 366. *Funaria hygrometrica* (L.) Sibth. (*Funariaceae*) ヒョウタンゴケ 熊本県人吉市, 地上. 367. *Glyphtomium minutissimum* (Okamura) Broth. (*Ptychomitriaceae*) チャボサヤゴケ 熊本県球磨郡五木, ますがた山, 樹幹上. 368. *Grimmia apocarpa* (L.) Hedw. (*Grimmiaceae*) キボウシュゴケ 熊本県球磨郡一勝地, 岩上. 369. *Gymnostomiella longinervis* Broth. (*Splachnaceae*) フガゴケ 大分県南海部郡中野村, 小半, 風化した石灰岩上. 370. *Homaliadelphus targionianus* var. *rotundatus* Nog. (*Neckeraceae*) ヒメタチヒラゴケ 大分県大野郡川登村, 石灰岩上. 371. *Hookeria nipponensis* (Besch.) Broth. (*Hookeriaceae*) アブラゴケ 熊本県人吉市, 湿岩上. 372. *Gyrophysnum tsurugizanicum* Card. (*Amblystegiaceae*) テリハミズハイゴケ 埼玉県秩父十文字峠上部, 溪畔の倒木上. 373. *Molendoa sendtneriana* (Br. eur.) Limpr. (*Pottiaceae*) ハリバシゴケ 福岡県田川郡香春岳, 陽地の石灰岩上. 374. *Mnium subglobosum* Br. eur. (*Mniaceae*) マルバチョーテンゴケ 長野県八ヶ岳, 権現岳, シラベ林下の地上. 375. *M. trichomanes* Mitt. コツボゴケ 長野県夏沢峠, コメツガ, シラベ等の針葉樹林下. 376. *M. vesicatum* Besch. オーバチョーテンゴケ 鹿児島県屋久島一湊川, 急流水中の花崗岩礫上. 377. *Neckera konoi* Broth. (*Neckeraceae*) タカネメリンソゴケ 宮崎県鞍岡村白岩山頂上, 石灰岩上. 378. *N. menziesii* Drummond カタヒラゴケ 長野県上伊那郡美和村塩込, 落葉樹林内の陰所, 石灰岩上. 379. *N. pennata* (L.) Hedw. ハネヒラゴケ 長野県上伊那郡美和村白岩谷, 石灰岩地の老樹々皮上, 陰所.
380. *N. yezoana* Besch. エゾヒラゴケ 熊本県球磨郡五木, ますがた山, 樹幹上. 381. *Okamuraea brachydietyon* (Card.) Nog. (*Rhytidiaceae*) ホソオカムラゴケ 熊本県球磨郡西村, 樹幹上. 382-383. *Oligotrichum parallelum* (Mitt.) Kindb. (*Polytrichaceae*) タチゴケモドキ 長野県南アルプス仙丈岳, 藪沢小屋附近, 針葉樹帯(上限), 半陰, 地上; 木曾駒岳, 高山帯の水中〜地上. 384. *Oreoweisia laxifolia* (Hook.) Par. (*Dicranaceae*) タカネセンボンゴケ 長野県木曾駒岳, コメツガ帯の地上. 385. *Philonotis turneriana* Mitt. (*Bartramiaceae*) オニサワゴケ 埼玉県秩父郡大滝村, 三峯, 陽地の湿岩(石ぼく片岩)上. 386. *Pohlia elongata* Hedw. (*Bryaceae*) ナガヘチマゴケ 埼玉県秩父十文字峠頂上, コメツガ林縁の陽地上. 387. *P. revolvens* (Card.) Nog. オーヘチマゴケ 長野県夏沢峠, 針葉樹林下の集地岩上. 388. *P. scabridens* Mitt. ケヘチマゴケ 鹿児島県横川, シラス崖上. 389. *Polytrichum commune* L. (*Polytrichaceae*) ウマスギゴケ 熊本県人吉市, 地上. 390. *Rhaconitrium heterostichum* (Hedw.) Brid. (*Grimmiaceae*) クロカワキゴケ 熊本県人吉市, 湿岩上.
391. *Schlotheimia japonica* Besch. et Card. (*Orthotrichaceae*) モミゴケ 熊本県球磨郡大野, 岩上. 392. *Schwetschkea kiusiana* Sakurai (*Fabroniaceae*) ツクシケゴケ 熊本県球磨郡一武, 樹皮上. 393. *Sphagnum palustre* L. (*Sphagnaceae*) オーミズゴケ 鹿児島県屋久島小杉谷, 湿岩上. 394. *S. papillosum* Lindb. イボミズゴケ 群馬県利根郡片品村, 尾瀬沼附近, 湿原中. 395. *S. squarrosum* Crome ウロコミズゴケ 福島県南会津郡檜枝岐村, 尾瀬燧岳裏田代, 湿原周辺の林下. 396. *Thamnum sandei* Besch. (*Neckeraceae*) オートルアノオゴケ 熊本県人吉市, 岩上. 397. *Thuidium glaucinum* (Mitt.) Jaeg. (*Thuidiaceae*) アオシノブゴケ 熊本県人吉市, 岩上. 398. *T. uliginosum* Card. コモノシノブゴケ 青森県上北郡十和田村鷺沼附近, 溪畔. 399. *Trematodon flaccidisetus* Card. (*Dicranaceae*) ヒメナガダイゴケ 宮崎県日南市おび山川, 土手の露出した凝灰岩質土上. 400. *Weisia viridula* (L.) Hedw. (*Pottiaceae*) ミドリセンボンゴケ 熊本県人吉市, 土手上.

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