THE

JOURNAL

OF

THE LINNEAN SOCIETY.

BOTANY.

VOL. XXXV.

LONDON:
SOLD AT THE SOCIETY'S APARTMENTS, BURLINGTON HOUSE,
PICCADILLY, W.,
AND BY
LONGMANS, GREEN, AND CO.,
AND
WILLIAMS AND NORGATE.
1901–1904.

Dates of Publication of the several Numbers included in this Volume.

No. 242,	pp.	1– 77,	published	April 1, 1901.
„ 243,	„	77–118,	„	July 15, 1901.
„ 244,	„	119–265,	„	April 1, 1902.
„ 245,	„	265–402,	„	July 21, 1902.
„ 246,	„	403–474,	„	July 30, 1903.
„ 247,	„	475–559,	„	October 31, 1903.
„ 248,	„	559–719,	„	May 5, 1904.

PRINTED BY TAYLOR AND FRANCIS,

RED LION COURT, FLEET STREET.

LIST OF PAPERS.

EXPLANATION OF THE PLATES.

PLATE

1., 2., 3. FUNGI from the West Indies.

4., 5. TYPES of FUNGI.

6. HYPERICOPHYLLUM SCABRIDUM, N. E. Brown, n. sp.

7. SKETCH-MAP of TIBET, to illustrate W. Botting Hemsley's Paper, "The Flora of Tibet or High Asia, &c."

8. AFRICAN COMPOSITÆ: *Artemisiopsis linearis*, S. Moore, *Höhnelia vernonioides*, Schweinf.

9. DOUBLE PITCHERS of *Dischidia*.

10. SILVER-LEAF DISEASE.

11., 12. PLANTS of the CEYLON PATANAS.

13. MALDIVE and LACCADIVE ALGÆ.

14., 15., 16., 17., 18. SCOTTISH PLANKTON DESMIDS.

19. DAVIDIA INVOLUCRATA, Baill.

20., 21., 22., 23. SECTIONS of LEAVES of *Pinus*.

24. MYRIACTIS and COILODESME.

THE JOURNAL

OF

THE LINNEAN SOCIETY.

On some Fungi from the West Indies. By ANNIE LORRAIN SMITH. (Communicated by GEORGE MURRAY, F.R.S., F.L.S.)

[Read 3rd May, 1900.]

(PLATES 1–3.)

THE Fungi named and described in the following pages were, with one exception, collected in Dominica by Mr. W. R. Elliott, under the auspices of the West India Natural History Exploration Committee. They are now in the Herbarium of the British Museum.

GASTEROMYCETES.

CYATHUS STRIATUS, *Hoffm. Veget. Crypt.* p. 33, t. 8. f. 3 (1790).

On decaying wood, Roseau, Nov. 1892. No. 634.

On decaying lime-twigs, Shawford Estate, Dec. 1892. No. 802 and No. 1424.

LYCOPERDON LEPROSUM, *Berk. & Rav. in Peck's Mon. Lycop.* p. 29.

On twigs and on the ground, path up the Morne, Aug. 1892. No. 454.

On decaying wood, Shawford Estate, Roseau Valley, Dec. 1892. Nos. 800 & 803.

Lycoperdon pyriforme, *Schaeff. Icon.* t. 189.
On rotten wood, Prince Rupert's, March 1894. No. 914.

L. fuligineum, *Berk. & Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 319.
On fallen trees, Basin Hill, Aug. 1892. No. 264.
Growing on ground among rotten leaves, woods behind St. Aroment, Aug. 1892. No. 401.
On decayed leaves, Nigre Maron, Aug. 1892. No. 315.

HYMENOMYCETES.

Mycena citrinella, *Pers. Ic. Descr.* t. xi. f. 3.
Near Castle Bruce River, Feb. 1896. No. 1467.

Pleurotus semi-supinus, *Berk. & Broome, in Journ. Linn. Soc., Bot.* xi. (1871) p. 529.
River Douce Valley, Feb. 1896. No. 1391 and No. 1417.

P. applicatus, *Batsch, El. Fung.* p. 125.
On fallen tree, Basin Hill, Aug. 1892. No. 279.

P. subbarbatus, *Berk. & Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 288, no. 47.
On decaying trees, woods behind St. Aroment, Aug. 1892. No. 396.

P. Hobsoni, *Berk. Outl.* p. 138.
St. Aroment, March 1896. No. 1351.
River Douce Valley, Feb. 1896. No. 1418.

Marasmius rigidus, *Mont. Syll. Crypt.* no. 447.
River Douce Valley, Feb. 1896. No. 1410.

M. rotalis, *Berk. & Broome, in Journ. Linn. Soc., Bot.* xiv. (1875) p. 40.
Head of Castle Bruce River, Feb. 1896. No. 1451.

Lentinus Lecomtei, *Fr. Epic.* p. 368.
On rotten wood, St. Aroment, Aug. 1892. Nos. 426 & 439.

Panus torulosus, *Fr. Epic.* p. 397.
On fallen trees, Basin Hill, Aug. 1892. No. 272.

P. cantharelloides, *Mont. in Ann. Sci. Nat.* sér. 4, vol. i. (1854) p. 120.
On rotten wood, St. Aroment, Aug. 1892. No. 420.

Lenzites striata, *Swartz, Fl. Ind. Occ.* p. 19.
Prince Rupert's, Dec. 1895. No. 1279.

L. applanata, *Fr. Epic.* p. 401.
St. Aroment, Jan. 1896. No. 1350.

L. villosus, *Klotzsch, in Linnæa,* viii. (1833) p. 479.
Slope of Diablotin, March 1896. No. 1964.

L. subcervinus, *Berk. & Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 300, no. 149.
On trees, Grand Marigot, Aug. 1892. No. 364.

L. calvescens, *Berk. in Hook. Kew Journ. Bot.* viii. (1856) p. 141.
On decaying trees, Morne Couronne, July 1892. No. 184.

L. exilis, *Klotzsch, in Ann. & Mag. Nat. Hist.* ser. 1, iii. (1839) p. 379.
On tree, Grand Marigot, Aug. 1892. No. 163.
Windward slope of Diablotin, Aug. 1896. No. 1963.

L. repanda, *Fr. Epic.* p. 404.
No. 402.

Schizophyllum commune, *Fr. Syst. Myc.* i. p. 330.
On decaying trees, Morne Couronne, July 1892. No. 180.
On rotten wood, Ball Estate, Nov. 1892. No. 638.

Agaricus (§ Psathyrella) hiascens, *Fr. Syst. Myc.* i. p. 303.
Roseau, March 1896. No. 1862.

Polyporus tricholoma, *Mont. in Ann. Sci. Nat.* sér. 2, viii. (1837) p. 365.
On rotten wood, Basin Hill, Aug. 1892. No. 282.
River Douce Valley, Feb. 1896. No. 1412.

P. picipes, *Fr. Syst. Myc.* i. p. 353.
On fallen tree, St. Aroment, Aug. 1892. No. 450.

P. sulphureus, *Fr. Syst. Myc.* i. p. 357.
River Douce Valley, Feb. 1896. No. 1423.
Windward slope of Morne Diablotin, March 1896. Nos. 1947 & 1952.

P. lacteus, *Fr. Syst. Myc.* i. p. 359.
On decaying tree, Morne Couronne, July 1892. No. 191.

P. chioneus, *Fr. Syst. Myc.* i. p. 359.
On walls of rest-house at Roseau Lake, Feb. 1896. No. 1501.

POLYPORUS GILVUS, *Schwein. in Leipzig Schr. Nat. Gesell.* i. (1822) p. 96.
Morne Couliabon, Jan. 1896. No. 1570.

P. ZONALIS, *Berk. Fung. Brit. Mus., in Ann. & Mag. Nat. Hist.* x. (1842) p. 375.
Windward slope, Diablotin, March 1896. No. 1956.

P. CUBENSIS, *Mont. in Ann. Sci. Nat.* sér. 2, viii. (1837) p. 364.
On decaying trees, Morne Couronne, July 1892. No. 193.
On rotten wood, Prince Rupert's. Nos. 1270 & 1281.

FOMES LUCIDUS, *Cooke, in Grev.* xiii. (1885) p. 118.—Polyp. lucidus, *Fr. Epic.* p. 442.
Prince Rupert's, Dec. 1895. No. 1278.

F. CURTISII, *Cooke, l. c.*—Polyp. Curtisii, *Berk. in Hook. Kew Journ. Bot.* i. (1849) p. 101.
Grande Soufrière Hills, Feb. 1896. No. 1526.

F. SENEX, *Cooke, l. c.*—Polyp. senex, *Nees & Mont. in Ann. Sci. Nat.* sér. 2, v. (1836) p. 70.
On fallen trees, path to Grande Soufrière, Jan. 1895. No. 795.
Windward slope of Diablotin, March 1896. No. 1959.
On rotten wood, Prince Rupert's, Dec. 1895. No. 1288.

F. AUSTRALIS, *Cooke, in Grev.* xiv. (1885) p. 18.—Polyp. australis, *Fr. Elench.* p. 108.
Prince Rupert's, Dec. 1895. No. 1282.
Windward slope, Diablotin, March 1896. No. 1960.

F. APPLANATUS, *Cooke, l. c.*—Polyp. applanatus, *Wallr. Flora Crypt.* ii. p. 591.
On decaying timber, Morne Couronne, July 1892. No. 183.

F. FOMENTARIUS, *Cooke, l. c.*—Polyp. fomentarius, *Fr. Syst. Myc.* i. p. 374.
On fallen tree in woods between St. Aroment and Montpelier, Dec. 1892. No. 793.
Roseau Valley, Jan. 1896. No. 1346.

F. HEMILEUCUS, *Cooke, l. c.* p. 19.—Polyp. hemileucus, *Berk. & Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 312.
No. 353.

FOMES SCUTELLATUS, *Cooke, in Grev.* xiii. (1885) p. 118.—Polyporus scutellatus, *Schwein. in Trans. Amer. Phil. Soc.* New series, iv. (1834) p. 157.

On rotten wood, Salybia (Carib Settlement), Aug. 1892. No. 358.

F. CONNATUS, *Cooke, l. c.*—Polyp. connatus, *Fr. Epic.* p. 472.

Prince Rupert's, Dec. 1895. No. 1297.

F. MICROPORUS, *Cooke, l. c.*—Polyp. microporus, *Fr. Syst. Myc.* i. p. 376.

On decaying tree, Morne Couronne, July 1892. Nos. 187 & 190.

On fallen wood, Basin Hill, Aug. 1892. No. 355.

On fallen tree, Morne Diablotin, Oct. 1892. No. 625.

St. Aroment, Jan. 1896. No. 1347.

F. OBLIQUUS, *Cooke, in Grev.* xiv. (1886) p. 21.—Polyp. obliquus, *Fr. Syst. Myc.* i. p. 378.

On rotten wood, Roseau, Aug. 1892. No. 446. Prince Rupert's, Dec. 1895. No. 1271.

F. BISTRATOSUS, *Cooke, l. c.*—Polyp. bistratosus, *Berk. & Cooke, in Journ. Linn. Soc., Bot.* xv. p. 384 (1877).

Prince Rupert's, Dec. 1895. No. 1283.

POLYSTICTUS MUTABILIS, *Cooke, l. c.* p. 78.—Polyp. mutabilis, *Berk. & Curt. in Grev.* i. (1872) p. 38.

On rotten wood, Basin Hill, Aug. 1892. No. 344.

P. NEPHRIDIUS, *Cooke, l. c.*—Polyp. nephridius, *Berk. in Hook. Journ. Bot.* viii. (1856) p. 195.

On felled trees, Basin Hill, Aug. 1892. Nos. 347 & 289. Negre Maron. No. 300.

P. ALBO-CERVINUS, *Cooke, l. c.* p. 79.—Polyp. albo-cervinus, *Berk. in Hook. Journ. Bot.* viii. (1856) p. 234.

On rotten wood, Basin Hill, Aug. 1892. No. 351.

P. SANGUINEUS, *Fr. Nov. Symb.* p. 75.

On rotten wood, Prince Rupert's, Dec. 1895. Nos. 1272 & 1290.

On felled trees, Salybia (Carib Settlement), Aug. 1892. No. 368.

On rotten tree, Camp at Trois Pitons. No. 633.

POLYSTICTUS TRICHOMALLUS, *Cooke, in Grev.* xiv. (1886) p. 81.—Polyporus trichomallus, *Berk. & Mont. in Ann. Sci. Nat.* sér. 3, xi. (1849) p. 238.

On rotten wood, Prince Rupert's, Dec. 1895. No. 1287.
Morne Couliabon, Feb. 1896. No. 1569.

P. CINNABARINUS, *Cooke, l. c.* p. 82.—Polyp. cinnabarinus, *Fr. Syst. Myc.* i. p. 371.

Common on trees. No. 464.

P. VERSICOLOR, *Fr. Nov. Symb.* p. 86.

On felled or decaying trees, Morne Couronne. Nos. 177 & 186.

P. PAVONIUS, *Cooke, l. c.*—Polyp. pavonius, *Fr. Epic.* p. 477.

On fallen trees, Basin Hill, Aug. 1892. No. 311.

P. OBSTINATUS, *Cooke, l. c.*—Trametes obstinatus, *Cooke, in Grev.* xii. p. 17.

On rotten wood, Prince Rupert's, Dec. 1895. No. 1274.

P. HIRSUTUS, *Fr. Nov. Symb.* p. 86.

On rotten wood, Shawford Estate, Dec. 1892. No. 906.

P. PINSITUS, *Cooke, l. c.*—Polyp. pinsitus, *Fr. Epic.* p. 479.

On rotten wood, Prince Rupert's, Dec. 1895. No. 1268.
St. Aroment, Jan. 1896. No. 1347.
River Douce Valley, Feb. 1896. No. 1412 *a*.

P. CYCLODES, *Fr. Nov. Symb.* p. 90.

Prince Rupert's, Dec. 1895. No. 1280.
Windward slope, Diablotin, March 1896. No. 1954.
On rotten wood, Negre Maron, Aug. 1892. No. 339.

P. CROCATUS, *Fr. Nov. Symb.* p. 91.

Roseau Valley, Jan. 1896. No. 1343.
On rotten wood, Salybia (Carib Settlement), Aug. 1892.

P. BRAUNII, *Cooke, l. c.* p. 87.—Polyp. Braunii, *Rabh.* (*in Fungi Europ.* 2005), *Wint. Die Pilze*, i. p. 454.

Woods at head of Castle Bruce River, Feb. 1896. No. 1473.

PORIA MEDULLA-PANIS, *Cooke, l. c.* p. 109.—Polyp. medulla-panis, *Fr. Syst. Myc.* i. p. 380.

On fallen wood, Basin Hill, Aug. 1892. No. 330.

PORIA TEPHROPORA, *Cooke, in Grev.* xiv. (1886) p. 111.—Polyp. tephropora, *Mont. Syll. Crypt.* p. 161.

Prince Rupert's, Dec. 1895. Nos. 1269 & 1275.

Shawford Estate, Feb. 1896. No. 1430.

P. NIGER, *Cooke, l. c.*—Polyp. niger, *Berk. in Hook. Lond. Journ. Bot.* iv. (1845) p. 304.

On decaying wood, Basin Hill, Aug. 1892. No. 345.

P. RUFITINCTA, *Berk. & Curt. in Grev.* xv. (1887) p. 25 (nomen tantum).

Dominica. No. 346.

Late effusa, rufa, circa 1 mm. crassa; poris regularibus, minutissimis, circ. $\frac{1}{8}$ mm. diam., altitudine variantibus.

The effused habit of this plant, the reddish tinge, and minute size of the pores differentiate it entirely from *P. ferruginosa*. In the specimen from Dominica the pores have a brighter tinge of red throughout their length, but are brown at the opening. The type specimen, hitherto undescribed, is from Cuba, in the Kew Herbarium.

P. SANGUINOLENTA, *Cooke, l. c.* p. 112.—Boletus sanguinolentus, *Alb. & Schw. Conspec. Fung.* p. 257.

On rotten wood, St. Aroment, Aug. 1892. No. 435.

Shawford Estate, Feb. 1896. No. 1428.

P. RAVENALÆ, *Cooke, l. c.* p. 111.—Polyp. Ravenalæ, *Berk. & Broome, in Journ. Linn. Soc., Bot.* xiv. (1875) p. 53.

Head of Castle Bruce River, Feb. 1896. No. 1499.

FAVOLUS FIMBRIATUS, *Speg. Fung. Guar. Pug.* i. no. 60.

On fallen tree, Morne Massière, Aug. 1892. No. 321.

LASCHIA TREMELLOSA, *Fr. Summa Veg.* p. 325.

On decaying trees, Morne Couronne, July 1892. No. 185.

L. PEZIZÆFORMIS, *Berk. & Curt. in Proc. Amer. Acad.* iv. (1860) p. 123.

Morne Couliabon, March 1896. No. 1579.

HYDNUM VERSICOLOR, *Berk. & Broome, in Journ. Linn. Soc., Bot.* xiv. (1875) p. 59.

Growing inside rest-house at the Lake, Aug. 1892. No. 448.

The broad leathery pileus tapers down to a stem-like base, which is covered with the long spines. The spores are elliptical, $5 \times 2\mu$, and are tinged yellow.

IRPEX SINUOSUS, *Fr. Elench.* p. 145.
Morne Couliabon, March 1896. No. 1571.

I. MOLLIS, *Berk. & Curt. in Hook. Kew Journ. Bot.* i. (1849) p. 236.
Morne Couliabon, March 1896. No. 1558.

RADULUM STRATOSUM, sp. n.; effusum, fuscum, margine paullo reflexum, circa 1 mm. crassum; tuberculis dentiformibus, rare papilliformibus, minutis, obliquis, fuscis, plerumque in apicem pallidem sterilem attenuatis; thallo sectione verticali e stratis cellularum parenchymaticarum et sporarum velut inclusarum pluribus alternis composito; basidiis amplis, irregularibus, obtusis; sporis ovato-oblongis, spadiceis, levibus, $10\,\mu \times 7\,\mu$. (Pl. 1. figs. 1–5.)

"Growing in form of rosette" on rotten wood, Basin Hill, Sept. 1892. No. 343.

On rotten wood, St. Aroment, Sept. 1892. No. 443.

The outward facies of this plant is that of *Radulum*. The spores seem to have dropped off and become embedded in the tissue by the subsequent growth of the thallus; they lie in distinct layers, but they are also scattered through the tissue and the hymenium is thickly powdered with them. It is not ossible from the specimens to determine the period of growth.

GRAMMOTHELE LINEATA, *Berk. & Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 329.
Prince Rupert's, Oct. 1895. No. 1302.

G. GRISEA, *Berk. & Curt. l. c.*
Windward slope, Morne Diablotin, March 1896. No. 1955.

KNEIFFIA CANDIDISSIMA, *Berk. & Rav. in Grev.* i. (1873) p. 147.
Windward slope, Diablotin, March 1896. No. 1972. Also without locality, No. 1566.

K. SETIGERA, *Fr. Epic.* p. 529.
On decayed wood, St. Aroment, Sept. 1892. No. 466.

THELEPHORA MURRAYI, *Berk. & Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 329.
Prince Rupert's, Dec. 1895. No. 1285.

Mr. Elliott's specimen corresponds in facies with that collected by C. Wright in Cuba. It is widely effused, on very rotten wood; spores faintly brown, globose, warted, 5–$7\,\mu$ in diameter.

STEREUM ELEGANS, *G. W. F. Mey. Essiq.* p. 305.

On rotting wood, Basin Hill, Aug. 1892. No. 324. Morne Massière, Aug. 1892. No. 331.

S. VERSICOLOR, *Fr. Epic.* p. 547.

St. Aroment, Jan. 1896. No. 1353.

S. VESPILLONEUM, *Berk. in Journ. Linn. Soc., Bot.* xvi. (1878) p. 44.

On decaying trees, Morne Couronne, July 1892. No. 192.

S. LOBATUM, *Fr. Epic.* p. 547.

On rotten wood, Prince Rupert's, March 1894. No. 916. Morne Diablotin, Oct. 1892, No. 628, and March 1896, No. 1953. Hampstead Valley, March 1894. No. 2332.
Roseau Valley, Jan. 1896. No. 1345.

S. ATRATUM, *Fr. Epic.* p. 547.

On rotten wood, Basin Hill, Sept. 1892. No. 267.

S. COMPLICATUM, *Fr. Epicr.* p. 548.

Roseau Valley, Jan. 1896. No. 1342.

HYMENOCHÆTE DAMÆCORNIS, *Lev. in Ann. Sci. Nat.* sér. 3, v. (1846) p. 151.

On tree, Negre Maron, Aug. 1892. Nos. 309 & 318.
On roots of decayed tree, Prince Rupert's, March 1894. No. 913.

H. BADIO-FERRUGINEA, *Lev. in Ann. Sci. Nat.* sér. 3, v. (1846) p. 152.

Hampstead Valley, March 1896. No. 2333.

H. SCABRISETA, *Cooke, in Grev.* xi. (1883) p. 106.

On rotten wood, Basin Hill, Aug. 8, 1892. No. 348.

H. ASPERA, *Berk. & Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 334.

Covering decayed trees in woods, Basin Hill camp, Aug. 1892. No. 259.

CORTICIUM LEVE, *Pers. Disp.* p. 30.

Windward slope of Morne Diablotin, March 1896. No. 1946 *a*.

C. AUBERIANUM, *Mont. in Sagra, Cuba*, ix. p. 372.

Roseau Valley, Jan. 1896. No. 1336.

PENIOPHORA ROSEA, *Massee, in Journ. Linn. Soc., Bot.* xxv. (1898) p. 146.

Roseau Valley, Jan. 22, 1896. No. 1340.

PENIOPHORA PAPYRINA, *Cooke, in Grev.* viii. (1879) p. 20.
Shawford Estate, Feb. 12, 1896. No. 1438.

P. CINEREA, *Cooke, l. c.*
Grande Soufrière Hill, Feb. 25, 1896. No. 1528.
Hampstead Valley, March 1896. No. 2335.

CYPHELLA FRAXINICOLA, *Berk. & Broome, in Ann. & Mag. Nat. Hist.* xv. (1875) p. 32.
River Douce Valley, Feb. 1896. No. 1415. St. Aroment, Jan. 1896. No. 1381. The spores are brown and measure $7 \times 3\text{–}5\,\mu$.

C. CONVOLUTA, *Cooke, in Journ. Linn. Soc., Bot.* xvii. (1880) p. 141.
Windward slope, Diablotin. On bark of tree, March 1896. No. 1978.

C. PATENS, sp. n.; sparsa, tubæformis, dein elongata, fere ad basin fissa et expansa, margine superiore incurvata, circa 5 mm. longa, 2 mm. lata, extus flava tomentosa; hymenio brunneo, lamellis paucis angustis lamelliformis instructis; sporis globosis, minute asperulis, $5\,\mu$ diam., hyalinis. (Pl. 1. figs. 6–8.)

On bark of tree, Morne Niger Maron, Sept. 1892. No. 323.

This species seems to form a transition between the forms with a rugulose hymenium such as *C. Malbranchei*, Pat., and genera with regular gills such as *Lentinus*; the incurving margin and the shape of the immature specimens have decided the placing it in *Cyphella*.

CLAVARIA FLACCIDA, *Fr. Syst. Myc.* i. p. 471.
On felled trees in clearing. Head of Friendship Valley, St. Vincent, June 1892. No. 474.

C. LÆTICOLOR, *Berk. & Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 338.
On rotten wood, Basin Hill, Aug. 1892. No. 304.

C. CERVICORNIS, sp. n.; lignicola, 8 cm. alta, basi simplici, subtereti, 2 cm. alta; ramis subdichotomis, supra dumosis, compressis, siccitate sulcatis; planta tota carnea, dein cinnamomea, velutino-pruinosa; sporis ellipticis, echinulatis, flavido-brunneis, $6\,\mu \times 8\,\mu$.

Growing in clumps on rotten wood, Prince Rupert's, March 1894. No. 917.

Among rotten leaves, St. Aroment, Aug. 1892. No. 419.

The flattened branches and the brownish echinulate spores seem to indicate *Thelephora* rather than *Clavaria* for this species, but the hymenium covers the whole surface of the plant and necessitates the placing of it in the latter genus.

CALOCERA CORNEA, *Fr. Syst. Myc.* i. p. 486.

On rotten wood, Prince Rupert's, Dec. 1895. No. 1289.

HIRNEOLA POLYTRICHA, *Mont. in Bél. Voy. Ind. Or., Crypt.* p. 154.

Among rotten leaves, St. Aroment, Aug. 1892. No. 427.

On decaying trees, Morne Couronne, July 1892. No. 188. Roseau Valley, Jan. 1896. No. 1341.

TREMELLA FRONDOSA, *Fr. Syst. Myc.* ii. p. 212.

On decaying tree-stumps, Prince's Grove, March 1894. No. 915.

GUEPINIA SPATHULARIA, *Fr. Elench.* ii. p. 32.

On felled trees, Salybia (Carib Settlement), Aug. 1892. No. 367.

On road to Hampstead from Portsmouth, Nov. 1892. No. 827.

Windward slope, Diablotin, March 1896. No. 1971.

HYPHOMYCETES.

RHINOTRICHUM CURTISII, *Berk. in Grev.* iii. (1875) p. 108.

On bark, Shawford Estate, Feb. 1896. No. 1429.

ACROSTALAGMUS FUNGICOLA, *Preuss. in Linnæa*, xxiv. (1851) p. 126.

On decaying Agaric, Morne Couliabon, March 1896. No. 1583.

A. TETRACLADOS, sp. n.; cæspitibus tenuibus; ramis fertilibus erectis, 2–4-verticillatis; ramulis 25 μ longis, apice leviter attenuatis; capitulis sphæricis, minutis; sporis leviter curvatis, $5–7\ \mu \times 1\frac{1}{2}\ \mu$, hyalinis. (Pl. 1. figs. 9, 10.)

On a decaying Agaric, Bruce River, Feb. 1896. No. 1500.

HELICOMYCES MIRABILIS, *Peck*, 34 *Rep. State Mus.* p. 46.

On decaying tree, Basin Hill, Aug. 1892. No. 379.

On decayed *Dieffenbachia*-stem, Morne Anglais, July 1892. No. 452.

On rotten wood, head of Castle Bruce River, Feb. 1896. No. 1441.

Clonostachys Gneti, *Oudem. Microm.* i. p. 10.

On a stick, St. Aroment, Jan. 1896. No. 1368.

The spores of this specimen measure 8–10 × 1–2 μ; they are slightly longer and more slender than those recorded for the type species, but in other respects the two plants are alike.

Coniosporium asterinum, sp. n.; acervulis superficialibus in lineas radiante circa 2 mm. longas dispositis; conidiis triangularibus, sublenticularibus, atro-fuscis, 5 μ diam. (Pl. **1.** figs. 11, 12.)

On bark, Shawford, Feb. 1890. No. 1433.

Zygodesmus umbrinus, sp. n.; effusus, velutinus, 1–2 mm. altus, carneus vel umbrinus; hyphis superioribus, laxe contextis, hyalinis, spinulis conidiophoris conspersis; septis zygodesmoideis raris; conidiis globoso-ovatis, levibus, 5–6 μ × 4 μ vel 5 μ × 5 μ, umbrinis, numerosis. (Pl. **2.** figs. 1–4.)

On rotting tree, path to Grande Soufrière, Dec. 1892. No. 791.

On rotting tree-stump, Botanic Garden, Nov. 1892. No. 794.

Stilbum cinnabarinum, *Mont. in Sagra, Cuba,* ix. p. 308, t. 11. f. 3.

On bark of trees, windward slope, Diablotin, March 1896. No. 1976.

S. Hibisci, *Pat. in Journ. Bot.* v. (1891) p. 320.

On bark, head of Castle Bruce River, Feb. 1896. No. 1452.

This specimen agrees with that described by M. Patouillard from Tonkin, in colour, size of spores, length of sporophores, and also in the asperulate hyphæ of the stem, but the projecting ends of the hyphæ give the stem a papillate appearance, even under slight magnification. The Tonkin specimen has a smooth stem, but the difference may be due to conditions of growth.

S. albipes, sp. n.; minutum, sparsum vel cæspitosum, erectum, ½ mm. altum; stipite albo; capitulo flavo, globoso, nitido, circa 120μ diam.; sporis globosis, minutis, 1–2μ diam., hyalinis. (Pl. **1.** figs. 16–18.)

On bark or herbaceous stem, River Douce Valley, Feb. 1896. No. 1421.

Isaria clavata, *Ditm. in Sturm, Deutschl. Fl.* iii. 4, tab. 56.

On fragments of wood and bark, River Douce Valley, Feb. 1896. No. 1389.

Isaria citrina, *Pers. Syn.* p. 689.
Windward slope, Diablotin, March 1896. No. 1958 *a*.
Growing on *Hypoxylon effusum*, Nits.

Graphium Desmazierii, *Sacc. Syll.* i. p. 254.
On a twig, River Douce Valley, Feb. 1896. No. 1400.

Heydenia trichophora, sp. n.; stromatibus verticalibus, sparsis vel cæspitosis, atro-purpureis; stipite crasso, 2–4 mm. alto; capitulis globosis, $\frac{2}{3}$ mm. diam.; stromate et stipite e medulla parenchymatica densa brunnea compositis; conidiophoris e disco radiantibus, circa 80 μ longis, pilis paraphysiformibus tenuibus duplo longioribus, hyalinis, dense interspersis; conidiis globosis vel subovatis, minutissimis, 1–2 μ diam., hyalinis. (Pl. 2. figs. 5–7.)
On wood, head of Castle Bruce River, Feb. 1896. Nos. 1447 & 1457.

Arthrobotryum fusisporium, sp. n.; stromatibus sparsis, erectis, atro-brunneis, nitidis, 7 mm. altis, apice expansulis et flavidis; conidiis ex apice tantum ortis, elongato-fusiformibus, supra medium leviter dilatatis, utrinque attenuatis, 130–140 $\mu \times$ 8 μ, 12–15-septatis, hyalinis. (Pl. 1. figs. 13–15.)
On wood, Castle Bruce River, Feb. 1896. No. 1456.

Tubercularia vulgaris, *Tode, Fungi Meckl.* i. p. 18.
On wood, River Douce Valley, Feb. 1896. No. 1415.

Dendrodochium microsorum, *Sacc. in Mich.* ii. (1878) p. 298.
On a branch, Roseau Valley, Jan. 1896. No. 1320.

DISCOMYCETES.

Mitrula rufa, *Sacc. Syll.* viii. p. 38.
Among rotten leaves, woods above St. Aroment, Sept. 1892. No. 405.

Humaria bella, *Berk. & Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 366.
On wood, Shawford, Feb. 1896. No. 1434.

Lachnea stictica, *Sacc. Syll.* viii. p. 177.
On wood, River Douce Valley, Feb. 1896. No. 1393.

L. barbata, *Massee, in Journ. Bot.* xxx. (1892) p. 163.
On rotting trees, Basin Hill, Sept. 1892. No. 298. The

spores in this specimen measure 20–25 $\mu \times$ 10–12 μ, but in other respects it agrees with Mr. Massee's species.

SOLENOPEZIZA GRISEA, sp. n.; ascomatibus sessilibus, circa 1 mm. diam., griseis, disco paullum nigrescente, extra hyphis subflexuosis, hyalinis, apice obtusis, circa 3 μ diam. vestitis; ascis cylindraceis, curvatis, deorsum attenuatis, 120 $\mu \times 10 \mu$; sporis oblongis, 1-septatis, hyalinis, oblique monostichis, 15–17 $\mu \times 10 \mu$; paraphysibus filiformibus. (Pl. 2. figs. 8 & 9.)

On the stalks and leaves of some Monocotyledon, head of Castle Bruce River, Feb. 1896. No. 1477.

BELONIDIUM SCLEROTII, sp. n.; ascomatibus gregariis vel sparsis, ochraceis; pilis ochraceis, septatis, asperulis vestitis, disco concavo, dein leviter convexo, ad 1 mm. diam., e sclerotio parvulo ortis; ascis subclavatis, 75 $\mu \times 7 \mu$; sporis fusiformibus, 20 $\mu \times 3 \mu$, 3-septatis, hyalinis; paraphysibus filiformibus, septatis. (Pl. 2. figs. 10–12.)

On a decorticated branch, St. Aroment, Jan. 1896. No. 1367.

B. HIRTIPES, sp. n.; ascomatibus sparsis, stipitatis, aurantiacis, disco nigrescente, cupulis circa 2 mm. latis, leviter tomentosis, subplanis; stipite 2 mm. $\times \frac{1}{2}$ mm., dense tomentoso, basi dilatato; ascis cylindraceis, 130 $\mu \times 10 \mu$; sporis oblongo-fusiformibus, 3-septatis, 20–25 $\mu \times 5 \mu$, hyalinis; paraphysibus filiformibus, septatis. (Pl. 2. figs. 13–15.)

On wood, head of Castle Bruce River, Feb. 1896. No. 1443.

ERINELLA CALOSPORA, *Pat. & Gaill. in Bull. Soc. Myc.* iv. (1888) p. 101.

On bark, Morne Couliabon, Sept. 1896. No. 1578.

This specimen is somewhat smaller than the one described by Patouillard and Gaillard, and the external hairs are rough; the asci measure over 100 μ, and the spores are more than 6-septate.

OMBROPHILA PELLUCIDA, sp. n.; ascomatibus gregariis, sessilibus, basi mycelio radicelliformi instructis, subplanis, circa 8 mm. latis, tenuibus, siccitate violaceis rugosis, humiditate albidis, margine anguste brunneo-violacea; hypotheciis e hyphis teneris contextis, extra cellulis elongatis brunneis compositis; ascis 8-sporis, cylindraceis, 55 $\mu \times 5 \mu$, deorsum attenuatis; sporis oblique monostichis, hyalinis, 2-guttulatis, 5 $\mu \times 2\frac{1}{2} \mu$; paraphysibus tenuibus, rectis.

On wood, Castle Bruce River, Feb. 1896. No. 1466.

OMBROPHILA LILACINA, *P. A. Karst. Myc. Fenn.* i. p. 90.
On wood, head of Castle Bruce River, Feb. 1896. No. 1474.

ORBILIA LUTEO-RUBELLA, *P. A. Karst. Myc. Fenn.* i. p. 101.
On wood, head of Castle Bruce River, Feb. 1896. No. 1498.

CALLORIA CITRINA, sp. n.; ascomatibus breviter stipitatis vel sessilibus, circa 4 mm. latis, variicoloribus vel citrinis vel fuscis, extra cellulis amplis angulatis, demum vetustate fuscescentibus vestitis; ascis cylindraceis, 50 $\mu \times 6$ μ; sporis oblique monostichis, ellipticis, demum 1-septatis, hyalinis; paraphysibus filiformibus.
On wood, head of Castle Bruce River, Feb. 1896. No. 1476.
Morne Couliabon, March 1896. No. 1581.

COCCOMYCES LEPTOSPORUS, *Speg. Fung. Guar.* i. p. 138.
On rotten leaves, St. Aroment, Jan. 1896. No. 1383.

PYRENOMYCETES.

EUTYPA PHASELINA, *Sacc. Syll.* i. p. 179.
Growing in regular lines on a decorticated branch, Shawford Estate, Feb. 1896. No. 1439.

ROSELLINIA SUBICULATA, *Sacc. Syll.* i. p. 255.
On decaying wood, head of Castle Bruce River, Feb. 1896. No. 1475.

R. AMBLYSTOMA, *Berl. & F. Sacc. in Rev. Mycol.* p. 118 (1889).
On rotten wood, some kind of cane, head of Castle Bruce River, Feb. 1896. No. 1442.

XYLARIA POLYMORPHA, *Grev. Fl. Edin.* p. 35.
On rotten trees, St. Aroment, Aug. 1892. No. 442.

X. CUBENSIS, *Mont. Syll. Crypt.* no. 782.
On fallen trees, Morne Mahaut, Aug. 1892. No. 302.

X. ANISOPLEURA, *Mont. Syll. Crypt.* no. 688.
On rotten trees, Morne Mahant, Aug. 1892. No. 270.
Head of Castle Bruce River, Feb. 1896. No. 1468.

X. RHOPALOIDES, *Mont. in Ann. Sci. Nat.* sér. 4, iii. (1855) p. 99.
On rotten wood, windward slope, Diablotin, March 1896. No. 1961.

X. HYPOXYLON, *Grev. Fl. Edin.* p. 355.
Roseau Valley, Jan. 1896. No. 1345.

USTULINA VULGARIS, *Tul. Sel. Fung. Carp.* ii. p. 23.
On decaying wood, Prince Rupert's, Dec. 1895. No. 1276.

HYPOXYLON PERFORATUM, *Fr. Summ. Veg. Scand.* p. 384.
On rotten wood, Shawford Estate, Feb. 1896. No. 1432.
Windward slope, Diablotin, March 1896. No. 1970.

H. RUBIGINOSUM, *Fr. l. c.* p. 384.
On wood, Shawford, Feb. 1896. No. 1429 *b*.

H. EFFUSUM, *Nits. Pyr. Germ.* p. 48.
On branches &c., Laudat, Feb. 1896. No. 1502.
Windward slope, Diablotin, Feb. 1896. No. 1502.

H. COLLICULOSUM, *Nits. l. c.* p. 44.
Head of Castle Bruce River, Feb. 1896. No. 1478.

KRETZSCHMARIA CŒNOPUS, *Sacc. Syll.* ix. p. 565.
On bark, Prince Rupert's, Dec. 1895. No. 1298.

DALDINIA CONCENTRICA, *Ces. & de Not. Schema Sf. It. in Comm. Crit.* i. p. 198.
On rotten wood, Prince's Grove, March 1894. No. 919.
St. Aroment, Jan. 1896. No. 1348.

RHYNCHOSTOMA PYRIFORME, sp. n.; peritheciis cæspitosis, basi confluentibus, omnino superficialibus, atris, globoso-pyriformibus, rostro leniter curvulo, noduloso instructis, basi circa 1 mm. latis, fere 2 mm. longis; ascis cylindraceis, breviter stipitatis, 85 μ longis; sporis oblique et irregulariter monostichis, oblongo-ovatis, 1-septatis, brunneis, 10 $\mu \times 4$ μ. (Pl. 2. figs. 16–18.)
On rotten wood, head of Castle Bruce River, Feb. 1896. No. 1449.

XYLOBOTRYUM ANDINUM, *Pat. in Bull. Herb. Boiss.* iii. (1895) p. 69.
On wood, head of Castle Bruce River, Feb. 1896. No. 1481.

XYLOCERAS, g. n.

Stroma erectum, atrum, intus ex hyphis laxis compositum, cellulis corticis et peritheciis parvulus confertis; peritheciis ostiolatis, superficialibus, confertis; ascis 8-sporis, stipitatis; sporis irregulariter bi-seriatis, 1-septatis, brunneis.

XYLOCERAS ELLIOTTI, sp. n.; stromatibus cæspitosis, apice attenuatis, 1 cm. altis, 1–2 mm. latis, basi et apice sterilibus;

hyphis internis circa 10 μ latis, brunneis; peritheciis subglobosis, circa 280 μ latis; ascis cylindraceo-clavatis, stipite 45 μ longo, basi leviter dilatata, parte sporifera 35 μ longa; sporis ovatis, 10 $\mu \times 4 \mu$; paraphysibus filiformibus. (Pl. **3.** figs. 1–5.)

On wood, head of Castle Bruce River, Feb. 1896. No. 1464.

CERIOSPORA ACUTA, sp. n.; peritheciis carbonaceis, atris, sparsis vel confertis et fere confluentibus, superficialibus, exiguis, inferne circa $\frac{1}{2}$ mm. latis, apice lineis brunneis longitudinaliter ornato attenuatis, 200 μ longis; sporis primum cylindraceis, utrinque appendiculatis dein demum dilatatis, grosse guttulatis, 2–pluri-septatis, circa 45 $\mu \times 8 \mu$, hyalinis. (Pl. **2.** figs. 19–21.)

On wood, Castle Bruce River, Feb. 1896. No. 1470.

ACANTHOSTIGMA SCLERACANTHUM, *Sacc. Syll.* ii. p. 209.

On rotten wood, Castle Bruce River, Feb. 1896. No. 1459.

HYPOMYCES ARENACEUS, sp. n.; peritheciis sparsis vel confertis, velut si arenæ micæ sint, fulvis, exiguis, circa 150 $\mu \times 250 \mu$; ascis cylindraceis, angustis, 100 μ longis; sporis monostichis, ovato-oblongis, circa 10 $\mu \times$ 4–5 μ, 1-septatis, hyalinis; paraphysibus filiformibus. (Pl. **3.** figs. 6–8.)

On the hymenial surface of a decaying *Stereum*. Roseau Valley, Jan. 1896. No. 1345.

NECTRIA RUSSELLII, *Berk. & Curt. in Grev.* iv. (1875) p. 45.

On rotting trees, Basin Hill, Aug. 1892. No. 299.

N. LÆTICOLOR, *Berk. & Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 377.

On wood, River Douce Valley, Feb. 1896. No. 1419.

N. SANGUINEA, *Fr. Summ. Veg. Scand.* p. 388.

On bark of tree, windward slope, Diablotin, March 1896. No. 1977.

N. CHRYSOCOMA, *Berl. & Vogl. Sacc. Syll.* Add. ad vols. i.–iv. p. 204.

On bark, Antigua. Collected by Mr. W. Cran, April 1897.

SPHÆROSTILBE CINNABARINA, *Tul. Carp.* iii. p. 103.

On rotten wood, Montpelier, Dec. 1892. No. 788.

HYPOCREA RUFA, *Fr. Summ. Veg. Scand.* p. 383.

On decaying wood, Shawford, Feb. 1896. No. 1859.

Trichoderma viride, Pers., the conidial form, is growing with the *Hypocrea*.

HYPOCREA DELICATULA, *Tul. Carp.* iii. p. 33.
On bark, Morne Couliabon, March 1896. No. 1573.

CALONECTRIA ORNATA, sp. n.; peritheciis minutis, sparsis, circa $\frac{1}{3}$ mm. latis, aurantiacis, superficialiter cellulis prominentibus vestitis; ascis cylindraceo-fusiformibus, apice angustioribus, deorsum attenuatis, breviter pedicellatis, 180–200 $\mu \times$ 20–30 μ; sporis elongatis, ascis fere æquilongis, 10–pluri-septatis, viridi-hyalinis. (Pl. **3.** figs. 9 & 10.)
On twigs, River Douce Valley, Feb. 1896. No. 1416.

HYPOCRELLA RUBIGINOSA, sp. n.; stroma pulvinatum, rubiginosum, circa 5 mm. latum, basi late affixum, rugosum, peritheciis prominulis, punctatum; peritheciis elongatis, angustatis, circa 1 mm. longis, $\frac{1}{4}$ mm. latis, basi rotundatis, deorsum attenuatis, ostiolum versus attenuatis; ascis 8-sporis, apice rotundatis, deorsum attenuatis, 500 $\mu \times$ 8 μ; sporis filiformibus, leviter curvulis, vel rectis fere ascis æquilongis, pluri-septatis, hyalinis. (Pl. **3.** figs. 11–14.)
Parasitic on an old specimen of *Hypoxylon*, Castle Bruce River, Feb. 1896. No. 1497.

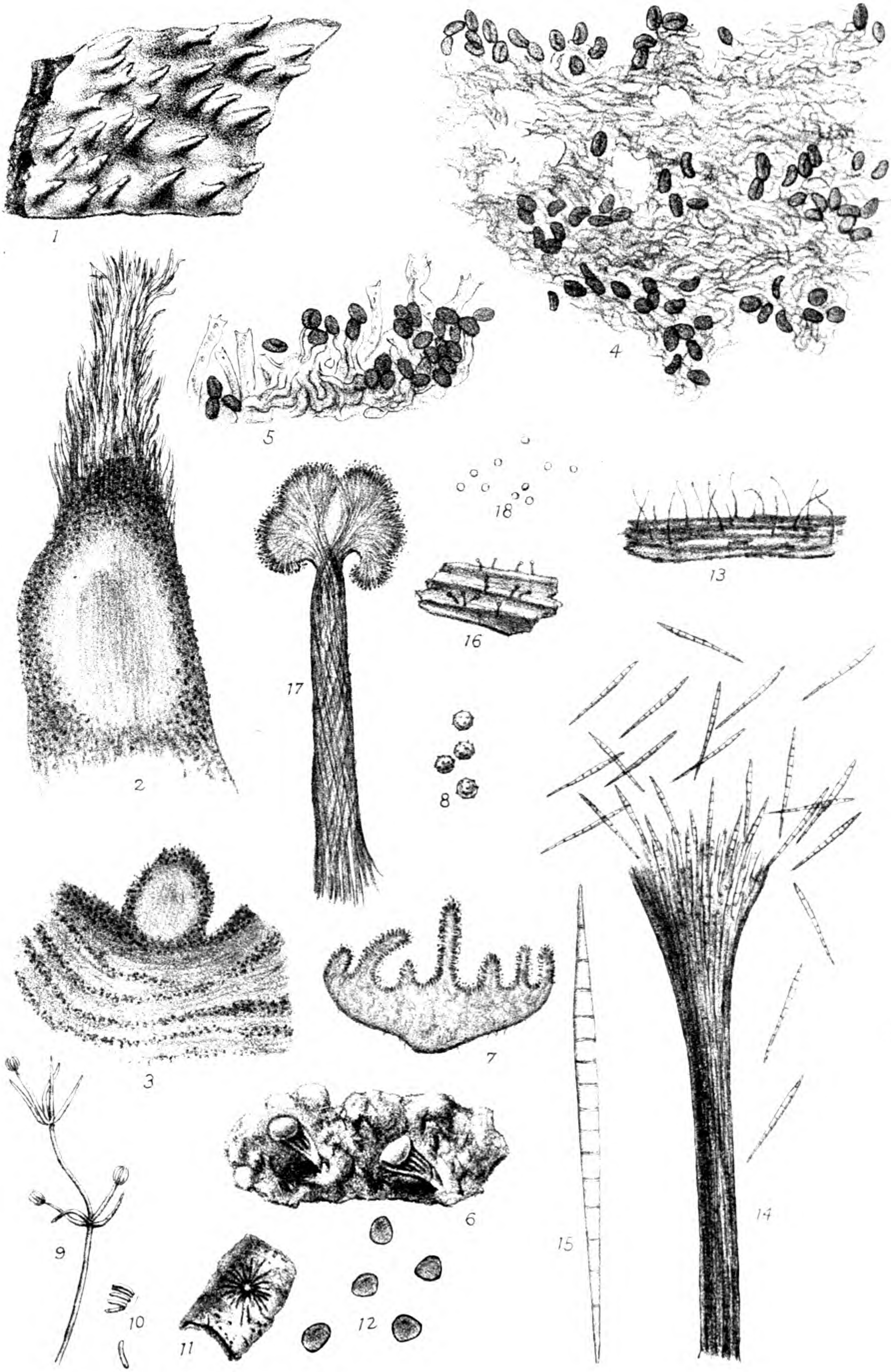
SPHÆROPSIDEÆ.

DOTHIORELLA GUARANITICA, *Speg. Fung. Guar.* ii. no. 162.
On bark, Shawford, Feb. 1896. No. 1553.
Roseau Valley, March 1890. No. 1862 *b*.

EXPLANATION OF THE PLATES.

PLATE 1.

Fig. 1. *Radulum stratosum*, × 3.
2. „ „ Sterile tip of tooth, × 70.
3. „ „ Vertical section with spore-layers, × 25.
4. „ „ Part of section with spores embedded, × 300.
5. „ „ Basidia and spores, × 300.
6. *Cyphella patens*, natural size.
7. „ „ Section of plant, × 25.
8. „ „ Spores, × 500.
9. *Acrostalagmus tetraclados*. Fertile branch, × 500.
10. „ „ Spores, × 500.
11. *Coniosporium asterinum*. Plant, slightly enlarged.
12. „ „ Spores, × 500.



A. L. S. del. Highley del. et. lith.

Hanhart imp.

FUNGI FROM THE WEST INDIES.

A.L.S.del. Highley.del.et lith. Hanhart imp.

FUNGI FROM THE WEST INDIES.

A.L.S. del. Highley del. et lith.   Hanhart imp.

FUNGI FROM THE WEST INDIES.

Fig. 13. *Arthrobotryum fusisporium.* Plants, natural size.
14. " " Head of plant, × 100.
15. " " Spore, × 500.
16. *Stilbum albipes.* Plants, slightly enlarged.
17. " " Plant, × 100.
18. " " Spores, × 500.

PLATE 2.

Fig. 1. *Zygodesmus umbrinus.* Section of plant, × 30.
2. " " Zygodesmoid hyphæ, × 500.
3. " " Sporiferous hyphæ, × 500.
4. " " Spores, × 500.
5. *Heydenia trichophora.* Plants, natural size.
6. " " Section of head, × 30.
7. " " Spores, × 500.
8. *Solenopeziza grisea.* Section of plant, × 30.
9. " " Ascus, × 500.
10. *Belonidium Sclerotii.* Plants, natural size.
10 *a.* " " Section of plant, × 30.
11. " " Ascus, × 500.
12. " " Spores, × 500.
13. *B. hirtipes.* Section of plant, slightly enlarged.
14. " " Ascus, × 500.
15. " " Spores, × 500.
16. *Rhynchostoma pyriforme.* Plants, slightly enlarged.
17. " " Ascus, × 430.
18. " " Spores, × 500.
19. *Ceriospora acuta.* Plants, natural size.
19 *a.* " " Plant, × 30.
20. " " Ascus, × 200.
21. " " Spores, × 500.

PLATE 3.

Fig. 1. *Xyloceras Elliotti.* Plant, natural size.
2. " " Plant, slightly enlarged.
3. " " Section of plant, × 30.
4. " " Ascus, × 500.
5. " " Spores, × 500.
6. *Hypomyces arenaceus.* Plants, enlarged.
7. " " Section of plant, × 100.
8. " " Ascus, × 500.
9. *Calonectria ornata.* Plant, × 100.
10. " " Ascus, × 430.
11. *Hypocrella rubiginosa.* Plant on host, natural size.
12. " " Sections, natural size.
12 *a.* " " Section of plant and host, enlarged.
13. " " Section of perithecia, × 30.
14. " " Ascus with spores escaping, × 500.

THE FLORA OF VAVAU, one of the Tonga Islands. By I. H. BURKILL, M.A., F.L.S.; with a short Account of its Vegetation by CHARLES STEELE CROSBY, M.A.

[Read 20th December, 1900.]

THE Tonga or Friendly Islands are composed of three groups: to the south is Tongatabu, a low coral island, with Eua near it; in the centre lie the Habai Islands, small and numerous; and to the north is Vavau, with its attendant islets.

They are the summits which rise from an extensive submerged plateau—the higher ones a line of volcanoes. Eua attains to more than 1000 ft.; Vavau has two hills rising to 600 ft., and some of the volcanoes exceed Eua in height.

"Generally," says Lister*, "all the high ground of the group is either the summits of volcanoes, active or extinct, or composed of reef-limestones," and "while the contour of the sea-bottom, with the great southerly extension of the Tonga plateau, suggests that a closer connection may at one time have existed between New Zealand and land to the northward, the geological structure of the present Tonga Islands would not lead us to expect that an ancient fauna and flora survives on them; for all the high ground of the group either consists of the outpourings of volcanoes or has been submerged within the period during which the existing reef-limestones have been formed."

Tongatabu has been visited by more collectors of plants than all the other islands. Cook touched at it in each of his three voyages, and the specimens then obtained are in the Natural History Museum, S. Kensington. It was visited by the United States exploring expedition under Captain Wilkes, by the 'Challenger,' and by the German 'Gazelle' expedition. Graeffe collected all his Tonga plants in it, and J. J. Lister and Sir Everard Home many of theirs.

Vavau was visited by the 'Gazelle' expedition; but I only know of the collection there by the officers of this vessel of three marine plants. Barclay, Harvey, and Sir E. Home also collected in it.

Of other islands in the group, Eua was explored by J. J. Lister, Lifuka by Harvey, and Nomuka by Forster. The last two are among the Habai Islands.

All the collections of the travellers named were made use of by Mr. W. B. Hemsley when he published through this Journal

* J. J. Lister in Journ. Linn. Soc., Bot. xxx. (1894) pp. 160, 162.

(Botany, vol. xxx. 1894, pp. 158–217) his paper entitled "The Flora of the Tonga or Friendly Islands." By the nature of the available material it is in chief part the flora of the southern islands—Tongatabu and Eua.

Mr. Crosby's collection from Vavau—the foundation of the present paper—was not received at Kew until half a year after Hemsley's "Flora of the Tonga Islands" had been published.

Hemsley had enumerated for the whole group 303 phanerogams and 33 vascular cryptogams; Crosby collected, in Vavau, 262 phanerogams and 27 vascular cryptogams; and out of his total, 83 are species additional to Hemsley's list.

Many of Crosby's plants were received with correct names which he had given to them on the spot; the vascular cryptogams and orchids were subsequently examined by Mr. J. G. Baker and Mr. R. A. Rolfe; to these, and to Messrs. W. B. Hemsley, C. B. Clarke, and C. H. Wright, I offer thanks for their kind assistance, and, further, to Mr. Crosby for the account of the vegetation of Vavau which follows.

Vegetation of Vavau, by C. S. Crosby.

Vavau is twelve miles long and has a maximum breadth of six miles. The two hills, Mo'ugalafa and Talau, which rise towards the rock-bound northern coast (the Liku), reach an elevation of 600 ft. above sea-level. The southern coast is much indented, and possesses the lovely harbour of Vavau, where, to one sailing perhaps not a stone's throw from the beach, nothing but the green of the trees and their interlacing creepers can be seen, so well is the face of the land buried from sight by the canopy which the giant climbers weave with the tree-tops.

The grassy uplands towards the Liku contrast with this dense forest. They are marked by the weird Casuarinas and zigzag-branching *Pandanus*, and, of smaller plants, by *Waltheria americana*, *Euphorbia Chamissonis*, *Wikstrœmia rotundifolia*, and *Dianella ensifolia*. In the forest-land we have (i) the sea-shore vegetation, (ii) the bush, and (iii) the land now or formerly in cultivation. On the shore we find *Paritium tiliaceum*, *Thespesia populnea*, *Vitex trifolia*, *Mæsa nemoralis*, *Cordia subcordata*, *Calophyllum Inophyllum*, *Pemphis acidula*, *Gymnosporia vitiensis*, species of *Eugenia*, the mangroves, &c. *Suriana maritima* does not occur in Vavau itself. I found it just above a sandy beach in one of the small low attendant islands which lies to the south-east. In the bush are to be found the majority of the climbing plants, chief among them being *Mucuna gigantea* and *Entada scandens* with its huge hanging pods. In or near cultivated ground, besides the plants actually in cultivation, such as banana, yam, sweet potato, paper-mulberry (which furnishes the native cloth, tapa), sugar-cane, maize, &c., we meet bread-fruit, custard-apple, papaw, pine-apple, *Gossypium brasiliense*, *Manihot utilissima*, *Curcuma longa*, *Zingiber Zerumbet*, *Canna indica*, and *Cordyline terminalis*. In the towns we come upon orange-trees, Kava (*Piper methysticum*), tobacco, &c. A town is merely a collection of huts dotted about a grassy space in the midst of cocoanut- and orange-trees, and generally surrounded by a fence. The orange—"Moli-papalagi," or white man's orange (papalagi = a white man)—was introduced early in the nineteenth century. The "Moli Toga," or Tongan orange, is a shaddock. The lime is also common, and huge fruits of a citron are sometimes to be seen.

One small part of Vavau has a flora all its own. Bordering a lake near the town of Tuanuku is a small fen, the entrance to which is very difficult to find. This is the home of *Gleichenia dichotoma*, *Davallia solida*, *Lindsaya ensifolia*, *Lycopodium cernuum*, *Psilotum complanatum*, *Ophioglossum pendulum*, *Lepironia mucronata*, *Spathoglottis pacifica*, and *Phaius grandifolius*.

I met with *Schizæa digitata* only in Lotuma, a little island in Vavau harbour.

The sensitive plant is the prevailing weed of the islands, and it quickly and painfully reveals imperfections in the soles of one's shoes, though a native walks over it unconcernedly. The sensitive plant, however, may be avoided; not so *Chrysopogon aciculatus*, the awns of which cleave to one's socks, and are apt to produce irritating sores which may confine the sufferer to his couch for months.

Of useful plants which are grown, *Pometia pinnata* (Tava), *Anona squamosa*, *Spondias dulcis* (Vi), and *Carica papaya* (Oliji) may be mentioned for their pleasant fruits. *Eugenia malaccensis* (Fekika) has fruits resembling an apple in flavour but less coarse. *Artocarpus integrifolia*, the bread-fruit, from the domestic point of view, is a vegetable and not a fruit: like the yam, sweet potato, and Talo (*Colocasia antiquorum*—Taro in other parts of the Pacific) it must be cooked. The small beans of *Dolichos Lablab* make an excellent vegetable, though they are only used by white people. The natives grow sugar-cane for mastication only. Tobacco is smoked in the form of a "suluka"—a kind of cigarette in which the dried banana-leaf replaces the cigarette-paper. The oil of the Dilo-nut, or Feta'u as the Tongans call it (*Calophyllum Inophyllum*), is well known as a remedy for rheumatism. The leaves of the Toi (*Alphitonia excelsa*) make an excellent substitute for soap, more effective than those of Fihoa (*Colubrina asiatica*). The fan-shaped leaves of the Biu (*Pritchardia*), when dried, are used by the native preachers as wraps for their black suits when they go from home to conduct services.

There are some fine specimens of the "Ovava-tahi" (*Ficus prolixa*) in the islands, notably one on Bagaimotu (Vavau group), the trunk of which forms an arch through which a coach could easily be driven.

The pigs, which are common in the island, find a favourite food in the tubers of *Cyperus rotundus*. One frequently comes across great patches of turned-up earth, showing where they have grubbed out these tubers. They clean out oranges in very neat style. The horses first taught me to distinguish *Cordyline terminalis* from *Canna indica* by the leaves (the flowers and fruits of course are very different). The way they nose out the former, though hidden among a mass of *Canna indica*, is surprising. But bread-fruit leaves are their chief delight, and a horse can be coaxed from a bread-fruit tree only by the use of the whip.

The young leaves of several trees have a pink or red colour. The young shoots of Tatau-amanu (*Cynometra*), when freed from the enveloping bud-scales, resemble a pendulous chain of red flowers. For a perfect blaze of colour, nothing exceeds the Fekika in flower (*Eugenia malaccensis*). The flowers of the Ipomœas are showy, but with the exception of the blue *I. congesta* they do not form compact masses. They have a way of peering out in solitary splendour from dark depths of foliage not their own. The orange-tree in flower is a beautiful, as well as fragrant, object; and it is difficult to say whether an orange-grove in flower or in fruit is the more pleasing sight. In the absence of flowers and fruit the tree is a shabby object.

When the more striking wonders of tropical scenery—the bright hues and fragrant odours of flowers, and the ceaseless waving of the palm-leaves—have lost their novelty, the quiet beauty of the Tavahi (*Rhus taitensis*) may perhaps arrest attention. To my mind the Tavahi, with its pinnate leaves and panicles of white flowers, is the most beautiful tree in these islands.

Lastly, a few words on climate. There is little to remind one of change of seasons, except perhaps a touch of prickly heat in December. The temperature is very even, ranging practically from 70° F. to 90° F. One bitterly cold night we found the thermometer had gone down to 63° F. From January to March may be considered the rainy season, during which time also the advent of hurricanes is dreaded. The annual rainfall is about 150 inches. My notes contain such entries as the following:—16 in. in three days ($9\frac{1}{2}$ in. on one of the days); 4 in. in a night, followed by 6 in. in a day; 4 in. in two hours, &c. The rain is by no means confined to this season. I find an entry for July of 7 in. in two days. A different kind of entry (also for July) reads "no rain for three months." In such circumstances every drop of water becomes precious, for the island furnishes no fresh-water. The natives acquire freshwater by collecting rain in holes in the ground, and when their store fails, as it usually does, they sponge on the "Papalagi." I had a 500-gallon tank. The first night's rain filled it to overflowing, and it never became dry, notwithstanding continual visits of Tongan neighbours with buckets.

The dampness and warmth of the atmosphere produce certain inconveniences. A pair of boots left undisturbed soon becomes covered with mould; salt is always wet, and butter is a liquid.

C. S. Crosby.

To the enumeration of the Phanerogams and Vascula Cryptogams of Vavau I have added the dispersal of each of the species, naming first any of the Tonga Islands whence the plant is known, then Fiji and Samoa, if it is found in them, and after that the wider distribution. The islands of Futuna and Uea, between Fiji and Samoa, are reckoned to Fiji; Easter Island is considered as belonging to the Low Archipelago, and the Isle of Pines as belonging to New Caledonia.

The endemic flora of the Pacific is centred in three (or perhaps four) nuclei. These are New Caledonia, the Fijian Archipelago, the Sandwich Islands, and the fourth, if recognized, Tahiti. The influence of the Fijian nucleus extends to Samoa and the Tonga Islands, and the area comprising these is here called the Fiji-Samoan area. Savage Island also belongs to it.

Of the flora of Vavau:

33 phanerogams (11·8 %) are confined to the Fiji-Samoan area.
12 „ (4·3 %) occur in it, and only to the east of it.
55 „ (19·6 %) „ „ west „
67 „ (23·9 %) are restricted to the Pacific.

The phanerogams confined to the Fiji-Samoan area are thus distributed:

12 phanerogams are confined to the Tonga group.
9 „ „ Tonga and Fiji.
6 „ „ „ Samoa.
5 „ „ Fiji and Samoa.
1 „ „ „ Savage Island.

One hundred and eighty-seven phanerogams of Vavau are not world-wide in the tropics, and they are distributed as follows:—

East and West extension of the Phanerogams of Vavau, which are not world-wide.

Westward Extension.	Eastward Extension.						Totals.
	Fiji-Samoan area.	Cook Islands.	Society Islands and Tahiti.	Marquesas Islands.	Low Archipelago.	Tropical America.	
Fiji-Samoan area	33	1	5	3	3	...	45
New Hebrides	1	...	...	1	1	...	3
New Caledonia	5	...	6	1	3	1	16
Solomon Islands	2	...	1	1	...	...	4
Australia-Malaya	16	...	7	3	2	1	29
Tropical Asia	13	2	5	6	3	1	30
Mascarene Islands	3	...	7	2	6	...	18
East Africa	9	...	1	5	3	3	21
West Africa	6	2	3	7	3	...	21
Totals	88	5	35	29	24	6	187

Ninety-two species, besides several plants universally cultivated in the Pacific, are common to Vavau and the Sandwich Islands.

Vavau possesses none of the Cyrtandreæ which are characteristic of the mountains of Fiji; no Melastomaceæ except *Memecylon Harveyi*, no Saxifragaceæ, no Vacciniaceæ, and the orders Rubiaceæ and Orchidaceæ are poorly represented. Herein its flora differs strikingly from that of Fiji, where the greater elevation, greater age (greater permanence), and wider range of soil and climate favour a richer flora.

Enumeration of Phanerogams and Vascular Cryptogams of Vavau, not including certain species only in cultivation.

An asterisk is prefixed to the names of plants not represented in Mr. Crosby's collection.

Anonaceæ.

Cananga odorata, *Hook. f. & Thoms.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 168; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 631.

Tongatabu; Fiji and Samoa; westward in the Solomon Islands; and to Tropical Asia. Extended from Tropical Asia by cultivation.

*Anona squamosa, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 168.

Introduced from America into all parts of the Tropics.

Menispermaceæ.

Stephania hernandiæfolia, *Walp.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 168.

Tongatabu; Samoa; eastward to the Marquesas Islands; westward to Africa.

Bixaceæ.

Bixa Orellana, *Linn. Sp. Pl.* p. 512.

A native of Tropical America now widely cultivated.

Xylosma orbiculatum, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 169; *Drake del Castillo, Fl. Polyn. Franç.* p. 7.

Fiji and Samoa; eastward to the Marquesas Islands, in insular forms of perhaps subspecific rank.

Pittosporaceæ.

Pittosporum arborescens, *Rich.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 169.

Tongatabu, Eua; Fiji.

Pittosporum spathaceum, *Burkill, in Hook. Ic. Plant.* t. 2561.

Endemic.

PORTULACACEÆ.

PORTULACA QUADRIFIDA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 169.

Fiji and Samoa; westward in New Caledonia and to Africa.

*PORTULACA OLERACEA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 169.

Samoa; eastward to Tahiti; Sandwich Islands; westward in the Marshall Islands. Tropics generally.

GUTTIFERÆ.

*GARCINIA sp. Noted by Mr. Crosby, but not collected.

CALOPHYLLUM INOPHYLLUM, *Linn. Sp. Pl.* p. 513; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 656.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the Solomon Islands; and to East Africa.

CALOPHYLLUM sp.

There exists also in Eua and Vavau and in some of the not remote islands a second species of *Calophyllum*, for the full identification of which we hope, by the kindness of Mr. Crosby, to receive further material.

MALVACEÆ.

SIDA MICROPHYLLA, *Cav.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 169.

Tongatabu; Fiji and Samoa; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to the Mascarene Islands.

SIDA RHOMBIFOLIA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 169.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in New Caledonia and the Solomon Islands. Tropics generally.

SIDA CARPINIFOLIA, *Linn. f. Suppl.* p. 307.

Sandwich Islands; westward in New Caledonia. Tropics generally.

URENA LOBATA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 169.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides and New Caledonia. Tropics generally.

HIBISCUS ABELMOSCHUS, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 170.

Fiji and Samoa; eastward to Tahiti; westward in the New Hebrides. Tropics generally.

*HIBISCUS TILIACEUS, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 170; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 654.

Tongatabu; Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in New Caledonia, Solomon Islands. Tropics generally.

GOSSYPIUM BRASILIENSE, *Macf. Fl. Jamaic.* i. p. 72.

Introduced; widely cultivated.

THESPESIA POPULNEA, *Corr.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 170; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 653.

Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in New Caledonia and the Solomon Islands; and to Africa.

STERCULIACEÆ.

HERITIERA LITTORALIS, *DC.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 170.

Tongatabu; Fiji; westward in New Caledonia; and to East Africa.

KLEINHOVIA HOSPITA, *Linn. Sp. Pl.* (ed. 2) p. 1365; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 655.

Fiji and Samoa; eastward in the Society Islands; westward in New Caledonia and the Solomon Islands; and to the Mascarene Islands.

MELOCHIA ODORATA, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 170.

Tongatabu; Fiji and Samoa; westward in the New Hebrides, New Caledonia, and Solomon Islands; and into Malaya.

WALTHERIA AMERICANA, *Linn. Sp. Pl.* p. 673.

Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward in the New Hebrides and New Caledonia. Tropics generally.

TILIACEÆ.

GREWIA MALOCOCCA, *Linn. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 170; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 652.

Tongatabu; Fiji and Samoa; eastward to Tahiti; westward in New Caledonia.

TRIUMFETTA PROCUMBENS, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 170.

Tongatabu, Eua; Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in the New Hebrides, New Caledonia, and the Solomon Islands: and to the Mascarene Islands.

TRIUMFETTA RHOMBOIDEA, *Jacq. Enum. Pl. Carib.* p. 22.

Samoa; eastward to Tahiti; Sandwich Islands; westward in the New Hebrides and New Caledonia; and to Africa.

ELÆOCARPUS TONGANUS, *Burkill*; species ex affinitate *E. floridani*, Hemsl., et *E. glanduliferi*, M. T. Mast., differt præcipue petalis; etiamque ab *E. Græffei*, Seem., foliis distinguitur.

Rami glabri, foliorum cicatricibus inconspicue notati, crassiusculi. *Folia* glabra, dense ad apices ramorum conferta; lamina ovata vel elliptica, breviter acuminata, basi obtusissima, 3–4 poll. longa, $1\frac{1}{2}$–2 poll. lata, margine integra vel dentibus perpaucis et parvis instructa, nervis lateralibus utrinque 6–7 ad costam infra foveola singula iis *E. glanduliferi* minora formantibus; petiolus $\frac{3}{4}$–1 poll. longus, ad laminam pulvinatus. *Racemus* simplex, foliis æquilongus, flores ad 25 gerens; bracteæ deciduæ. *Flores* in alabastris ovatis in anthesi $1\frac{1}{2}$ lin. diametro. *Sepala* dorso pilis argenteis minutis pubescentia, supra carinata, lanceolata, 3 lin. longa. *Petala* intra et extra fulvo-pubescentia, intra carinata, carina pilis reflexis densissime vestita, apice leviter 7–9-fida, basi 2-foveolata. *Stamina* 2 lin. longa; antheræ apice appendiculatæ; filamenta sparse hirsuta. *Discus* crenatus. *Ovarium* glabrum, 3–4-loculare; ovula ad 6 in loculo quoque. *Fructus* oliviformis, 7 lin. longus; nucleus osseus, sæpissime triangularis, lateribus verrucosus; semen solitarium; embryo in albumine corneo oleiferi immersus.

Hab. Tonga Islands. Vavau, *Crosby*, 15.

Its allies, *Elæocarpus glandulifer* from Ceylon, *E. floridanu* from the Solomon Islands, and *E. Græffei* from Fiji, are so closely allied that it is possible to regard them as insular subspecies. *E. bifidus*, Hook. & Arn., from the Sandwich Islands, and *E. rarotongensis*, Hemsl., from Rarotonga, are also closely allied.

RUTACEÆ.

EVODIA HORTENSIS, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 141; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 642.

Tongatabu; Fiji and Samoa; westward in the New Hebrides and Solomon Islands; and into Malaya.

ZANTHOXYLUM BLACKBURNIA, *Benth. Fl. Austral.* i. 363.

Westward in Lord Howe's Island and Norfolk Island.

MICROMELUM PUBESCENS, *Blume*, var. GLABRESCENS, *Oliver*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 171.

Tongatabu; Fiji and Samoa; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to Tropical Asia.

SIMARUBACEÆ.

SURIANA MARITIMA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 171.

Islets to the south-east of Vavau (not on Vavau itself, nor in Fiji or Samoa); eastward to the Low Archipelago; Sandwich Islands; westward in the New Hebrides and New Caledonia; and to East Africa. Also in America.

BURSERACEÆ.

GARUGA PACIFICA, *Burkill*; staminibus glabris, disco margine æquali, petalis ovatis satis distincta.

Rami crassi, cortice brunnei. *Folia* imparipinnata, 14–18 poll. longa, 6–8-juga; petiolus pubescens; foliola ovato-lanceolata, $2\frac{1}{2}$–4 poll. longa, 12–20 lin. lata, basi obliqua obtusa, apice acuminata, margine crenato-serrata, breviter petiolulata, ad basin petiolulorum præsertim inferiorum pinnula parva ornata, novella supra et infra parce pubescentia, dein aliquatenus glabrescentia *Inflorescentia* 6–8 poll. longa, ampla, paniculata, pubescens; pedicelli 1–3 lin. longi. *Calyx* externus pubescens, lobis $\frac{2}{3}$ lin. longis subovatis tubo paullo excedentibus. *Petala* sepalis consimilia, sed dimidia majora. *Stamina* 10; filamenta sepalis æquilonga, fere glabra. *Discus* margine æqualis, inter staminum insertiones paullo incrassatus nec dentatus, fere glaber. *Ovarium* globosum ; stylus $\frac{2}{3}$ lin. longus.

Hab. Tonga Islands. Vavau, *Crosby*, 291.

CANARIUM HARVEYI, *Seem.*; *Hemsl. in Journ. Linn. Soc., Bot.*, xxx. (1894) p. 171.

Eua. Endemic to the group.

MELIACEÆ.

MELIA AZEDARACH, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 171.

Introduced from Tropical Asia.

DYSOXYLUM RICHII, *C. DC.* (D. alliaceum, *Seem. non Blume*); *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 171.

Tongatabu, Namuka ; Fiji and Samoa.

AGLAIA sp.

VAVÆA AMICORUM, *Benth.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 171.

Tongatabu ; Fiji.

CARAPA MOLUCCENSIS, *Lam.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 171.

Fiji ; westward in New Ireland ; and to Africa.

CHAILLETIACEÆ.

CHAILLETIA VITIENSIS, *Seem. Viti*, p. 434 ; *Fl. Vit.* p. 38.

Fiji.

OLACACEÆ.

XIMENIA ELLIPTICA, *Forst. f. Prodr.* p. 27.

Fiji and Samoa ; eastward to Tahiti ; westward in New Caledonia. Tropics generally.

ANACOLOSA ILICOIDES, *M. T. Masters, in Hook. f. Fl. Br. Ind.* i. p. 580.

Only known hitherto from the mountains of North-eastern India.

VILLAREZIA SAMOENSIS, *Benth. & Hook. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 172.

Eua ; Samoa.

Celastraceæ.

Gymnosporia vitiensis, *Seem.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 172.

Fiji and Samoa; eastward to the Marquesas Islands.

Rhamnaceæ.

Rhamnus vitiensis, *Benth. Fl. Austral.* i. p. 413.

Fiji; westward in North Australia.

Colubrina asiatica, *Brongn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 172.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to Africa.

Alphitonia excelsa, *Reiss.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 172; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 652.

Tongatabu; Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward in New Caledonia and Solomon Islands; and to Malaya.

The form of the Sandwich Islands (*A. ponderosa*, Hillebr.) differs in its fruit.

Sapindaceæ.

*Cardiospermum Halicacabum, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 172.

Identified by Mr. Crosby, but not in his collection.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides, New Caledonia, Solomon Islands. Tropics generally.

Allophylus Cobbe, *Blume*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 172; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 651.

Samoa; eastward to Tahiti; Sandwich Islands; westward to Tropical Asia.

A very variable species, or perhaps a group of allied species.

Pometia pinnata, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 172; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 651.

Fiji and Samoa; westward in the New Hebrides and New Caledonia; and to Tropical Asia.

Ellatostachys falcata, *Radlk.* (Ratonia falcata, *Seem.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 172).

Tongatabu; Fiji and Samoa.

GUIOA GLAUCA, *Radlk.* (Cupania glauca, *Camb.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 172).
Eua; westward in New Caledonia.

ARYTERA BRACKENRIDGEI, *Radlk. in Sitzb. math.-phys. Acad. Muench.* ix. (1879) p. 555.
Fiji.

DODONÆA VISCOSA, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 172.
Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in New Caledonia. Tropics generally.

HARPULLIA sp.

ANACARDIACEÆ.

RHUS TAITENSIS, *Guill.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 172.
Tongatabu; Fiji and Samoa; eastward to Tahiti; westward in Malaya.

PLEIOGYNIUM SOLANDRI, *Engl. in DC. Monogr. Phan.* iv. p. 255.
North Australia.

LEGUMINOSÆ.

TEPHROSIA PISCATORIA, *Pers.* (T. purpurea, *Pers.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 173; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 638).
Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in the New Hebrides and New Caledonia. Tropics generally.

SESBANIA GRANDIFLORA, *Pers. Syn.* ii. p. 316 (S. tomentosa, *A. Gray*).
Eastward to Tahiti; Sandwich Islands; westward in New Caledonia; and to the Mascarene Islands.

ZORNIA DIPHYLLA, *Pers. Syn.* ii. p. 318.
Tropics generally, but hardly anywhere in the Pacific.

DESMODIUM SPIRALE, *DC. Prodr.* ii. p. 332.
Tropics generally, but scarce in the Pacific.

DESMODIUM POLYCARPUM, *DC.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 173; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 640.

Eua; Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to East Africa.

DESMODIUM UMBELLATUM, *DC.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 173; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 640.

Fiji and Samoa; eastward to the Marquesas Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to East Africa.

INDIGOFERA ANIL, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 173.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in New Caledonia. Widely spread; supposed to be native of Tropical America.

URARIA LAGOPOIDES, *DC.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 173.

Eua; Fiji and Samoa; westward in the New Hebrides and New Caledonia; and to Tropical Asia.

ABRUS PRECATORIUS, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 173.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in New Caledonia. Tropics generally.

GLYCINE TABACINA, *Benth. Fl. Austral.* ii. p. 244.

Fiji; westward in the New Hebrides and New Caledonia; and to Tropical Asia.

MUCUNA GIGANTEA, *DC.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 174.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides, New Caledonia, and the Solomon Islands; and to Tropical Asia.

PUERARIA THUNBERGIANA, *Benth.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 174.

Tongatabu; westward in the Solomon Islands; and to Tropical Asia.

CANAVALIA ENSIFORMIS, *DC.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 174.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides and Solomon Islands. Tropics generally.

PHASEOLUS ADENANTHUS, *G F. W. Mey.* (P. truxillensis, *H. B. & K.*); *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 174.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in New Caledonia. Tropics generally.

DOLICHOS LABLAB, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 175.

Tongatabu; Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward in New Caledonia. Tropics generally.

DALBERGIA MONOSPERMA, *Dalz. in Hook. Kew Journ.* ii. (1850) p. 36.

Fiji; westward in New Caledonia; and to Tropical Asia.

DERRIS ULIGINOSA, *Benth.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 175.

Tongatabu; Fiji; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to East Africa.

INOCARPUS EDULIS, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 175; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 638.

Tongatabu; Fiji and Samoa; eastward to the Marquesar Islands; Sandwich Islands; westward to Malaya.

CÆSALPINIA BONDUC, *Roxb. Hort. Bengal.* p. 32.

Fiji; eastward to the Marquesas Islands; westward in Norfolk Island; and to Tropical Asia.

TAMARINDUS INDICA, *Linn. Sp. Pl.* p. 34.

Westward in New Caledonia. Tropics generally; but said to be a native of Africa, whence, according to Udoy Chand Dutt (Mat. Med. Hindus), the Arabs passed it on to India.

CYNOMETRA GRANDIFLORA, *A. Gray*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 176.

Eua; Fiji.

CYNOMETRA sp.

Entada scandens, *Benth.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 176.

Eua; Fiji and Samoa; westward in New Caledonia and Solomon Islands. Tropics generally.

Mimosa pudica, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 176; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 636.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands. Tropics generally; naturalized from America.

Acacia laurifolia, *Willd.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 176; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 635.

Fiji and Samoa; westward in the New Hebrides and New Caledonia.

Serianthes myriadenia, *Planch.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 176.

Fiji and Samoa; eastward to Tahiti.

Rosaceæ.

Parinarium laurinum, *A. Gray, in Bot. U. St. Expl. Exped.* i. p. 490.

Fiji and Samoa; westward in the Solomon Islands.

Parinarium insularum, *A. Gray, in Bot. U. St. Expl. Exped.* i. p. 488; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 635; ? var.

Fiji and Samoa. The Tongan plant is larger in the leaf than any specimens seen from Fiji or Samoa.

Rhizophoreæ.

Rhizophora mucronata, *Lam.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 176.

Fiji and Samoa; and tropical coasts generally to East Africa.

Bruguiera gymnorhiza, *Lam.* (B. Rheedei, *Blume*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 176).

Fiji and Samoa; and tropical coasts generally to East Africa.

Combretaceæ.

Terminalia littoralis, *Seem. Fl. Vit.* p. 94.

Fiji; westward in New Caledonia; and to Malaya.

TERMINALIA LITTORALIS, var. TOMENTELLA, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 177; ramis junioribus pedunculis, pedicellis, petiolis, foliis infra tomentella, forsan maturitate glabrescens.

Hab. Tonga Islands. Vavau, *Crosby*, 2226. Vavau and Lifuka, *Harvey*! "Tonga, Samoa and Marquesas," *Wilkes*. Tongatabu, *Lister*. Ellice Islands, *Jensen*.

MYRTACEÆ.

NELITRIS FORSTERI, *Seem.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 177.

Eua; Fiji and Samoa; eastward to Tahiti; westward in the Solomon Islands.

EUGENIA RARIFLORA, *Benth.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 177; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 659.

Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands.

EUGENIA MALACCENSIS, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 177.

Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward in New Ireland; and to Malaya; and further extended by cultivation.

EUGENIA CORYNOCARPA, *A. Gray*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 177; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 659.

Fiji and Samoa.

EUGENIA CLUSIÆFOLIA, *A. Gray, Bot. U. St. Expl. Exped.* i. p. 528; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 659 (E. jambolana, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 177, *non Lam.*).

Samoa; westward in the Solomon Islands.

EUGENIA DEALATA, *Burkill*; inter species insularum maris pacifici alis ramorum facile distincta.

Arbor 20–30 ped. alta (fide *Lister*), glabra. *Rami* crassi, juniores quadrangulares quadrialati, etiamque inter alis linea parum elevata notati, alis angustis per paria a petiolorum basibus ad nodos proximos decurrentibus ibique inter se conjunctis. *Folia* obovata, ad 6 poll. longa, ad 3 poll. lata, coriacea, utrinque 15–20-nervia, nervis rectis in nervam submarginalem satis conspicuam confusis, apice obtusa, basi acuta, supra nitida nervis distinctis, infra pallidiora costa carinata; petiolus brevis, 1–3 lin. longus. *Panicula* terminalis, quam folia brevior; bracteæ et bracteolæ caducæ, nec visæ; flores numerosæ. *Alabastra* pyriformia, sessilia, per tria ad apices paniculæ ramulorum disposita. *Sepala* late triangularia, apice subacuta, marginibus subhyalina, 1 lin. longa, 2–2½ lin. lata. *Petala* caduca. *Stamina* admodum conspicua ut flos ab antheris ad antheras diametro 9 lin. attingat, numerosissima, filamentis roseis. *Fructus* immaturus globoso-fusiformis.

Hab. Tonga Islands: Eua, *Lister*; Vavau, *Crosby*, 62. Flowering in December and January.

EUGENIA SAMOENSIS, *Burkill*; ex affinitate *E. effusæ*, A. Gray; foliis multo majoribus facile distincta.

Arbor alta, glabra. *Rami* juniores subquadrangulares, angulis mox explanati. *Folia* ad 6 poll. longa, ad 3 poll. lata, obovata, petiolata, apice rotundata vel obtusa vel rarissime ac brevissime acuminata, basi in petiolo 4–8 lin. longo attenuata, margine integra tenuiter incrassata nervis majoribus concolori, nervis lateralibus rectis supra indistinctis infra sat conspicuis margines subattingentibus ubi in nervam arcuatam submarginalem ineunt. *Panicula* corymbiformis, terminalis nunc pauciflora nunc multiflora (floribus ad 20), foliis brevior vel sublongior; bracteæ minutæ, ovatæ; pedicelli ad apices bibracteolati. *Alabastra* ad anthesin pyriformia, ¼ poll. longa. *Sepala* parva, margine subhyalina, vix ½ lin. alta, ad fructum maturum persistentia at enim vix recognoscenda. *Petala* ad anthesin caduca. *Stamina* numerosissima, lutea (?). *Fructus* ovoideus ad longus, disco calyceque coronatus. *Semen* solitarium, ovoideum.

Hab. Tonga Islands: Eua, on high ground; Vavau, flowering in February, *Crosby*, 64. Samoa, *Powell*, 267, 327. *Whitmee*, 96, from Samoa may well be a form of this species.

EUGENIA CROSBYI, *Burkill*; floribus *E. Grayi*, Seem., similis, sed alabastro longiore, et foliis ovatis vel ellipticis facile distinguitur.

Arbor vel frutex glaber. *Rami* læves nec angulati. *Folia* ovata vel elliptica, brevissime acuminata, apice obtusa, basi attenuata, ad 3 poll. longa, ad 1½ poll. lata, nervis tot supra quot infra conspicuis, lateralibus utrinque 28–30 in nervam submarginalem oblique excurrentibus; petiolus ad 3 lin. longus. *Paniculæ* 20–80-floræ, nisi majores foliis superatis; bracteæ bracteolæque caducæ nec visæ; pedicelli brevis, aliquo modo angulati. *Alabastra* ad anthesin 2½ lin. longa, 1½ lin. diametro. *Sepala* parva, inconspicua, obtusa, margine hyalina. *Petala* ad anthesin caduca. *Staminum* filamenta 1 lin. longa. *Stylus* 1½ lin. longus.

Hab. Tonga Islands. Vavau, *Crosby*, 61, flowering in June.

EUGENIA sp. aff. *E. neurocalyci*, A. Gray.

BARRINGTONIA SPECIOSA, *Linn. f.* (B. Butonica, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 178; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 660).

Fiji and Samoa; eastward to the Low Archipelago; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to the Mascarene Islands.

MELASTOMACEÆ.

MEMECYLON HARVEYI, *Seem.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 178.

Eua. Endemic to the group.

LYTHRACEÆ.

PEMPHIS ACIDULA, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 178.

Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to East Africa.

PASSIFLORACEÆ.

*CARICA PAPAYA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 178. Recorded in Mr. Crosby's notes.

Introduced from America into all parts of the tropics.

CUCURBITACEÆ.

MOMORDICA CHARANTIA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 179.

Spread by cultivation throughout the tropics, probably native of the Old World.

CUCUMIS MELO, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 179.

Spread by cultivation throughout the tropics; a native of the Old World.

BENINCASA CERIFERA, *Savi, in Bibl. Ital.* ix. 158.

Fiji and Samoa; eastward to the Marquesas Islands; westward in the Solomon Islands; and to the Mascarene Islands.

UMBELLIFERÆ.

HYDROCOTYLE ASIATICA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 179; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 664.

Tongatabu, Eua; Fiji and Samoa; Sandwich Islands; westward in New Caledonia and the Solomon Islands. Tropics generally.

APIUM LEPTOPHYLLUM, *F. Muell.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 197.

A weed of cultivation in many parts of the tropics.

ARALIACEÆ.

MERYTA MACROPHYLLA, *Seem.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 180; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 664.

Samoa.

RUBIACEÆ.

BADUSA CORYMBIFERA, *A. Gray*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 180.

Tongatabu, Eua; Fiji; westward in the New Hebrides. The genus is confined to the Pacific.

BIKKIA GRANDIFLORA, *Reinw.*; *Hemsl. in Journ. Linn. Soc. Bot.* xxx. (1894) p. 180.

Eua and Savage Island (south-east of Samoa).

A Malayan species has passed under this name, but probably in error. *B. grandiflora*, K. Schum. & Lauterb., in 'Flora der Deutschen Schutzgebiete in der Südsee' is, it seems, *B. australis*, DC.

OLDENLANDIA FŒTIDA, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 180.

Samoa and Savage Island; eastward to the Cook Islands.

MUSSÆNDA FRONDOSA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 180; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 690.

Nomuka; Fiji and Samoa; eastward to Tahiti; westward in the New Hebrides and the Solomon Islands; and to Tropical Asia.

Tarenna sambucina, *T. Durand*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 181.

Tongatabu; Fiji and Samoa; eastward to Tahiti; westward in New Caledonia; and in New Guinea.

Randia coffeoides, *Benth. & Hook. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 180.

Fiji; eastward to the Society Islands; westward in the New Hebrides and Solomon Islands.

Randia Crosbyi, *Burkill*; habitu *R. genipæfloræ*, DC., persimilis; calyce differt; verisimiliter *R. tahitensi*, Nadeaud, maxime affinis, differt præcipue fructu minore et calyce dentato et stipulis fere ad apicem connatis; a *R. coffeoide*, Benth. et Hook. f., inflorescentia parva jam prima scrutatione distinguiter.

Rami cortice grisei, aliquatenus torti. *Folia* elongato-elliptica, apice acuta vel brevissime acuminata, basi rare inæquilateralia acuta vel subobtusa, utrinque glabra, 4–7 poll. longa, 1½–2¼ poll. lata, nervis lateralibus utrinque 7–8; petioli 4–5 lin. longi; stipulæ intrapetiolares, connatæ et triangulas ad nodorum latera formantes, mox secedentes. *Inflorescentiæ* nunc ad alterum nunc ad tertium nodum rami ramos terminantes, ramis lateralibus vel singulis vel binis ramos florentes reponentibus, brevissimæ, 4–10-floræ, cymose modo Guettardarum compositæ; pedunculi duo, crassi, 1–5 lin. longi; pedicelli tenues, pilosi, 6–9 lin. longi. *Calycis* tubus, ovario incluso, 3 lin. longus, brevissime dentatus, extus et intus pilosus. *Corollæ* tubus 4–5 lin. longus, e basi angusta campanulatus dein ad os paullo contractus, extus pilis brevibus, intus pilis longioribus lectus; lobi 4½ lin. longi, in alabastro conspicue contorti, basi 1–1¼ lin. lati, longe angustati. *Stamina* ad medium tubi inserta; filamenta brevia; antheræ inclusæ. *Ovarium* 2-loculare; stylus paullo exsertus, bifidus. *Fructus* calyce persistente coronatus, globosus, 5 lin. diam. vel ultra.

Hab. Tonga Islands: Vavau, *Crosby*, 76.

Fruiting-specimens of a closely allied species from Fiji (*Graeffe*, 1400) and New Caledonia (*Deplanche*, 39) exist in the Herbarium at Kew. The inflorescence is interesting; it is produced as the termination of a short stem of 2 or 3 internodes, and from the last node arise 1 or 2 branches which continue the axis, pushing the little inflorescence to one side.

GUETTARDA SPECIOSA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 181.

Tongatabu; Fiji and Samoa; eastward to the furthest islands of the Low Archipelago; westward in New Caledonia and Solomon Islands; and to East Africa.

TIMONIUS FORSTERI, *DC. Prodr.* iv. p. 461; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 690.

Samoa; eastward to the Low Archipelago; westward perhaps in the New Hebrides.

PLECTRONIA BARBATA, *Benth. & Hook. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 181.

Fiji; eastward to the Low Archipelago.

PLECTRONIA ODORATA, *Benth. & Hook. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 181.

Nomuka, Eua; Fiji; eastward to the Low Archipelago; Sandwich Islands; westward in the New Hebrides, and to Australia.

IXORA SAMOENSIS, *A. Gray, in Proc. Amer. Acad.* iv. (1860) p. 40; var. GLABRICALYX, *Burkill*; floribus pauperior (ad apices ramorum ternis), calycibus ovariisque glaber.

Tonga Islands, *Lister*. Vavau, *Crosby*, 84.

The type in Samoa.

MORINDA CITRIFOLIA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 181.

Tongatabu, Eua; Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in New Caledonia and the Solomon Islands; and to Africa.

MORINDA FORSTERI, *Seem.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 181.

Nomuka; Fiji and Samoa; eastward to the furthest islands of the Low Archipelago; westward in New Caledonia.

PSYCHOTRIA INSULARUM, *A. Gray*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 182; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 687.

Fiji and Samoa; eastward to the Society Islands.

K. Schumann recorded this species as occurring in New Guinea in Engl. Jahrb. ix. (1887) p. 186. In the 'Flora der Deutschen

Schutzgebiete in der Südsee' (Leipzig 1900, but dated 1901), p. 580, he expresses a doubt as to the correctness of the statement. I have seen two specimens from New Guinea at Berlin named '*P. insularum*,' but neither is this species.

GEOPHILA RENIFORMIS, *D. Don*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 182.

Fiji and Samoa; eastward to Tahiti; westward in the New Hebrides and Solomon Islands. Tropics generally.

COMPOSITÆ.

VERNONIA CINEREA, *Less. in Linnæa*, iv. (1829) p. 291; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 692.

Fiji and Samoa; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to Africa.

ADENOSTEMA VISCOSUM, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 182.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands. Tropics generally.

AGERATUM CONYZOIDES, *Linn. Sp. Pl.* 839; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 693.

Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward in the New Hebrides and New Caledonia. Tropics generally.

SIEGESBECKIA ORIENTALIS, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 182.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides and New Caledonia. Tropics generally.

WEDELIA BIFLORA, *DC.*; *Hemsl. in. Journ. Linn. Soc., Bot.* xxx. (1894) p. 182.

Tongatabu; Fiji and Samoa; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to East Africa.

*WEDELIA STRIGULOSA, *Benth. & Hook. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 182. Collected by Barclay.

Tongatabu; Fiji and Samoa; westward in the New Hebrides, New Caledonia, Solomon Islands; and to Malaya.

BIDENS PILOSA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 183.

Tongatabu; Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in New Caledonia and Solomon Islands. Tropics generally.

SONCHUS ASPER, *Vill.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 183.

Tongatabu; Fiji; eastward to Tahiti; Sandwich Islands. Tropical and temperate countries generally.

GOODENIACEÆ.

*SCÆVOLA sp. Noted by Mr. Crosby, but not collected.

MYRSINACEÆ.

MÆSA NEMORALIS, *DC.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 183; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 665.

Eua; Fiji and Samoa; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to Malaya.

SAPOTACEÆ.

SIDEROXYLON VITIENSE, *Burkill* (Sapota? vitiensis, *A. Gray, in Proc. Amer. Acad.* v. (1862) p. 328); species *S. Brownii*, F. Muell., maxime affinis; differt floribus minoribus, foliis glabris.

Arbor 20–30 ped. alta. *Rami* glabri. *Folia* nunc fere elliptica, apice rotundata, ad 8 poll. longa, 4½ poll. lata, basi breviter in petiolum angustata, nunc obovata, 3 poll. longa, 2½ poll. lata, prima ætate pilis fulvis pubescentia, at mox glabrescentia matura supra nitentia, infra pallidiora; petioli 1–2 poll. longi. *Flores* ad axillas foliorum 2–8ni dispositi; pedunculi 3 lin. longi, pilis molliter obtecti. *Sepala* orbicularia facie externa pubescentia ½–⅔ lin. longa. *Corollæ* tubus brevis, lobi sepalis paulo majores. *Staminum* filamenta lobis corollæ æquantia: staminodia anguste subulata. *Ovarium* pubescens. *Fructus* (fide *Lister*) aurantio vulgo 'Tangerene' dicto magnitudine similis.

Hab. Tonga Islands: Eua, near summits, *Lister*; Vavau, *Crosby*, 99, 100. Fiji: Ovalau, *U.S. Exploring Expedition*; Mountains of Ovalau, *Horne*, 317, 317 *a*.

The Tonga form has larger leaves than the Fijian, but I can find no other difference; and further I have only seen the obovate-leaved form from Tonga. 'Kalaka' is the native name. The flowers are produced in January, the fruit ripens in June.

SIDEROXYLON sp.

BASSIA AMICORUM, *A. Gray*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 183.

Tongatabu. Endemic to the group.

EBENACEÆ.

MABA LATERIFLORA, *Hiern, in Journ. Linn. Soc.* xx. (1883) p. 366.

Fiji.

MABA ELLIPTICA, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 184.

Tongatabu; Fiji and Samoa; westward in New Caledonia; and to Malaya.

MABA sp. aff. *M. samoensi*, Hiern.

DIOSPYROS SAMOENSIS, *A. Gray*; *Hiern, Monogr. Eben. in Trans. Camb. Phil. Soc.* xii. (1873) p. 245.

Samoa.

OLEACEÆ.

JASMINUM SIMPLICIFOLIUM, *Forst. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 184.

Tongatabu, Eua; Fiji; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to Australia.

JASMINUM DIDYMUM, *Forst. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 184.

Tongatabu; Fiji and Samoa; eastward to Tahiti; westward in New Caledonia; and to Malaya.

LINOCIERA PAUCIFLORA, *C. B. Clarke, in Hook. f. Fl. Br. Ind.* iii. p. 609.

Fiji; westward in the Malay Islands and peninsula to Tenasserim.

APOCYNACEÆ.

MELODINUS VITIENSIS, *Rolfe* (M. scandens, *Seem.* non *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 184).

Eua; Fiji.

ALYXIA STELLATA, *Roem. & Schult.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 184.

Tongatabu; Fiji and Samoa; eastward to the Society Islands; westward in New Caledonia; and through Malaya to Tenasserim.

CERBERA ODOLLAM, *Gaertn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 184.

Tongatabu; Fiji and Samoa; eastward to the Low Archipelago; westward in the New Hebrides and Solomon Islands; and to Tropical Asia.

OCHROSIA ELLIPTICA, *Labill. Sert. Austro-Caled.* xxv. t. 30.

Fiji and Samoa; westward in New Caledonia.

OCHROSIA PARVIFLORA, *Henslow*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 184.

Fiji; eastward to Tahiti; westward in New Caledonia and Solomon Islands; and to the Mascarene Islands.

VINCA ROSEA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 185.

Tongatabu, Samoa; Sandwich Islands; westward in New Caledonia. Tropics generally.

TABERNÆMONTANA ORIENTALIS, *R. Br.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 185; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 668.

Eua; Fiji and Samoa; eastward to the Society Islands; westward in the New Hebrides and New Caledonia; and to Malaya. This species is nearly related to *T. Thurstoni*, a rubber-plant which, owing to the imperfect material on which the species was based, needs redescribing*.

---

* TABERNÆMONTANA THURSTONI, *Horne, ex Baker, in Journ. Linn. Soc., Bot.* xx. (1883) p. 368. Species *T. orientali*, R. Br., pedicellis crassis brevibus floribusque majoribus facile distincta; ad *T. Heyneanam*, Wall., aliquatenus accedit; recedit præcipue corolla extus puberula.

Arbor circa 30 ped. alta, trunco basin versus diametro 2-pedalis, cortice rugoso. *Rami* ultimi leves, glabri. *Folia* petiolata, oblonga, subacuminata, apice obtusa, basi acuta, majora 7 poll. longa, 3½ poll. lata, subcoriacea, glabra; petioli 1 poll. longi. *Cymæ* foliis breviores, 10–20-floræ; pedicelli crassi, ½ poll. longi, ad anthesin puberuli, dein fructu maturescente glabrescentes. *Calycis* segmenta extus puberula (nec pilosa), semiorbicularia. *Corollæ* tubus 1 poll. longus, siccitate 1 lin. diam., extus puberulus, intus glaber; lobi falcatim oblongi, 9–10 lin. longi. *Antheræ* ad medium tubi affixæ. *Ovarium* 3 lin. altum; stylus nequaquam antheras attingens. *Fructus* folliculi maturi valde recurvi, 1¼–1½ poll. longi, 7 lin. diam. *Semina* ad 15 in utroque folliculo.

Hab. Fiji. "Common throughout Fiji," *Horne.* Without precise locality, *Storck.* Vanua Levu, Bua, *Holmes.*

This tree yields a little caoutchouc (see Kew Bulletin, 1898, p. 164).

Asclepiadaceæ.

Asclepias curassavica, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 185.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides, Tropics generally.

Hoya australis, *R. Br.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 185.

Fiji and Samoa; westward in the New Hebrides aud Solomon Islands; and in Australia.

Loganiaceæ.

Geniostoma rupestre, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 185; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 666.

Fiji and Samoa; eastward to Tahiti; westward in New Caledonia; and to Malaya.

Fagræa Berteriana, *A. Gray*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 185; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 665.

Tongatabu, Eua; Fiji and Samoa; eastward to the Marquesas Islands; westward in New Caledonia and Solomon Islands.

Boraginaceæ.

Cordia aspera, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 185; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 671.

Tongatabu; Fiji and Samoa; westward in Australia.

Cordia subcordata, *Lam.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 185.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides and Solomon Islands; and to East Africa.

Convolvulaceæ.

Argyreia tiliæfolia, *Wight, Ic.* t. 1358 (Ipomœa denticulata, *Seem.* non *Choisy*).

Fiji and Samoa; Sandwich Islands; westward to Africa.

Ipomœa grandiflora, *Lam. Ill.* vi. p. 403.

Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward in New Caledonia and Solomon Islands; and to East Africa.

IPOMŒA NYMPHEÆFOLIA, *Blume, Bijdr.* p. 719.

Fiji and Samoa; westward to East Africa. Also in Tropical America.

IPOMŒA BONA-NOX, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 186.

Tongatabu; Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward to Tropical Asia, etc. A native of America.

IPOMŒA TURPETHUM, *R. Br.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 186; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 670.

Fiji and Samoa; eastward to Tahiti; westward in New Caledonia, and to the Mascarene Islands.

IPOMŒA PELTATA, *Choisy*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 186.

Eua; Fiji and Samoa; eastward to Tahiti; westward in the Solomon Islands; and to the Mascarene Islands.

IPOMŒA COCCINEA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 186.

Tongatabu, Eua; cultivated in the Sandwich Islands; cultivated and quasi-wild in India and Japan. A native of America.

IPOMŒA CONGESTA, *R. Br.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 186.

Tongatabu; Fiji and Samoa; Sandwich Islands; westward in New Caledonia, Solomon Islands; and to Tropical Asia.

IPOMŒA BILOBA, *Forsk.* (I. Pes-Capræ, *Roth*); *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 186.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands. Tropics generally.

IPOMŒA DENTICULATA, *Choisy*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 186; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 671.

Tongatabu; Fiji and Samoa; eastward to the Society Islands; Sandwich Islands; westward in the New Hebrides and Solomon Islands; and to the Mascarene Islands.

IPOMŒA PHYLLONEURA, *Baker in Journ. Linn. Soc., Bot.* xxi. (1885) p. 426 (Aniseia hastata, *Meissn.*).

A native of Brazil, introduced also into the New Hebrides and Madagascar.

SOLANACEÆ.

SOLANUM UPORO, *Dun.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 186; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 674.

Tongatabu; Fiji and Samoa; eastward to Tahiti; westward perhaps in New Caledonia.

SOLANUM FORSTERI, *Seem.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 187.

Eastward to Tahiti and in Easter Island.

SOLANUM AMICORUM, *Benth.*: *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 186.

Tongatabu. Endemic to the group.

PHYSALIS MINIMA, *Linn. Sp. Pl.* p. 183.

Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in New Caledonia. Tropics generally.

Mr. Crosby believes it a new arrival in Vavau.

PHYSALIS PERUVIANA, *Linn. Sp. Pl.* (ed. 2) p. 1670.

Fiji; eastward to the Marquesas Islands; Sandwich Islands; westward in New Caledonia. Warm countries generally.

CAPSICUM FRUTESCENS, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 187; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 674.

Very widely cultivated and naturalized; probably native of America.

DATURA STRAMONIUM, *Linn. Sp. Pl.* p. 179.

Fiji; Sandwich Islands. Warm countries generally.

Quite recently introduced into Vavau, but spreading rapidly.

DATURA ARBOREA, *Linn. Sp. Pl.* p. 179.

Sandwich Islands. Introduced from America.

It never seeds in Vavau (*teste* Crosby) and but rarely in the Sandwich Islands (Hillebrand, Fl. Hawaii, p. 311).

SCROPHULARIACEÆ.

VANDELLIA CRUSTACEA, *Benth. Scroph. Ind.* p. 35.

Fiji and Samoa; eastward to Tahiti; westward in the Solomon Islands; and to Africa. Introduced into America.

ACANTHACEÆ.

GRAPTOPHYLLUM SIPHONOSTENA, *F. Muell.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 187, and *Stapf ex Hemsl. l. c.* p. 214.

Eua; Fiji.

VERBENACEÆ.

PREMNA TAITENSIS, *Schauer*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 187; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 672.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; westward in the New Hebrides and New Caledonia.

VITEX TRIFOLIA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 187; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 671.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to Africa.

CLERODENDRON AMICORUM, *Seem.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 187; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 672.

Eua; Samoa.

CLERODENDRON INERME, *Gaertn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 188; *C. B. Clarke, in Hook. f. Fl. Brit. Ind.* v. p. 589; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 672.

Tongatabu; Fiji and Samoa; westward in New Caledonia and Solomon Islands; and to Tropical Asia.

LABIATÆ.

OCIMUM BASILICUM, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 188.

Tongatabu; Eua; Fiji and Samoa. Widely spread by cultivation throughout the warmer parts of the world.

SALVIA PSEUDO-COCCINEA, *Jacq. Coll.* ii. p. 302.

Introduced from America into many parts of the tropics.

LEUCAS FLACCIDA, *R. Br.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 188.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward to Tropical Asia.

TEUCRIUM INFLATUM, *Sw.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 188.

Tongatabu; Fiji; westward in the New Hebrides and New Caledonia. Widely distributed in Tropical America; also in the Galapagos Islands.

Plantaginaceæ.

Plantago major, *Linn. Sp. Pl.* p. 112.

Fiji and Samoa; eastward to Tahiti; Sandwich Islands. Very widely spread by man from Europe and Tropical Asia.

Nyctaginaceæ.

Boerhaavia repens, *Linn. Sp. Pl.* p. 3.

Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in New Caledonia. Tropics generally.

Pisonia grandis, *R. Br.* (P. inermis, *Forst.*; *Hemsl. in. Journ. Linn. Soc., Bot.* xxx. (1894) p. 188).

Nomuka, Lifuka; Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in Norfolk Island; and to the Mascarene Islands.

Amarantaceæ.

Cyathula prostrata, *Blume*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 189; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 630.

Fiji and Samoa: eastward to the Marquesas Islands; westward in the New Hebrides and Solomon Islands. Tropics generally.

Achyranthes aspera, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 189; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 630.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides and New Caledonia. Tropics generally.

Polygonaceæ.

Polygonum glabrum, *Willd.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 189.

Nomuka; Fiji; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides and New Caledonia. Tropics generally.

Piperaceæ.

Piper methysticum, *Forst. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 189; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 609.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in New Guinea.

PIPER MACGILLIVRAYI, *C. DC.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 189; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 609.

Tongatabu; Fiji and Samoa; eastward to the Society Islands.

LAURACEÆ.

CRYPTOCARYA GLAUCESCENS, *R. Br. Prodr.* p. 402, var. PACIFICA, *Burkill.* Flores typo australiensi comparando paullo majores. Fructus basi in pedunculo brevissime angustatus.

Hab. Tonga Islands, Vavau, *Crosby*, 241. Fiji, Bua, *Horne*, 1117, 1068. New Caledonia, Wagap, *Vieillard*, 3109.

The Fijian specimens have rather smaller fruit than the others.

The type occurs in Australia.

CASSYTHA FILIFORMIS, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 190; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 632.

Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in New Caledonia and Solomon Islands. Tropics generally.

HERNANDIA PELTATA, *Meissn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 190; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 633.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the Solomon Islands; and to the Mascarene Islands.

HERNANDIA MŒRENHOUTIANA, *Guill.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 190.

Tongatabu; Fiji and Samoa; eastward to Tahiti.

THYMELÆACEÆ.

WIKSTRŒMIA ROTUNDIFOLIA, *Decne.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 190.

Tongatabu. Endemic to the group.

LORANTHACEÆ.

LORANTHUS INSULARUM, *A. Gray*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 191; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 628.

Tongatabu; Fiji and Samoa.

EUPHORBIACEÆ.

EUPHORBIA CHAMISSONIS, *Boiss. in DC. Prodr.* xv. II. 14.

Fiji; eastward to the Society Islands and Malden Island; westward in the Marshall and Loyalty Islands.

EUPHORBIA RAMOSISSIMA, *Hook. & Arn.* (E. Sparrmanni, *Boiss.*; *Hemsl. in. Journ. Linn. Soc., Bot.* xxx. (1894) p. 191).

Eua; Fiji; eastward to the extreme islands of the Low Archipelago; westward in the Marianne Islands; and in Australia.

EUPHORBIA ATOTO, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 191.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in New Caledonia and Solomon Islands; and to Tropical Asia.

EUPHORBIA PILULIFERA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 191.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands and Fanning Island; Sandwich Islands; westward in the New Hebrides, New Caledonia, Solomon Islands. Tropics generally.

PHYLLANTHUS RAMIFLORUS, *Muell.-Arg.*, var. GENUINUS, *Muell.-Arg.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 191.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; westward in the New Hebrides.

PHYLLANTHUS SIMPLEX, *Retz.*, var. VIRGATUS, *Muell.-Arg.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 191; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 644.

Eua; Fiji and Samoa; eastward to the Marquesas Islands; westward in New Caledonia; and to Tropical Asia.

PHYLLANTHUS sp.

BISCHOFFIA JAVANICA, *Blume*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 192.

Tongatabu, Lifuka; Fiji and Samoa; eastward to Tahiti; westward in New Caledonia; and to Tropical Asia.

JATROPHA CURCAS, *Linn. Sp. Pl.* p. 1006; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 674.

Very widely naturalized.

ALEURITES MOLUCCANA, *Willd.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 193; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 647.

Tongatabu, Eua; Fiji and Samoa; eastward to the extreme islands of the Low Archipelago; Sandwich Islands; westward in New Caledonia; and to Tropical Asia.

CROTON (§ EUCROTON) MICROTIGLIUM, *Burkill*; *C. Tiglio*, Linn., prima scrutatione similis, at enim *C. Verrauxii*, Muell.-Arg., et ejus varietati *Storckii* Muell.-Arg., maxime affine.

Rami juniores pilis stellatis sparse tecti, dein glabrescentes. *Folia* ovata, basi rotundata biglandulosa, apice breviter acuminata, 2½–4 poll. longa, 1½–2 poll. lata, iis *C. Tiglii* colore et forma et magnitudine persimilia, sed venis omnino pennatis dissimilia nec basi modo *C. Tiglii* conspicue 3-nervia; petioli ½–1 poll. longi. *Flores masculini* in racemos ramos terminantes dispositi; racemi 1½–2 poll. longi, 15–20 flores gerentes; bracteæ subulatæ ½ lin. longæ, pilis stellatis 1–3 tectæ; pedicelli 1–2 lin. longi. *Calyx* extus sparse pilosus; lobi ovati ad marginem præcipue apicem versus dense pilis simplicibus tecti ¾ lin. longi. *Petala* obovata, extus glabra intus et ad marginem dense pilis simplicibus tecta, apice rotundata, sepalis æquantia. *Staminum* 10 filamenta glabra. *Discus* pilosus. *Ovarium* nullum. *Flores feminei* hinc inde imi racemorum pedicello calyceque floribus masculinis similes. *Ovarium* sepalis vix longius dense pilis stellatis tectum; stigmata basi semel bifurcata, tenuia. *Fructus* 3 lin. longus. *Semina* castanea albo-variegata, levia.

Hab. Tonga Islands: Vavau, *Crosby*, 150.

MANIHOT UTILISSIMA, *Pohl, Pl. Bras. Ic.* i. p. 32, t. 24.

Very widely spread from America by cultivation.

ACALYPHA BOEHMERIOIDES, *Miq. Fl. Ind. Bat. Suppl.* p. 459.

Fiji and Samoa; westward in the New Hebrides and New Britain; and to Malaya.

MACARANGA HARVEYANA, *Muell.-Arg.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 192; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 646.

Nomuka; Fiji; westward in New Caledonia, Solomon Islands, and Norfolk Island; and to Tropical Asia.

*RICINUS COMMUNIS, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 192. Recorded in Mr. Crosby's notes.

Grown in all parts of the tropics.

EXCŒCARIA AGALLOCHA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 192.

Nomuka; Fiji and Samoa; eastward to Tahiti; westward in the New Hebrides, New Caledonia, and Solomon Islands.

HOMALANTHUS PEDICELLATUS, *Benth.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 192.

Tongatabu, Eua; Fiji and Samoa; eastward to Tahiti; westward in the New Hebrides and New Caledonia.

URTICACEÆ.

SPONIA AMBRYNENSIS, *Decne. in Nouv. Ann. Mus. Par.* iii. (1834) p. 498, non *Hillebr.*

Fiji and Samoa; westward in the Caroline Islands; and to Tropical Asia.

*BROUSSONETIA PAPYRIFERA, *Vent.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 193. Identified but not collected by Mr. Crosby.

Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward to Tropical Asia. Chiefly cultivated.

FICUS OBLIQUA, *Forst. f. Prodr.* p. 77.

Nomuka; Fiji; westward in the New Hebrides and New Caledonia.

FICUS PROLIXA, *Forst. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 193.

Eastward to Tahiti; westward in the New Hebrides and New Caledonia.

FICUS TINCTORIA, *Forst. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 193; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 613.

Tongatabu; Fiji and Samoa; eastward to Tahiti.

FICUS 2 spp.

*ARTOCARPUS INTEGRIFOLIA, *Linn. f. Suppl.* p. 412. Noted by Mr. Crosby, but not in his collection.

Widely introduced from Asia.

FLEURYA INTERRUPTA, *Gaudich.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 193; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 628.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides and Solomon Islands; and to East Africa.

PIPTURUS ARGENTEUS, *Wedd.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 193; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 627.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; westward in the New Hebrides and New Caledonia; and to Malaya.

CASUARINACEÆ.

*CASUARINA EQUISETIFOLIA, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 194.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in New Caledonia and Solomon Islands; and to East Africa. Spread more widely by cultivation.

HYDROCHARIDACEÆ.

*HALOPHILA OVATA, *Gaudich.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 194; H. ovalis, *Hook.*, *Engler, in Engl. bot. Jahrb.* vii. (1886) p. 446. Not collected by Mr. Crosby.

Tongatabu; Fiji and Samoa; westward in the Marianne Islands; and to East Africa.

ORCHIDACEÆ.

SPATHOGLOTTIS PACIFICA, *Reichb. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 194; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 603.

Fiji and Samoa; eastward to Tahiti.

PHAIUS GRANDIFOLIUS, *Lour. Fl. Cochinch.* p. 529.

Eastward to the Cork Islands; westward in New Caledonia; and to Tropical Asia.

GEODORUM sp.

SCITAMINEÆ.

CURCUMA LONGA, *Linn. Sp. Pl.* p. 2; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 598.

Fiji and Samoa; eastward to the Marquesas Islands. Widely cultivated.

ZINGIBER ZERUMBET, *Rosc. ex Sm. Exot. Bot.* ii. p. 105, t. 112; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 597.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the Solomon Islands; and to Tropical Asia.

CANNA INDICA, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 194.

Fiji and Samoa; Sandwich Islands; westward in New Caledonia and Solomon Islands. Tropics generally.

BROMELIACEÆ.

*ANANAS SATIVUS, *Schult. f. Syst.* vii. p. 1283. Observed by Mr. Crosby.

Introduced from America into most parts of the tropics.

Taccaceæ.

Tacca pinnatifida, *Forst.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 195; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 595.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in New Caledonia and Solomon Islands; and to Africa.

Dioscoreaceæ.

Dioscorea sativa, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 195.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the Caroline Islands; and to Africa.

Dioscorea alata, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 195.

Fiji and Samoa; eastward to the Marquesas Islands; westward to Africa.

Liliaceæ.

Cordyline terminalis, *Kunth*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 195; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 594.

Tongatabu; Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in New Caledonia; and to Tropical Asia, but introduced into the tropics generally.

Dianella nemorosa, *Lam.* (D. ensifolia, *Red.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 193).

Nomuka; Fiji; eastward to Tahiti; Sandwich Islands; westward in New Caledonia and Solomon Islands; and to the Mascarene Islands.

Commelinaceæ.

Commelina nudiflora, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 195; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 594.

Fiji and Samoa; Sandwich Islands; westward in Solomon Islands. Tropics generally.

Palmæ.

Pritchardia pacifica, *Seem. & H. Wendl.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 195.

Eua; Fiji and Samoa; eastward to the Marquesas Islands.

*Cocos nucifera, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 195. Named in Mr. Crosby's notes.

Common in the Pacific and distributed throughout the tropics.

Pandanaceæ.

Pandanus odoratissimus, *Linn. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 196.

Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward in New Caledonia; and to Tropical Asia.

Araceæ.

Amorphophallus sp.

Colocasia antiquorum, *Schott, Meletem.* i. p. 18.

Widely spread through the tropics by cultivation.

Naiadaceæ.

*Cymodocea isoetifolia, *Aschers.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 196; *Engler, in Engl. bot. Jahrb.* vii. (1886) p. 446. Not in Mr. Crosby's collection.

Tongatabu; Fiji; westward to East Africa.

*Halodule australis, *Miq.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 196; H. uninervis, *Boiss.*, *Engler, in Engl. bot. Jahrb.* vii. (1886) p. 446. Not in Mr. Crosby's collection.

Tongatabu; Fiji; Sandwich Islands; westward in the Marianne Islands, New Caledonia, and New Ireland; and to East Africa and the Levant.

Cyperaceæ.

Mariscus flabelliformis, *H. B. & K. Nov. Gen. et Sp.* i. p. 215.

Westward in New Caledonia and Solomon Islands; Malaya. Tropics of the New World.

Mariscus sieberianus, *Nees in Linnæa*, ix. (1834) p. 286.

Samoa; eastward to the Cook Islands; westward in New Caledonia; and to Africa. Warm countries of the Old World generally.

Mariscus albescens, *Gaudich.*; *C. B. Clarke, in Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 196.

Tongatabu, Eua; Fiji and Samoa; eastward to the Cook Islands; Sandwich Islands; westward in the New Hebrides and Solomon Islands; and to Africa.

Mariscus cyperinus, *Vahl*; *C. B. Clarke, in Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 196.

Fiji and Samoa; eastward to the Cook Islands; Sandwich Islands; westward in New Caledonia; and to Tropical Asia.

CYPERUS ROTUNDUS, *Linn. Sp. Pl.* 45.

Samoa; eastward to the Cook Islands; Sandwich Islands; westward in New Caledonia. Tropics generally.

KYLLINGIA MONOCEPHALA, *Rottb.*; *C. B. Clarke, in Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 197.

Tongatabu; Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to Africa. Warmer countries of the Old World generally.

ELEOCHARIS PLANTAGINEA, *R. Br. Prodr.* p. 224.

Fiji and Samoa; westward in New Caledonia; and to Africa.

FIMBRISTYLIS MONOSTACHYA, *Hassk. Pl. Jav. Rar.* p. 61.

Fiji; westward in New Caledonia. Tropics generally.

FIMBRISTYLIS DIPHYLLA, *Vahl*; *C. B. Clarke, in Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 197.

Tongatabu; Fiji and Samoa; westward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands. Tropics generally.

LEPIRONIA MUCRONATA, *Rich.*; *Druce in Journ. Bot.* xxx. (1892) p. 86.

Fiji; westward to the Mascarene Islands.

RYNCHOSPORA AUREA, *Vahl, Enum. Pl.* p. 229.

Fiji and Samoa; eastward to Tahiti; westward in the New Hebrides and New Caledonia. Tropics generally.

SCLERIA MARGARITIFERA, *Willd. Sp. Pl.* iv. p. 312.

Fiji and Samoa; westward in the New Hebrides, New Caledonia, and Solomon Islands; and in Australia.

SCLERIA LITHOSPERMA, *Sw.*; *C. B. Clarke, in Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 197.

Fiji and Samoa; westward in the Solomon Islands; and to East Africa. Also in Tropical America.

SCLERIA DEPAUPERATA, *Boeckl.*; *C. B. Clarke, in Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 197.

Fiji and Samoa; westward in New Caledonia.

Gramineæ.

Paspalum scrobiculatum, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 197; *Reinecke, in Engl. Bot.* xxv. (1898) p. 582.

Fiji and Samoa; eastward to the extreme islands of the Low Archipelago; Sandwich Islands; westward in the New Hebrides and New Caledonia; and to Africa.

Panicum pilipes, *Nees*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 197.

Fiji; westward in the Louisiade Islands; and to the Mascarene Islands.

Panicum sanguinale, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 197; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 583.

Fiji and Samoa; eastward to the extreme islands of the Low Archipelago; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands. Tropics generally.

Panicum ambiguum, *Trin.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 197.

Fiji and Samoa; eastward to the extreme islands of the Low Archipelago; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to the Mascarene Islands.

Oplismenus compositus, *Roem. & Schult.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894), p. 198; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 583.

Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in the Caroline Islands and New Caledonia. Tropics generally.

Setaria glauca, *Beauv. Agrost.* p. 51.

Sandwich Islands; westward in the Marianne Islands and New Caledonia. Tropics generally.

A new arrival in Vavau (*Crosby*).

Cenchrus calyculatus, *Cav.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 198; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 583.

Tongatabu; Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in the New Hebrides and New Caledonia.

THUAREA SARMENTOSA, *Pers.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 198.

Fiji; eastward to the Low Archipelago; westward in the New Hebrides, New Caledonia, and Caroline Islands; and to the Mascarene Islands.

COIX LACHRYMA-JOBI, *Linn.*; *Hemsl. in Journ. Linn. Soc.. Bot.* xxx. (1894) p. 198; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 582.

Tongatabu; Fiji and Samoa; eastward to the Society Islands, Low Archipelago, and Sandwich Islands; westward in New Caledonia and Solomon Islands. Very widely cultivated in the tropics.

IMPERATA EXALTATA, *Brongn. in Duperr. Voy. Coq., Bot.* p. 101.

Fiji; westward in the New Hebrides; and to Tropical Asia. Tropics of the New World.

ANDROPOGON INTERMEDIUM, *R. Br. Prodr.* i. p. 202.

Westward in the New Hebrides; and to Africa.

HETEROPOGON CONTORTUS, *Beauv. ex Roem. & Schult. Syst.* ii. p. 836.

Fiji; eastward to Tahiti; Sandwich Islands; westward in New Caledonia. Warm countries generally.

CHRYSOPOGON ACICULATUS, *Trin.* (Andropogon aciculatus, *Retz.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 198).

Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in New Caledonia and Marianne Islands; and to the Mascarene Islands.

CYNODON DACTYLON, *Pers. Syn.* i. p. 85; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 584.

Samoa; eastward to Tahiti; Sandwich Islands; westward in New Caledonia. Tropics generally.

ELEUSINE INDICA, *Gaertn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 198; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 584.

Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands. Tropics generally.

CENTOTHECA LAPPACEA, *Desv.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 198; *Reinecke, in Engl. Jahrb.* xxv. (1898) p. 584.

Fiji and Samoa; eastward to the Marquesas Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to Africa.

CONIFERÆ.

PODOCARPUS ELATA, *R. Br.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 199.

Fiji; westward in Australia and Malaya.

CYCADACEÆ.

CYCAS CIRCINALIS, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 199.

Fiji and Savage Island; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to East Africa.

SELAGINELLACEÆ.

*SELAGINELLA sp. Mentioned in Mr. Crosby's notes, but not collected.

LYCOPODIACEÆ.

LYCOPODIUM CERNUUM, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 202; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 366.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands. Warmer countries generally.

PSILOTUM COMPLANATUM, *Sw. Syn. Fil.* pp. 188, 414, tab. 4. fig. 5.

Fiji and Samoa; eastward to the Society Islands; Sandwich Islands; westward in the Solomon Islands; and in most parts of the tropics.

FILICES.

GLEICHENIA DICHOTOMA, *Hook.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 199; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 364.

Fiji and Samoa; eastward to the Marquesas Islands; Sandwich Islands; westward to the New Hebrides, New Caledonia, and Solomon Islands. Tropics generally.

DAVALLIA SOLIDA, *Sw.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 199; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 339.

Fiji and Samoa; eastward to the Low Archipelago; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to the Mascarene Islands.

DAVALLIA SPELUNCÆ, *Baker, Syn. Fil.* 100; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 341.

Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands. Tropics generally.

Hypolepis tenuifolia, *Bernh.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 200; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 343.

Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward in New Caledonia and Solomon Islands; and to the Mascarene Islands.

Adiantum hispidulum, *Sw.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 200.

Fiji; eastward to Tahiti; westward in the New Hebrides and New Caledonia; and to East Africa. Also in Jamaica.

Lindsaya ensifolia, *Sw. Syn. Fil.* pp. 118, 317; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 342.

Fiji and Samoa; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to the Mascarene Islands.

Pteris quadriaurita, *Retz.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 200; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 344.

Fiji and Samoa; eastward to Tahiti; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands. Tropics generally.

Pteris tripartita, *Sw. Syn. Fil.* pp. 100, 293.

Fiji and Samoa; eastward to Tahiti; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to Africa.

Pteris longifolia, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 200.

Eua; Fiji; westward in the New Hebrides, New Caledonia, and Solomon Islands. Tropics generally.

Pteris ensiformis, *Burm. f.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 200.

Fiji and Samoa; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to the Mascarene Islands.

Asplenium Nidus, *Linn. Sp. Pl.* p. 1537; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 345.

Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in the New Hebrides and New Caledonia; and to the Mascarene Islands.

Asplenium falcatum, *Lam.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 200; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 347.

Tongatabu; Fiji and Samoa; eastward to Tahiti and Christmas Island; westward in New Caledonia, Solomon Islands, Norfolk Island, and the Louisiade Islands; and to Central Africa.

Nephrodium dissectum, *Desv.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 200.

Fiji and Samoa; eastward to Tahiti; westward in the New Hebrides and New Caledonia; and to the Mascarene Islands.

Nephrodium unitum, *R. Br. Prodr.* p. 148.

Fiji and Samoa; eastward to Tahiti; Sandwich Islands. Warm countries generally.

Nephrodium invisum, *Carruth.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 201.

Tongatabu; Fiji and Samoa; eastward to Tahiti and the Cook Islands; westward in the New Hebrides and New Caledonia; and in Malaya.

Nephrodium molle, *Desv.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 201.

Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in the New Hebrides and New Caledonia. Tropics generally.

Nephrodium latifolium, *Baker*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 201.

Eua; Fiji and Samoa; eastward to Tahiti; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to Malaya.

Nephrolepis acuta, *Presl*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 201; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 355.

Tongatabu; Fiji and Samoa; eastward to the Austral Islands; westward in the New Hebrides, Solomon Islands, and Caroline Island. Tropics generally.

It is the commonest fern in the island; the type and the variety *rufescens* both occur.

Polypodium adnascens, *Sw.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 201.

Fiji and Samoa; eastward to Tahiti and Christmas Island; westward in the New Hebrides, New Caledonia; and to Africa.

Polypodium Phymatodes, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 201.

Tongatabu; Fiji and Samoa; eastward to the Marquesas Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands; and to Africa.

Acrostichum aureum, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 201.

Tongatabu; Fiji and Samoa; eastward to Tahiti; westward in the New Hebrides, New Caledonia, and Solomon Islands. Tropics generally.

Acrostichum scandens, *J. Sm. in Hook. Journ. Bot.* iv. (1842) 149.

Fiji and Samoa; westward in New Caledonia; and to Tropical Asia.

Schizæa digitata, *Sw. Syn. Fil.* pp. 150, 380.

Fiji; westward to the Mascarene Islands.

Schizæa dichotoma, *Sw.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 201; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 364.

Fiji and Samoa; eastward to the Low Archipelago; Sandwich Islands; westward in the New Hebrides, New Caledonia, and Solomon Islands. Tropics generally.

Ophioglossum pendulum, *Linn.*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 202; *Christ, in Engl. Jahrb.* xxiii. (1897) p. 365.

Tongatabu; Fiji and Samoa; eastward to the Society Islands; westward in the New Hebrides and New Caledonia; and to East Africa.

On the British Species of Sea-Thrifts and Sea-Lavenders.

By G. Claridge Druce, M.A., F.L.S.

[Read 6th December, 1900.]

The Sea-Thrift is one of our most widely distributed maritime plants, occurring as it does along the entire coast-line of the British Isles. It grows on mud-flats and on sandy and shingly places fronting the sea, extends up the sides of tidal rivers, and is even more at home on the bare rocky cliffs and islets of the western coast; again we meet with it on rocky cliffs, and on the bare stony shoulders and summits of our highest mountains. There is evidence to show that it is found on sea-cliffs up to 700 feet, but few details are forthcoming as to its occurrence from this altitude to that of 1800 feet, although it is not unlikely that in the West of Scotland it may be pretty generally distributed through this altitudinal zone. In Durham it grows on Widdy-bank in Teesdale, but, so far as my experience goes, it is a rare plant between 1500 and 2000 feet. It is rather common on the cliffs of Snowdon between 2200 and 2700 feet, as it is on some of the Scottish mountains between 2900 and 4000 feet. On the Great Orme's Head it occurs at 600 feet, on Scawfell between 300 and 900 feet, and is common on the Irish mountains, between 2400 and 3400 feet. It grows at Killarney, where the land surface is only 90 feet above sea-level; but in Ireland it is not recorded from situations more than 10 miles from the coast. In Somersetshire it has been seen in stony fields 300 feet above sea-level and as far inland as 30 miles.

This wide altitudinal, combined as it is with an extensive geographical, range, and with a power of adaptability such as is evidenced by the extreme differences of localities, already indicated, would lead us to expect considerable variation in the species. That it possesses at any rate superficial differences, is shown by the fact that at one time or another attempts have been made by British botanists to establish varieties; but whether from the diagnoses being faulty, or from the inconstant characters on which these varieties have been based, or from want of attention being given to the subject, only one variety now figures in our British list, namely the var. *planifolia* of Syme. In the first edition of the 'Manual of British Botany,' p. 245 (1843), Babington established a variety of *Statice Armeria* as var. *alpina*, but this, as his herbarium shows, is based on a specimen gathered by him on Twll Dhu, Carnarvonshire, in 1832, which differs in "being only more constantly hairy"; but in the second edition of the Manual (1847), p. 261, he describes it as having "broader leaves" and "with petals ½ as long as the villose-striate tube of the calyx," and there is a specimen in his herbarium from Snowdon gathered in 1847. Neither of these has anything to do with *Armeria alpina*, Willd. (which is a plant of the mountains of Central Europe), and they are scarcely separable from the coast form of *A. pubescens*, Link. In the third edition, p. 262 (1851), he describes var. *pubescens* (Link), and refers to the "Engl. Bot. plate no. 226" of the first edition as representing it, and says "the calyx-tube is hairy on the ribs only." In the seventh edition of 1874 three varieties are given:—var. a. *maritima* (Willd.) (which he says is synonymous with *A. maritima*, Boiss., and *A. pubescens*, Link); var. b. *planifolia* (the variety established by Syme in the third edition of English Botany, vol. vii. p. 158, under *A. vulgaris*, Benth., and figured on plate 1153); and var. c. *duriuscula*, Bab., described as having very slender 1-veined subtriquetrous leaves.

In 1848 the genus *Armeria* was monographed by Boissier for De Candolle's 'Prodromus' (vol. xii. pp. 674–689); and the author divides the genus into two sections—1. Macrocentron, and 2. Plagiobasis; the latter contained the British species. Boissier has again divided Plagiobasis into two groups: i. Holotrichæ, characterized "Tubus calycinus totus et ad costas et ad costarum intervalla pilosus"; and ii. the Pleurotrichæ, with "Tubus calycis ad costas tantum pilosus, intervallis costarum glabris."

In section 1 he puts *A. maritima*, Willd., Enum. Hort. Berol. i. p. 333, which he says occurs in "Suecia et Norvegia, Anglia, Hibernia, Germania boreali et Gallia occidentali." To this group he also puts *A. pubigera*: "Ab *A. maritima* sat differre videtur caule basi suffrutescente foliis 1–1½ pollic. rigidis triquetris regulariter in rosulam more *Acantholimonis* congestis. β *scotica*, pubescentia foliorum rariori, involucro glabro. In Insula Staffa Scotiæ ubi Seapink dicitur legit cl. A.DC."

In Pleurotrichæ Boissier puts *A. pubescens*, Link, in 'Repert. Nat. Cur. Berol. i. p. 180' . . . "In arenosis præsertim maritimis Sueciæ in Hallandiæ, Germaniæ septent., Angliæ et Scotiæ (hic quoque in montibus ex herb. gen. Berol.), Galliæ Islandiæ . . ." It is the *Statice elongata* var. *pubescens* of Koch, Syn. p. 595

(1837), and the *S. Armeria*, Engl. Bot. t. 226 ("præter pubem non indicatam bene respondet"). This differs, he says, from *A. maritima* "ab ea tantum bracteis paulo acutioribus, scapis longioribus et præsertim calyce ad costarum intervalla non piloso vix recedit. Si observationes ulteriores hunc characterem non constantem esse probarent tunc huic speciei potius quam nulli aliæ *A. pubescens* conjungenda esset." We shall gather from the description that Boissier was somewhat doubtful as to the specific distinction of *A. maritima* and *A. pubescens.* We must, however, bear in mind that this rather artificial character of the pubescence being limited to the ribs or being spread over the whole of the calyx-tube determines the limitations of the two groups, the Holotrichæ and the Pleurotrichæ, and that the European members of the genus which I have examined fall very clearly into one or other of the groups; and, so far as I am aware, no one has suggested that *A. sibirica*, *A. filicaulis*, or *A. juncea*, which belong to the Holotrichæ, are mere homologues of any species included in the Pleurotrichæ, however closely allied *A. pubescens* and *A. maritima* may be.

In 'The Student's Flora,' Sir J. D. Hooker has called our British plant *A. vulgaris*, Willd., and under it has placed as synonyms *A. maritima*, Willd., *A. pubescens*, Link, *A. pubigera* var. *scotica*, Boissier, *A. duriuscula*, Bab., and *Statice Armeria*, L.; but this latter synonym does not belong to the British plants, and, as the specimen in the Linnean Herbarium shows, is the *Armeria elongata*, Hoffm. Hooker's description includes no reference to the spaces between the ribs being naked or hairy, and with the exception of the var. *planifolia* all varieties are ignored. In the third edition of 'English Botany' (vol. vii. p. 158) Syme says that the character derived from the calyx-tube being glabrous or hairy between the ribs is "inconstant and is utterly worthless as a means of separating the various forms, as has unfortunately been done by M. Boissier in . . . the 'Prodromus.'" This very positive statement led me to examine our British forms as well as the European species; and it is with the desire to call the attention of botanists to the subject that I have prepared this paper. It may be well to mention that Willkomm & Lange in their 'Prodromus Flora Hispanica,' following Grenier & Godron in their 'Flore de France,' have united under one species *A. maritima* and *A. pubescens*; and Hartman, in his 'Handbok i Skandinaviens Flora,' has gone still further by putting *A. maritima* and

A. sibirica as sub-species under *A. elongata*; so that these authors appear to agree with Sir J. D. Hooker and Syme in their opinion of the insignificance of the value of the character which Boissier thought sufficiently definite to separate the genus into sections. Nyman, in his 'Conspectus Floræ Europææ,' pp. 614–616, however, follows M. Boissier's arrangement, with the result that the two species, which by many authors are considered to be synonymous, are separated by five intervening species, *A. pubescens* being numbered 35 and *A. maritima* 41.

So far as my limited observations of the European plants go, I have been surprised to find how readily this trifling character proved sufficient to separate the two groups, and, with the exception of the British plants, the division does not appear to be unnatural.

In the examination of a large number of British specimens, I also found this character more definite and stable than I expected, and there was but little difficulty in referring the fruits of mature specimens to one or other of the varieties. In order to do this correctly care must be taken, especially with immature specimens from the herbarium, as sometimes, from the hairs on the ribs being pressed down, the appearance is given of the hairs being situated also upon the intercostal spaces. In such examples it is a good plan to cut the fruit transversely and look down the intercostal spaces, when one can more readily determine to which variety it belongs, and it is best to use a one-inch objective. Therefore my experience does not support Boswell Syme's statement as to the instability of the character. The fruits vary considerably in hairiness, and it is well to bear in mind that the hairs are not soft and thin, but that they are stiff and relatively stout; also, that while a fruit may be thickly or thinly clothed with hairs, it does not follow that the plant which has the fruits thickly covered with hairs on the nerves have them also on the intercostal spaces, nor does the fruit when the ribs are thinly covered with hairs have necessarily the interspaces bare. These bare spaces between the ribs are sometimes wide enough to allow of the character being observed by the naked eye. Distinct as the character appears to be, I am at present unable to correlate it with any other distinctive character; nor can I suggest that it is due to climatal, altitudinal, or geographical cause, since both forms are found on the cold shoulders and summits of mountains, and on the face of sunny cliffs, both are found not only on estuarine mud-flats at the coast-level, but also on mountain tops, the plant with bare intercostal spaces occurring on Ben Lawers, Snowdon, Little Culrannoch, and Carran Tual, while others from Ben Heasgarnich in Glen Lyon belong to the form with hairy intercostal spaces.

The geographical distribution of the two plants, so far as the British Isles are concerned, is also very similar. But although the character alluded to is trifling it is, as I have said, constant, and hitherto I have been unable to find two fruits from the same plant that differ in this particular: not only so, but all the individual specimens (numbering a hundred) which I examined on the Snowdonian cliffs belonged to the variety with the intercostal spaces bare; while specimens gathered by Dillenius 174 years previously, and others in the British Museum Herbarium obtained nearly half a century ago from Snowdon Peak, and those collected by Babington from Crib Goch in 1847 and from Twll Dhu in 1832, belong to the same form. From this fact we may presume that the character has some degree of constancy and can be perpetuated by seed, although at present we lack direct evidence on this latter point. It is not improbable that the numerous plants of the Thrift on the Snowdonian cliffs may have originated from a comparatively small number of wind-blown seeds from the neighbouring coast. Various theories have at one time or another been suggested to account for the occurrence of the Maritime Thrift in alpine places. I am not one of those who believe that it is caused by any advancing or receding thermal changes, but think that its presence on the mountains can be accounted for by the wind carrying the seeds from the coast to a place which, being bare of other vegetation, is suitable for the Thrift; and its comparative rarity on the lower levels is probably due to the fact that in these situations there is a much greater amount of competing vegetation against which the Thrift cannot successfully colonise. Mountains offer the not less important factor of a moisture-laden air, which is not so uniformly present in the lower areas away from the coast. An examination of the structure of the fruit with its enveloping calyx will show how highly specialized it has become, and chiefly perhaps in those structural characters which enable it to be more readily carried by the wind to a suitable place of growth.

I hope to have the assistance of Mr. Poulton, Jun., of Oxford, in making some experiments on the comparative culture of the two varieties in various soils, and also in growing them from seed, so as to ascertain more positively than I can at present the permanence of the character here described, and whether it can be transmitted to the offspring unchanged.

Brief allusion may be made to the variety *planifolia* of Syme, which unfortunately is only based on a cultivated specimen from Mr. H. C. Watson's garden, said to have been brought from the Scottish Highlands, and thus lacks the importance it might have had if it had been compared with the plant growing in its natural home. I have observed that plants of both *A. maritima* and *A. pubescens*, when cultivated, have a tendency to produce broader leaves which are also flatter, and consequently the veins are more readily seen. Moreover, if the basal portion of the early leaf, even of the coast or mountain plant, be examined, one is able to see the fibro-vascular strands varying from five to seven in number. These usually either run out, coalesce, or disappear at a greater or lesser distance from the base. If a section of the leaf with apparently one nerve only be made, one is able to observe seven fibro-vascular strands; but the type specimen of Mr. Watson's cultivated in the Cambridge Botanic Garden, which is preserved in Babington's Herbarium, shows that some of the leaves are three-nerved. Personally, I do not attach great importance to the character derived from leaf-nervation; but it may be found that the mountain plants which Prof. Babington named *planifolia*, from specimens collected by me on Little Culrannoch and Ben Lawers, in which the leaves are certainly broader than is usual, possess other marks of distinction, but I at present know of none. I have a plant from the Norfolk mud-flats with even broader leaves, in which three nerves are more distinctly seen than in the Breadalbane specimens, and a similar plant from Wensleydale is contained in Babington's Herbarium, and these are worthy further study.

In the 'Conspectus Floræ Europææ,' Nyman, following the arrangement adopted by Boissier in the 'Prodromus,' puts the variety *planifolia* of Syme under *Armeria pubescens*, Link, in the Pleurotrichæ; but I possess specimens agreeing with the leaf-characters of *planifolia* which have the fruit of the Holotrichæ and therefore belong to *A. maritima*: that is, if we give specific distinction to *maritima* and *pubescens*, each has a broad-leaved form *planifolia*.

Nyman places Babington's *A. duriuscula* under *A. pubescens*, but *A. maritima* has an equally narrow-leaved form; while Babington's *A. pubigera* from Southern England (which is said not to be identical with Boissier's plant similarly named) is put under *A. maritima*. Boissier's *A. pubigera*, it will be remembered, has a variety *scotica* from the Isle of Staffa; but I cannot see that either Boissier's or Babington's *pubigera* is specifically distinct from *A. maritima*. The British plants named *pubigera* differ chiefly in the shorter leaves, which form therefore more compact tufts.

A few words may be given to the nomenclature of the Thrifts and the Sea-Lavenders. To those who follow the law of priority for genera as well as species, the present arrangement adopted in our text-books must be unsatisfactory, and especially so to those who choose the date 1753 as the starting-point for the citation of both genera and species. Tournefort in his 'Institutiones' properly defined these two genera, which are well differentiated not only by their habit, but by their morphological characters, giving the name *Statice* to the Thrifts and *Limonium* to the Sea-Lavenders; but, unfortunately, Linnæus, in the first edition of the 'Species Plantarum,' united them into the one genus *Statice*, the first and only Thrift being the first species, which he calls *Statice Armeria*. This Linnean species is, however, an aggregate one; and from examination of the Linnean Herbarium I can say that the specimen there is not our British plant, but the species named by Koch *Armeria elongata* and by Willdenow *A. vulgaris*, and referred to by Linnæus in the first and second editions of the 'Flora Suecica.' The remaining species of *Statice* in the 'Species Plantarum' are all Sea-Lavenders. In 1809 Willdenow, in the 'Enumeratio plantarum Horti Regii Botanici Berolinensis,' separated the Thrifts from the Sea-Lavenders and called them *Armeria*, a name which had been used by Linnæus in the first edition of the 'Systema' of 1735; but the synonym of *Lychnidea*, quoted by Linnæus from Dillenius, Kuntze (in opposition to the view of the 'Index Kewensis') identifies with the Linnean genus *Phlox*, and in the 2nd vol. p. 432 of the 'Revisio Generum Plantarum,' where he takes 1735 as the starting-point for generic citation, he replaces the name of the Polemoniaceous genus *Phlox* by that of *Armeria*, and substitutes Willdenow's *Armeria* by that of *Statice*. Boissier, unfortunately, in the 'Prodromus' followed Willdenow in reversing the names given by Tournefort for these genera, as then would have been a convenient time to have restored the names used by Tournefort in the 'Institutiones.' It is possible that if, in the years intervening between the dates of 1753 and 1809, there had been no restoration of Tournefort's genera, Willdenow may have been justified in finding another name for the Thrifts, since, although the Thrift has the "priority of place" in the 'Species Plantarum,' this Neo-American law necessarily was unknown to Willdenow, and is even now not generally followed, while he possibly was influenced by the fact that the greater number of species in the Linnean genus *Statice* consisted of Sea-Lavenders, and therefore to them belonged the name *Statice*; but I think there is no valid reason for his neglect of the general opinion of contemporary botanists or in wilfully ignoring the use of these names by the distinguished botanists Tournefort, Dillenius, Moehring, Amman, and many other pre-Linnean botanists (I am using the term pre-Linnean to signify that their use of the names *Statice* and *Limonium* was made before the date of 1753, and not necessarily that in all cases they preceded Linnæus). Moreover, very shortly after the establishment of the Linnean genus *Statice* in 1753, our own countryman John Hill (who was a keeper of Kew Gardens, and who lived at Denham in Buckinghamshire) published in 1756 the 'British Herbal' on Tournefortian lines, in which he again separated the two genera under Tournefort's names, and thus describes the Thrift:— Linnæus, he says, "confounds the sea-lavender with the thrift. He takes away the generical name limonium, and makes all these plants species of statice; but there is an absolute and essential distinction in the general cup, which supports that in the form and universal aspect. Thus Nature confirms the obvious differences, and thus [Linnæus] has confounded them; not heedlessly, for he names this very difference, acknowledging, that while the common cup of the limonium contains a great number of flowers in a long series, and is simple, and of an oblong form; that of statice is triple, and comprehends them in a round cluster. This we shall explain at large in its place, treating of statice." Under *Limonium* he has three species, and under *Statice* one species, *Statice vulgaris*; and says "there is no other known species distinct from this," a statement quite Benthamian in its generalization, although Kuntze is even now practically in accord with him. In this 'Herbal' Hill has not adopted the binomial system, and for that reason some authorities would probably say that it is not valid for the citation of genera; but I do not see that this should be the case, however it may militate against Hill being cited as the author of the specific name, which in one of these instances happens to comply with the Linnean plan. Even if we ignore Hill, we shall find that Miller, in the sixth and seventh editions of the 'Gardener's Dictionary' of 1752 and 1759, had also taken the same line; but these again are editions in which the binomial system is not adopted. In the eighth edition of 1768, however, the reformed plan is followed, and there are three species described, namely: *Statice Armeria*, which is the *Armeria elongata* of Link; *Statice minor*, which is the *A. alpina* of Willdenow; and *Statice maritima*, our Sea-Thrift, and which, following Nyman and other authors, we shall connect with the Holotrichous *Armeria maritima*.

In addition to Hill and Miller, Fabricius in the 'Enumeratio . . . . . plantarum . . . Helmstadtiensis' also uses the Tournefortian names of the genera in the same way; as does Adanson in the 'Familles des Plantes' of 1763, and Moench in the 'Methodus' of 1794, and other authors. Moreover, Medikus in 'Staatsw. Vorles. Churpf. Phys.-Oek. Gesell.' (1799), p. 228, used the name *Polyanthemum* for the Thrifts before the establishment of Willdenow's genus *Armeria*, which is therefore invalid from another cause, the only reason left for the retention being the powerful one, that of its being in nearly general use. Kuntze in his severely criticised 'Revisio' adopted the view I advocate, and it is followed in N. L. Britton's 'List of Pteridophyta and Spermatophyta of North-eastern North America,' and by N. L. Britton and A. Brown in their 'Illustrated Flora of the Northern States and Canada.'

I now give the results of my examination of British specimens of the Thrifts which belong to the Pleurotrichous *Armeria pubescens*, Link, from the following localities:—

Cobo, Guernsey ("*A. duriuscula*"); Tors near the sea, Ilfracombe (Herb. Bab. 1848); Torr Cross, S. Devon; Portland, Dorset; Littlehampton, Hastings, Sussex; Gravesend, E. Kent; Porlock Weir, Somerset; Wells, Norfolk; Aber coast, Pwlheli coast, Crib Goch (Dillenius, 1726), Snowdon (Herb. Bab. 1847 and Twl Dhu 1832, as *alpina*), Clogwyn du yr Arddu, at 2200–2700 feet, Carnarvonshire; Dulas Bay, and Aberfrawy, Anglesey; Wainfleet, Lincolnshire (Rev. H. J. Riddelsdell); Hillno, Cheshire; Southport, Lancashire; Wensleydale, Yorkshire; Torr

Sands, Wigtownshire; Gullane Links, East Lothian; Ben Lawers (a broad-leaved form), Mid Perthshire; Ben Laiogh, Argyll; Little Culrannoch (a broad-leaved form), Forfar; shores of Loch Duich, West Ross-shire; Balta Sound, Shetland; summit of Carran Tual, Co. Kerry; top of Croghea mountain (Herb. Babington, 1840), Achil Island, Co. Mayo.

The following localities yield the Holotrichous *A. maritima*, Willd., *Statice maritima*, Mill.:—

St. Helier, Jersey (Herb. Babington, 1837); between Northfleet and Greenhithe, Folkestone (*A. pubigera scotica*, W. W. Newbould, 1848, and also named *pubigera* by Syme), Kent; Selsey Island (Herb. Dillenius), West Wittering (*A. pubigera scotica*, W. W. Newbould in Herb. Bab. 1843), Hastings, Shoreham, Sussex; Southampton (*A. pubigera scotica*, Herb. Bab. 1827), Hants; Brading, Isle of Wight; Chesil Beach, Dorset; Slapton, Devon (Rev. H. J. Riddelsdell); The Lizard (Riddelsdell), St. Ives, Cornwall; Brean, and also 30 miles inland at 300 feet, Somersetshire; Tenby, Pembrokeshire; Borth, Cardiganshire; Barmouth, Merionethshire; Great Orme, Bangor, Carnarvonshire; Dulas Bay, Anglesey; Rhuddlan Bay, Flintshire; Redcar, Worthall, Yorkshire; mud-banks by the Tees, Seaton Carew (Herb. Oxon.), Teesdale, Co. Durham; Firth of Forth; Kirkcaldy; coast of Elgin; Brodick, Isle of Arran; coast of Inverness; Ben Heasgarnich (broad-leaved form), M. Perthshire; Flagga, Shetland; Bangor, Co. Down; Ashedon, Co. Antrim.

Armeria vulgari-plantaginea. Under this name Syme, in Engl. Bot. vii. p. 159, describes and on plate 1155 figures a plant which he gathered on the slopes of St. Brelade's Bay, Jersey, growing with both the supposed parents. There is a specimen in Babington's Herbarium which shows that, as far as size goes, it is intermediate between the two species. The fruit is pleurotrichous and the stems are glabrous, and I can see no trace of hybridity in the herbarium specimen; but it would be advisable to see the plants growing before making a positive statement. For the present I should prefer to leave it under *Statice plantaginea* var. *bupleuroides* [*Armeria*, Gren. & Godr.], which it appears to agree with. There is but little difference, size alone excepted, to distinguish it from *plantaginea*. In the peculiar and characteristic leaves of *plantaginea* there is a scarious margin which is crenulated, but this is not present in the leaves of Syme's supposed hybrid in Babington's Herbarium (which leaves have the peculiar shape of the type although smaller and somewhat narrower, differences perhaps caused by growing in a drier or more exposed situation).

To conclude, one must now decide upon the names which should be given to our British species of Thrifts and Sea-Lavenders. For the first, in order to comply with the law of strict priority, I think we must choose *Statice*, for the second *Limonium*. Next we must decide upon the question as to whether we have two or three species of Thrift. It may well be urged that the characters already alluded to are not sufficient to warrant the specific separation of *maritima* and *pubescens*. In that case, we should have to make another section between the Pleurotrichæ and Holotrichæ to contain our British plant, which should be then called *Statice maritima*, Miller, with a var. *pubescens* and sub-vars. *planifolia*, *duriuscula*, and *pubigera*. For the present, however, I think it preferable to keep them as distinct species, putting one at the end of the Pleurotrichæ and the other at the beginning of the Holotrichæ, as in the following arrangement:—

STATICE, [*Tourn.* Inst. 341, t. 177, ex *Linn.* Syst. ed. 1 (1735)] *Hill*, Brit. Herbal. 345 (1756).

Pleurotrichæ.

1. S. PLANTAGINEA, *All. Fl. Pedem.* ii. 90 (1789).

Armeria plantaginea, Willd. Enum. Hort. Berol. 334.

—— var. BUPLEUROIDES.

Armeria bupleuroides, Gren. & Godr. Fl. Fr. ii. 736.

A. vulgari-plantaginea, Syme, Engl. Bot. ed. III. vii. 159, t. 1565.

2. S. PUBESCENS, *Sm. ex Schult. Syst.* vi. 772.

Armeria pubescens, Link, in 'Repert. Nat. Cur. Berol. i. 180.' *A. maritima* var. *Linkii*, Gren. & Godr. Fl. Fr. ii. 733.

—— var. PLANIFOLIA.

Armeria vulgaris, Benth. var. *planifolia*, Syme, E. B. ed. III. vii. 158.

—— var. (vel subvar.) DURIUSCULA.

A. maritima, var. *duriuscula*, Bab. in Ann. & Mag. Nat. Hist. Ser. II. iii. (1849) 436.

Holotrichæ.

3. S. MARITIMA, *Mill. Gard. Dict.* ed. VIII. n. 3.
Armeria maritima, Willd. Enum. Hort. Berol. 333.

—— var. (vel subvar.) COMPLANATA : foliis latioribus planiusculis sæpe distincte trinervatis.

—— var. (vel subvar.) PUBIGERA : foliis uninervatis anguste subtriquetribus.
Armeria pubigera, Boiss. in DC. Prod. xii. 678.

LIMONIUM, [*Tourn.* Inst. 341, t. 177] *Hill*, Brit. Herbal, 343 (1756); *Mill.* Gard. Dict. ed. VI. (1852) and VII. (1759). *Statice*, Linn., partim.

1. L. VULGARE, *Mill. l. c.* ed. VIII. n. 1.
Statice Limonium, Linn. Sp. Pl. 274 (1753).

—— var. PYRAMIDALE.
S. Limonium var. *β pyramidalis*, Syme, Eng. Bot. ed. III. vii. 161.

2. L. RARIFLORUM, *O. Kuntze, Rev. Gen.* 396.
Statice rariflora, Drejer, Fl. Excurs. Hafn. 121.

3. L. LYCHNIDIFOLIUM, *O. Kuntze, l. c.*
Statice lychnidifolia, Girard, in Ann. Sc. Nat. Sér. II. xvii. (1842) 18.

4. L. AURICULÆFOLIUM.
Statice auriculæfolium, Vahl, Symb. Bot. i. 125.

—— var. DODARTI.
S. auriculæfolia var. *Dodartii*, (Girard, in Ann. Sc. Nat. Sér. II. xvii. (1842) 31) as a species.

5. L. OCCIDENTALE.
Statice occidentalis, Lloyd, Fl. Loire-Inf. 212.

—— var. INTERMEDIUM.
Statice occidentalis var. *intermedia*, Syme, Engl. Bot. ed. III. vii. 164.

6. L. RETICULATUM, *Mill. Gard. Dict.* ed. VIII. no. 9.
Statice reticulata, Linn. Sp. Pl. 275.

On a small Collection of dried Plants obtained by Sir Martin Conway in the Bolivian Andes. By W. Botting Hemsley, F.R.S., F.L.S., and H. H. W. Pearson, M.A., F.L.S.

[Read 4th April, 1901.]

Our knowledge of the plants of the Bolivian Andes is principally due to the labours of D'Orbigny, F. J. F. Meyen, Pentland, and more especially those of Weddell and Mandon. D'Orbigny in 1830 ascended the western slopes to Lake Titicaca, crossed the ridge, and descended on the Eastern side as far as Chiquitos. On his return he visited the Highlands of Cochabamba and brought plants from the vicinity of the snow-limit*. He was followed a year later by Meyen†. J. B. Pentland, a contemporary of D'Orbigny and Meyen, resided for some years in Bolivia as British Consul. He was particularly interested in the geology and meteorology of the Andes, and during his numerous journeys collected a few plants which are now at Kew. Some of these are from elevations exceeding 17,000 ft.

The foundation of Weddell's *Chloris Andina*, the classic contribution to our knowledge of the botany of the High Andes, was laid during his own journeys in the Bolivian Andes in 1845 and the two following years. Doctor and botanist to a French expedition under the leadership of Francis de Castelnau, Weddell landed at Rio de Janeiro in June 1843. In May 1845, the expedition was at Villa Maria on the confines of Paraguay. Here Weddell severed his connection with the Castelnau expedition and followed an independent route westward. He crossed the Andes and travelled in a north-westerly direction through Chuquisaca and Cochabamba to La Paz. He thoroughly explored the banks of Lake Titicaca, crossing the numerous affluent watercourses "dans de singulières embarcations composeés de deux grosses bottes ou cylindres de Jones liés ensemble, et relevés en pointe aux extrémités."‡ This plant he states to be a *Scirpus* near *S. lacustris*, which was found in great abundance. Several minor journeys were made among the mountains from the Lake as a centre. In the course of these

* These are incorporated in the De Candollean Herbarium.

† Reise um die Erde. Berlin, 1834–5, vol. i. Kap. 8; vol. ii. Kap. 9.

‡ Annales des Sciences Naturelles, Série 3, vol. xiii. p. 95.

journeys he crossed the ridge of the Cordilleras no less than five times. In November 1848 he embarked at Lima and returned to France with the most valuable contribution to the materials for the Flora of the High Andes which had ever been brought together. In 1851 Weddell set out again at the head of a commercial expedition whose object was to investigate the gold-producing possibilities of the soil of the Tipuani valley. The expedition lasted only a few months, but its leader found time to collect plants on Mount Sorata besides making valuable notes concerning the distribution of the species and taking a series of barometric observations *. Meanwhile another botanist, a friend of Weddell, commenced a very valuable collection of plants on the Bolivian Andes in the neighbourhood of Sorata. This was Gilbert Mandon, of French peasant parentage, who went to Bolivia in an industrial capacity in 1848. For six years he studied the flora of this region of the Andes and sent his extensive collections to Weddell, who was then engaged in writing the *Chloris Andina* †, which was commenced in 1852. The original idea of this work was to include the names, descriptions, and distribution, not of Weddell's plants only but also of the alpine species collected by Humboldt in Columbia, Ecuador, and Northern Peru; by Haencke, Meyen, D'Orbigny, Pentland and C. Gay in Bolivia; and by Gay in Chili ‡. Of this work, so magnificently conceived, only two volumes were published. The first is devoted entirely to the Compositæ, members of which constitute a large proportion of the high-level floras of the world. The second, in which forty-one other natural orders are dealt with, was published in 1857. At this point other interests, family difficulties and ill-health supervened, and the work progressed no farther.

The latest collection of plants from the Bolivian Andes—that obtained by Sir Martin Conway in his expedition in 1898–9—is the subject of the present paper. Conway's principal work was done upon the Peaks of Sorata (21,500 ft.) and Illimani (21,200 ft.). The collection is a small one, numbering only forty-

* H. A. Weddell: Notice Biographique par M. Eug. Fournier. (Comptes Rendus du Congrès Intern. de Botanique et d'Horticulture), Paris, 1880, p. 19.

† Chloris Andina: Essai d'une Flore de la Région alpine des Cordillères de l'Amérique du Sud, par H. A. Weddell. 2 vols. Paris, 1855, 1857.

‡ Weddell: Chloris Andina, Preface.

six species. Eight of these were found at or above 18,000 ft., and include two from a locality 18,700 ft. above sea-level: these, the highest andine plants on record, are *Malvastrum flabellatum*, Wedd., and a grass, *Deyeuxia glacialis*, Wedd.

In a preliminary account* of his explorations, speaking of the Puna—a plateau 12,000–13,000 ft. above sea-level, which is bounded on the East by the Cordillera Real of which Sorata and Illimani are the highest peaks—Sir Martin Conway tells us that "a great part of the year is completely rainless, but from the beginning of December till the end of March or April rain is precipitated very frequently and with great violence. During the remainder of the year the slopes and plains are swept by dry winds, and sometimes scorched by a very hot sun so that, except at very high levels of perpetual snow, where bad weather lasts over a longer period, the surface of the whole country is dried and baked. In the rainy season mud avalanches fall down the slopes, gullies are deepened, every stream is in flood, waterways are ploughed in various directions in the plain, and all the rivers eat their way back."†

The flora of the high regions "appeared to us very sparse, though it is only fair to say that the rainy season must be the time when the flowers are most numerous, and as we quitted the country before the actual commencement of the rains we probably only encountered the earlier flowers . . . . . The flowers we found were much scattered about, one here, another there, but we never came across any carpet of blossoms such as form the great attraction of many high mountain regions."‡

Many of the plants in the following list bear flowers which appear to be adapted to fertilization by insects. As bearing indirectly upon the probability of the existence of insects at high levels in this region, the following remarks are interesting: "Up to an altitude of 17,000 ft., in suitable places, birds were numerous, and in a little tarn close to our base camp on Mount Sorata, at 16,000 ft. above the sea, we shot geese, gulls, wild duck, and snipe, besides several small birds; we saw a number of rather large green-headed humming-birds."§

The plants from the higher elevations in this collection are

* Journ. R. Geogr. Soc. xiv. (1899), p. 14 *et seqq.* † *L. c.* p. 16.
‡ *L. c.* p. 20. § *L. c.* p. 20.

alike in habit, in which they resemble also the high-level plants of other portions of the world. The subaerial parts are dwarfed and seldom rise more than three inches above the surface of the ground. The leaves are usually thick with a distinct tendency to fleshiness. Extreme hairiness and a very coriaceous texture are alike uncommon. The leaves are very commonly disposed in the form of a rosette; many plants of the same species are frequently crowded together, giving rise to the turf-formation * so frequently met with in cold and exposed situations. On the other hand, the subterranean organs attain an enormous development, which is seemingly out of all proportion to that of the aerial parts to which they belong. The root-system is usually either monopodial, consisting of a deep stout taproot and its widely extended branches, or a fascicle of more or less fleshy roots. Since the upper layers of the soil are usually at a temperature considerably below the minimum at which root-activity is possible, this fact is of great biological importance. In this connection it may be mentioned that the collection consists entirely of perennials; annual plants are very rare, if indeed they exist at all, at high elevations.

Omitting introduced species, the Conway collection contains thirty-eight species from 12,000 ft. † and above. These are distributed among thirty-one genera and twenty-one Natural Orders.

Of the Natural Orders, the Loasaceæ (one species at 15,000 ft.) are an essentially andine group, and are represented in the Old World only by the monotypic African and Arabian genus *Kissenia*. Cactaceæ (one species at 14,270 ft.) is almost endemic, only one genus, *Rhipsalis*, being indigenous in the Old World. Valerianaceæ (one species at 18,000 ft.), though well represented in the Old World, attains a much greater and remarkable development in South America, particularly in the Andes. Weddell enumerates no less than twenty-nine alpine species of *Valeriana* ‡. Fourteen species in the Conway Collection—rather more than one-third of the whole—belong to the Compositæ, the

* Warming: Ökol. Pfl.-Geogr.; German trans., Berlin (1896), p. 39.

† Ball places the lower limit of the alpine zone on the Puna at 12,000 ft. Journ. Linn. Soc., Bot. xxii. (1885) p. 6.

‡ Chloris Andina, ii. pp. 17 et sqq.

only Order which is represented by more than two species. One-third of Ball's alpine collection obtained above Chicla, 4° farther north, was composed of members of this Order *. A similar predominance of the most widespread modern group of plants obtains at high elevations in all parts of the world. It is interesting to note that of these fourteen species, one only (*Perezia cærulescens*) belongs to the typically andine subgroup Mutisiaceæ.

Of the thirty-one genera represented at and above 12,000 ft., two, each represented by one species only, viz., *Adesmia* and *Blumenbachia*, are andine †. *Echinocactus*, *Baccharis*, *Perezia*, and *Bomarea* are more widely distributed in America, but do not occur in the Old World; the two latter having their greatest development in the Andes. Four others, *Malvastrum*, *Lupinus*, *Werneria*, and *Bystropogon*, are centred in the Andes, but are represented in the Old World by a few outlying species. To these we may apply the term "Amphigean." *Azorella* and *Ourisia* are confined to the Southern Hemisphere; *Azorella* extends into the Antarctic islands, and *Ourisia* is represented by six species in New Zealand. The remaining nineteen genera are cosmopolitan. Expressing these results in tabular form we have:—

Andine	genera	2=6·4	per	cent.
American	,,	4=12·8	,,	,,
Amphigean	,,	4=12·8	,,	,,
South Temperate	,,	2=6·4	,,	,,
Cosmopolitan	,,	19=61·2	,,	,,

On comparing these results with those obtained by an analysis of the plants collected by the Fitzgerald Expedition on the slopes of Aconcagua below 14,000 ft., we find a larger proportion of endemic genera. This collection contains forty-two genera ‡, of which ten are endemic in South America, and three others centred in the Andes but extending into North America. Three are at home in the South Temperate zone and four may

* Ball, in Journ. Linn. Soc., Bot. xxii. (1885) p. 10.

† *i. e.* endemic in South America and either confined to the Andes or centred therein.

‡ Burkill in Fitzgerald's 'Highest Andes,' London, 1899, p. 369.

be classed as Amphigean. Thus we have

South American..	23·8	per cent.
American........	7·1	„ „
Amphigean......	9·5	„ „
South Temperate..	7·1	„ „
Cosmopolitan....	52·3	„ „

A comparison of these figures with those in the preceding table points to the conclusion that the flora of the upper* alpine zone of the Andes contains a smaller proportion of endemic elements than that of the lower alpine and subalpine zones.

This generalization is found to be equally true for the other high-level regions of the world.

The natural orders and genera represented in the alpine zone in the Bolivian Andes do not afford much indication of the specialization of the flora. The species, however, are usually very local. Those comprising the Conway collection are peculiar to the New World and all but one are confined to South America; the exception is *Lobelia nana*, which extends northward into Mexico. Of the thirty-one alpine species which are certainly identified, eight are found only in the Bolivian Andes, eleven extend northward into Peru, two to Ecuador, six to Venezuela or Colombia, and three are common to the whole length of the Andes.

It has already been mentioned that two of Conway's plants are from an elevation of 18,700 ft. In addition to these, six others are from an elevation of 18,000 ft. or upwards, viz.: *Saxifraga Cordillerarum*, Presl, var. *trigyna*, Engl., *Valeriana nivalis*, Wedd., *Werneria dactylophylla*, Sch.-Bip., *W. Mandoniana*, Wedd., *W. pygmæa*, Gill.?, and a species of *Draba*.

RANUNCULACEÆ.

ANEMONE INTEGRIFOLIA, *H. B. K. ex DC. Syst. Veg.* i. 217; *Wedd. Chloris Andina*, ii. t. 83 A. Hepatica? integrifolia, *DC. Syst. Veg.* i. 217; *H. B. K. Nov. Gen. et Sp.* v. 40. Hamadryas andicola, *Hook. Ic. Pl.* t. 137.

* All but three of the genera considered in the table relating to Conway's collection are represented above 14,000 ft.

37. Near top of Huallata Pass, 14,110 ft. 65. The Puna. "Common fuel-moss."

Andes of Bolivia and Peru, 9000–17,000 ft.

CRUCIFERÆ.

DRABA AFFINIS, *Hook. f. Fl. Antarct.* 235?

Near Rocktooth Camp, Mount Sorata, about 16,000 ft.

The specimen is too poor to be certainly identified.

VIOLACEÆ.

VIOLA PYGMÆA, *Juss. ex Poir. in Lam. Encycl. Méth.* viii. 630; *Wedd. Chloris Andina*, ii. t. 87 B.

38. Near the top of Huallata Pass, 14,110 ft.

Andes of Bolivia and Peru, above 12,000 ft.

CARYOPHYLLACEÆ.

CERASTIUM MUCRONATUM, *Wedd. in Ann. Sc. Nat.* Sér. V. i. (1864) 294.

6. Illimani, Camp 3, 16,500 ft.

Andes of Bolivia and Peru.

HYPERICACEÆ.

HYPERICUM THESIIFOLIUM, *H. B. K. Nov. Gen. et Sp.* v. 192. H. silenoides (*non Juss.*), H. indecorum, H. tarquense, H. multiflorum, H. uliginosum, *H. B. K. Nov. Gen. et Sp.* v. 191 *et sqq.*

48. High up on the south side of Huallata Pass; about 14,000 ft.

Andes, from 5000 to 14,000 ft.

MALVACEÆ.

MALVASTRUM FLABELLATUM, *Wedd. Chloris Andina*, ii. 281.

35. On ascent from Hiska Hankaña to Rocktooth Camp at about 18,700 ft.

Andes of Bolivia above 14,000 ft.

GERANIACEÆ.

ERODIUM CICUTARIUM, *L'Hérit. ex Ait. Hort. Kew*, ed. 1, ii. 414. Geranium cicutarium, *Linn. Sp. Pl.* 680.

63. La Paz racecourse. 18. Umapusa, 14,270 ft.

From the Himalayas westwards through the Mediterranean region to Britain; from Vancouver Island southwards through the Rocky Mountains and the Andes to the Falkland Islands (apparently introduced into America).

OXALIS LOTOIDES, *H. B. K. Nov. Gen. et Sp.* v. 241. O. medicaginea, *H. B. K. Nov. Gen. et Sp.* v. 241; *Hook. Ic. Pl.* vii. t. 661. O. pichinchensis, *Benth. Pl. Hartweg.* 166.

46. High up on south side of Huallata Pass.

Andes, from Venezuela to Bolivia, ascending to 12,000 ft.

LEGUMINOSÆ.

ADESMIA SPINOSISSIMA, *Meyen, Reise um die Erde*, ii. 27.

54. Hiska Hankaña and neighbourhood.

The same plant was collected by Mandon (No. 728) in the Bolivian Andes at about 13,000 ft.

ASTRAGALUS UNIFLORUS, *DC. Astragalogia*, 243, t. 50.

39. Near top of Huallata Pass, 14,110 ft.

Andes of Peru and Bolivia.

MEDICAGO DENTICULATA, *Willd. Sp. Pl.* iii. 1414.

64. La Paz, on the racecourse.

Europe, Canary Islands, Mediterranean region, Abyssinia, N.W. India and Central Asia, China, and Japan; introduced into America.

LUPINUS sp.

9. Illimani, near 1st Camp, 14,000 ft.

SAXIFRAGACEÆ.

SAXIFRAGA CORDILLERARUM, *Presl, Reliq. Hænk.* ii. 55, var. TRIGYNA, *Engler, Monogr. Saxifr.* 184. S. trigyna, *Rémy, in Ann. Sc. Nat.* Sér. III. viii. (1847) 235; *Wedd. Chloris Andina*, ii. 213 (*a* only).

Near Rocktooth Camp, about 18,000 ft.

Bolivian Andes, to the highest limits of phanerogamic vegetation.

LOASACEÆ.

BLUMENBACHIA CHUQUITENSIS, *Hook. f. Bot. Mag.* t. 6143. Loasa chuquitensis, *Meyen, Reise um die Erde*, i. 483 (*note***).

23. Frasciya, 15,000 ft.

Peruvian and Bolivian Andes.

Cactaceæ.

Echinocactus sp.

16. Umapusa, 14,270 ft. Specimen insufficient to determine the species.

Umbelliferæ.

Azorella diapensioides, *A. Gray, Bot. U.S. Expl. Exped.* i. 702; *Wedd. Chloris Andina*, ii. 190. A. glabra, *Wedd. loc. cit.* t. 67 A.

65. Vilahaque Hill, about 14,500 ft.

The High Andes of Bolivia and Peru.

Valerianaceæ.

Valeriana nivalis, *Wedd. Chloris Andina*, ii. t. 48 A.

34. On ascent from Hiska Hankaña to Rocktooth Camp. Common about 18,000 ft. 52. Puna.

The Bolivian Andes at the snow-limit.

Compositæ.

Aster limnophilus, *Hemsl. & H. H. W. Pearson.* Erigeron frigidum, *Wedd. Chloris Andina*, i. 231 (*non Boiss.*). E. limnophilus, *Sch.-Bip. Bull. Soc. Bot. Fr.* xii. (1865) 81.

Bolivia, La Paz, 16,400 ft., *Mandon*, 225, 226; Hiska Hankaña, 16,600 ft., *Conway*, 28; Andes of Yungas, 14,000-15,000 ft., *Pearce.*

Baccharis genistelloides, *Pers. Syn.* ii. 425; *Mart. Fl. Bras.* vi. pt. 3; *Var.* typica, *Hook. Bot. Misc.* ii. (1831) t. 94. Conyza genistelloides, *Lam. Encycl. Méth.* ii. 93. Molina reticulata, *Lessing, Linnæa*, vi. 142.

8. Illimani, near 1st Camp, at 14,000 ft.

Between 14,000 and 15,000 ft. on the Andes from Bolivia to Colombia.

Baccharis subpenninervis, *Sch.-Bip. in Linnæa*, xxxiv. (1865–66) 532.

10. Illimani, near 1st Camp, at 14,000 ft.

Andes from Bolivia to Peru.

Baccharis alpina, *Wedd. Chloris Andina*, i. 168, t. 28 (?).

24. Frasciya, about 15,000 ft.

Baccharis microphylla, *H. B. K. Nov. Gen. et Sp.* iv. 55 B. Incarum, *Wedd. Chloris Andina*, i. t. 29.

11. Illimani, near 1st Camp, at 14,000 ft.
Andes, from Venezuela to Bolivia, ascending to 14,000 ft.

ERIGERON BRITTONIANUM, *Rusby, in Mem. Torr. Bot. Club*, iii No. 3 (1893), 54.
36. Hiska Hankaña. 44. High up on the S. side of Huallata Pass.
Bolivian Andes.

SENECIO ADENOPHYLLOIDES, *Sch.-Bip. in Bonplandia*, iv. (1856) 55.
4. Illimani, on moraine, at about 16,000 ft.
Andes of Bolivia and Peru at 13,000 ft., and above.

SENECIO sp. (*cf.* S. LINEARIFOLIUS, *Poepp.*).
25. Frasciya, at about 15,000 ft.
The same plant was collected at Culluy by Matthews (640).

SENECIO sp.
13. Illimani, near 1st Camp, at 14,000 ft.

WERNERIA DACTYLOPHYLLA, *Sch.-Bip. in Bonplandia*, iv. (1856) 55; *Wedd. Chloris Andina*, i. 87.
32. On ascent from Hiska Hankaña to Rocktooth Camp, at about 18,000 ft.
Andes of Bolivia and Peru at high levels.

WERNERIA MANDONIANA, *Wedd. in Bull. Soc. Bot. France*, xii. (1865) 80.
29, 30, 31. On ascent from Hiska Hankaña to Rocktooth Camp, at about 18,000 ft.
Mt. Sorata.

WERNERIA PYGMÆA, *Gill. ex Hook. Journ. Bot.* iii. (1841) 348; *Wedd. Chloris Andina*, i. 84, t. 16 B.
21. Umapusa, 14,270 ft.
Alpine region of the Andes from Venezuela to Chili.

WERNERIA PYGMÆA, *Gill.* ?
"About 18,000 ft."
The specimen is too meagre for certain identification.

WERNERIA HETEROLOBA, *Wedd. Chloris Andina*, i. 88, t. 16 A?
51. Puna.
Material too small and immature for certain identification.

BARNADESIA POLYACANTHA, *Wedd. Chloris Andina*, i. 13, t. 1 A.

40. On the way down towards Sorata.

Andes of Ecuador and Bolivia, between 8000 and 11,000 ft.

PEREZIA CÆRULESCENS, *Wedd. Chloris Andina*, i. 39, t. 10 A.

2. Illimani, near 1st Camp at 14,000 ft. 56. Hiska Hankaña and neighbourhood, at about 16,000 ft.

Andes of Peru and Bolivia, from 13,000 ft.

HYPOCHŒRIS SESSILIFLORA, *H. B. K. Nov. Gen. et Sp.* iv. 2. Oreophila sessiliflora, *D. Don, in Trans. Linn. Soc.* xvi. (1830) 178. Achyrophorus sessiliflorus, *DC. Prodr.* vii. 95.

55. Hiska Hankaña and neighbourhood. 61. South slope of Huallata Pass.

Alpine region of the Andes, from Colombia to Bolivia.

CAMPANULACEÆ.

LOBELIA NANA, *H. B. K. Nov. Gen. et Sp.* iii. 317, t. 272; *Wedd. Chloris Andina*, ii. 13, t. 46 A.

45. High up on S. side of Huallata Pass. 59. Hiska Hankaña and neighbourhood. 60. Theodolite station 6, Puna, near Achacache. 59 and 60 are stoloniferous.

Mexico and the Bolivian Andes.

CENTROPOGON sp.

42. On the way down towards Sorata.

VACCINIACEÆ.

VACCINIUM PENÆOIDES, *H. B. K. Nov. Gen. et Sp.* iii. 264; *Wedd. Chloris Andina*, ii. 178, t. 73 A.

7. Illimani, Camp 3, 16,720 ft.

Andes, from Venezuela to Bolivia, from 9000 ft. to the snow-limit.

PLUMBAGINACEÆ.

PLUMBAGO SCANDENS, *Linn. Sp. Pl.* ed. 2. 215; *H. B. K. Nov. Gen. et Sp.* ii. 220; *Mart. Fl. Bras.* vi. part 4, p. 165, t. 46. f. 2.

43 & 44. On the way down towards Sorata.

Widely distributed in the West Indies and Tropical America from sea-level to about 9000 ft. in the Andes.

GENTIANACEÆ.

GENTIANA SEDIFOLIA, *H. B. K. Nov. Gen. et Sp.* 173, t. 225; *Wedd. Chloris Andina*, ii. 73, t. 52 B.

1. Illimani, near 1st Camp, at about 14,000 ft. 20 and 22. Umapusa, at about 14,500 ft. 50. Puna.

Andes from Colombia to Chili; very common between 10,000 and 17,000 ft.

BORAGINEÆ.

ERITRICHIUM sp. (*cf.* E. PYGMÆUM, *Wedd. Chloris Andina*, ii. 89).

62. Southern slope of Huallata Pass.

The same plant was collected in the subalpine region of Sorata by Mandon (No. 383).

SOLANACEÆ.

SOLANUM PALLIDUM, *Rusby, in Mem. Torr. Bot. Club*, iv. (1895) 228.

On the way down towards Sorata.

Bolivian Andes between 8000 and 10,000 ft.

SCROPHULARIACEÆ.

CALCEOLARIA DEFLEXA, *Ruiz & Pav. Fl. Per.* i. 18, t. 30 *b*. Fagelia deflexa, *O. Kuntze, Rev. Gen. Pl.* i. 459: *Rusby, in Mem. Torr. Bot. Club*, vi. (1896) 93.

41. On the way down towards Sorata.

MIMULUS sp. (*cf.* M. LUTEUS, *Linn. Pl.* ed. 2. 884).

57. Hiska Hankaña and neighbourhood, at about 16,000 ft. The single specimen is too poor for satisfactory determination.

OURISIA MUSCOSA, *Benth. in DC. Prodr.* x. 493; *Wedd. Chloris Andina*, ii. 117, t. 60 A.

26. Hiska Hankaña at about 16,500 ft.

Andes from Pichincha to Sorata at 14,000 ft. and upwards.

LABIATÆ.

BYSTROPOGON CANUS, *Benth. Lab.* 326.

12. Illimani, near 1st Camp, at 14,000 ft.

Andes from Venezuela to Bolivia.

MICROMERIA BOLIVIANA, *Benth. Lab.* 731; *Wedd. Chloris Andina*, ii. 149, t. 63 B.

3. Illimani, near 1st Camp, at 14,000 ft.

Andes of Peru and Bolivia, from 9000 to 14,000 ft.

AMARYLLIDACEÆ

BOMAREA GLAUCESCENS, *Baker*, *in Journ. Bot.* xx. (1882) 201.

5. Illimani, Camp 3, at about 16,700 ft.

Alpine region of the Andes of Ecuador, Peru, and Bolivia.

BOMAREA GLAUCESCENS, var. PUBERULA, *Baker*, *loc. cit.*

14. Illimani, about 11,500 ft., just below Atahuaillani.

Subalpine region of the Andes of Peru and Bolivia.

GRAMINEÆ.

DEYEUXIA GLACIALIS, *Wedd. in Bull. Soc. Bot. Fr.* xxii. (1875) 178.

33. On the ascent from Hiska Hankaña to Rocktooth Camp, at about 18,700 ft.

The Bolivian Andes at 16,000 ft. and upwards.

(It is not certain that the leaves and inflorescences really belong to the same plant, and therefore some doubt attaches to this determination.)

Redescriptions of Berkeley's Types of Fungi.—Part II. By GEORGE MASSEE, F.L.S., Principal Assistant (Cryptogams), Herbarium, Royal Gardens, Kew.

[Read 2nd May, 1901.]

(PLATES 4 & 5.)

THE following is a continuation, on the same plan, of the work commenced in this Journal, vol. xxxi. p. 462, and includes all the species of *Discomycetes* and *Hysteriaceæ*, of which type specimens exist at present in the Kew Herbarium.

PEZIZA ELAPHINES, *Berk. & Broome*, *in Ann. & Mag. Nat. Hist.* Ser. IV. vii. (1871) p. 434, tab. 19. f. 18.

Gregarious, sessile, base somewhat narrowed, subglobose and closed, then expanding and becoming saucer-shaped, about ½ mm. diameter; disc pale grey, externally pale buff, margin paler, everywhere covered with cylindrical, obtuse, continuous or septate, brownish hairs, which are parallel at the margin, 30–70 × 5–6 μ; asci narrowly cylindric-clavate, base stout, apex slightly narrowed, and the pore blue with iodine, about 50 × 6 μ; spores 8, irregularly 2-seriate, continuous, hyaline, narrowly cylindrical, ends rather acute, straight or slightly curved, 8–10 × 1·5–2 μ paraphyses slender, hyaline, tips not thickened.

Mollisia elaphines, Gillet, Champ. Fr. Disc. p. 131; Phillips, Brit. Disc. 179.

Pseudohelotium elaphines, Sacc. Syll. n. 1257.

Dasyscypha elaphines, Massee, British Fungus-Flora, iv. 366.

Exsicc. Cooke, Fung. Brit. Exs. n. 659; Rabenh. Fung. Eur. n. 1813 (the specimens furnished by Broome).

On dead wood. England, France.

Under a low power the outside of the ascophore looks as if dusted with saccharine granules, as described by Berkeley; but when seen under a power of 400 diameters, the apparent granulation is seen to consist of the obtuse tips of the short hairs with which the outside is covered. During expansion of the ascophore, the hairs are often arranged in vertical lines.

PEZIZA THOZETII, *Berk. in Journ. Linn. Soc., Bot.* xviii. (1881) p. 388. (Pl. **4**. figs. 1 & 2.)

Globose and closed at first, then expanding until plane, margin raised permanently, sessile or narrowed into a very short stem-like base, 1–2 mm. across, rather fleshy; disc brown, externally paler, glabrous, but with delicate wrinkles radiating from the point of attachment; asci cylindrical, apex rounded, 260 × 16 μ; spores 8, obliquely 1-serrate, hyaline, continuous, often 1–2-guttulate, when mature minutely warted or rugulose, elliptical, ends narrowed, and usually but not always furnished with a small, smooth, blunt apiculus, 24–28 × 13–14 μ; paraphyses rather stout, very slightly thickened at the tip, substance of ascophore parenchymatous throughout, cortical cells largest.

Humaria Thozetii, Sacc. Syll. viii. n. 569.

On *Nepenthes*: Australia (*Thozet*, n. 934). On wood: Upper Hunter River, New South Wales (*Carter*).

PEZIZA CARMICHAELI, *Berk. in herb.* (Pl. **4**. fig. 32.)

Scattered or cæspitose, stipitate, concave, then plane and slightly margined, eventually slightly concave and immarginate, up to 1·5 mm. across; disc blackish-brown when dry, externally paler, glabrous; cortex parenchymatous, cells irregular, small, running out into densely packed, parallel, septate hyphæ at the margin; stem 1·5–2 mm. long, slender, often slightly curved, brown, slightly thickened and minutely downy at the very base; asci clavate, apex slightly narrowed, pore blue with iodine, base slender, about 115 × 10 μ; spores 8, irregularly 2-seriate, cylindrical or fusiform, ends acute, sometimes widest above the middle and becoming clavato-fusiform, often slightly curved, hyaline, smooth, continuous, often guttulate, 24–28 × 5 μ; paraphyses slender, numerous, tips very slightly clavate, brown, agglutinated together.

Hymenoscypha Carmichaeli, Phillips, in Grevillea, xix. (1891) p. 106.

Phialea Carmichaeli, Sacc. Syll. x. n. 4499.

Helotium Carmichaeli, Massee, Brit. Fung.-Fl. iv. p. 250.

On decayed wood and bark. Appin, Scotland (*Carmichael*).

The colour given is that of the dried specimen, and may require modification when fresh material is examined.

PEZIZA PROTRUSA, *Berk. & M. A. Curt. in Grevillea*, iii. (1875) p. 159; *Journ. Mycol.* vi. (1891) p. 179, pl. 7. ff. 8–11 (the asci are represented too broad).

Gregarious, rarely crowded, hypophyllous, at first subglobose and surrounded by the torn epidermis, at length becoming superficial and almost plane, about 0·5 mm. across, margin sometimes slightly flexuous; disc whitish, margin and outside darker, substance thin and soft; cortex and margin formed of rows of large, coloured cells which are biggest at the periphery; asci cylindric-clavate, apex slightly narrowed, and the minute pore blue with iodine, 50–60 × 5–6 μ; spores irregularly 2-seriate, continuous, hyaline, smooth, straight, narrowly cylindrical, or often inclined to be clavate, 5–7 × 1·5 μ; paraphyses very delicate, filiform.

Pseudopeziza protrusa, Rehm, Ascom. n. 310; Sacc. Syll. viii. n. 2980.

Pyrenopeziza protrusa, Sacc. Syll. viii. n. 1503.

Exsicc. Ellis, N. Am. Fung. n. 143; Thümen, Myc. Univ. n. 519; Rehm, Ascom. n. 310.

On the underside of dead leaves of *Magnolia glauca*. Lower Carolina (*Curtis*, nn. 1194 & 1195); Newfield, N. J. (*Ellis*, n. 2148).

Erumpent, dot-like, here and there surrounded by the cuticle, externally granulated, chestnut, within concave, white; mouth flexuous (*Berk. & Curt.*).

PEZIZA VECTIS, *Berk. & Broome, in Ann. & Mag. Nat. Hist.* Ser. III. vii. (1861) p. 449.

Scattered or gregarious, superficial, minute, rarely exceeding

$\frac{1}{3}$ mm. across; when young subglobose and closed, then becoming hemispherical; disc pallid or pale grey, externally blackish-brown, and furnished, especially at the margin, with rigid, dark brown hyphæ 30–50 × 5–6 μ; excipulum formed of slender, interwoven hyphæ; asci clavate, apex somewhat narrowed, not blue with iodine, base stout, short, sometimes oblique, 60–65 × 8–9 μ; spores 8, irregularly 2-seriate, hyaline, continuous at first, becoming distinctly 3-septate at maturity, narrowly fusiform, ends acute, often slightly curved, 24–26 × 2·5–3 μ; paraphyses slender, very slightly thickened upwards.

Pirottæa Vectis, Sacc. Syll. viii. n. 1605; Phillips, Brit. Disc. p. 284, pl. 8. f. 52.

Echinella Vectis, Massee, Brit. Fung.-Flora, iv. p. 304.

On dead stem of *Centaurea nigra*. Ryde, I. of Wight (*Bloxam*, n. 344).

The present species belongs to the genus *Echinella*, established in Fungus-Flora, iv. p. 304. This genus is clearly separated from *Pirottæa* by the septate spores, and from *Erinella* in not having lanceolate paraphyses.

For some reason Phillips—in Brit. Discom. p. 24—placed this species in Saccardo's genus *Pirottæa*, which is characterized by having continuous spores. Phillips translates Saccardo's generic character, and says "sporidia continuous"; then, in the specific diagnosis of his only species, says "sporidia 1–3-septate." In the Sylloge, viii. n. 1605, Saccardo has retained the present species in his genus *Pirottæa*, and copies the description given by Phillips; but at the same time attempts to reconcile the anomaly of placing a species having septate spores in a genus characterized by continuous spores, as follows, "sporidiis (spurie), 1–3-septatis."

Peziza nitidula, *Berk. & Broome, in Ann. & Mag. Nat. Hist.* Ser. II. vii. (1861) p. 182. (Pl. **4**. figs. 28, 29.)

Scattered, stipitate, subglobose, and closed; then becoming cup-shaped, often irregular and nearly plane, pale tan, rather firm, externally very delicately powdered with glistening meal, $\frac{1}{2}$–1 mm. broad and high; stem short, equal, coloured like the ascophore; hypothecium and excipulum minutely parenchymatous; cortical cells small, irregularly hexagonal, elongated in the direction from stem to margin, almost hyaline; asci small, narrowly cylindric-clavate; apex slightly narrowed and not blue with iodine, base short, stout, about 50 × 5–6 μ; spores 8 irregularly 2-seriate, hyaline, smooth, continuous (permanently?) straight or curved, narrowly fusiform; ends acute, 7–11 × 2·5 μ paraphyses hyaline, slender, very slightly thickened at the tip.

Hymenoscypha nitidula, Phillips, Brit. Disc. p. 142.

Phialea nitidula, Sacc. Syll. viii. n. 1115.

Helotium nitidulum, Massee, Brit. Fung.-Fl. iv. p. 263.

On dead leaves of *Aira cæspitosa*. England.

There are indications of the spores being 1-septate at maturity, but I am not certain on this point. Spores often curved or rather irregularly crooked.

PEZIZA FURFURIPES, *Berk. & M. A. Curt. in herb.* (Pl. 4. figs. 30, 31.)

Usually in small, crowded clusters, rarely scattered, stipitate, closed and piriform at first, then expanding until almost plane, but the extreme margin persistently raised, up to 1 mm. across and 15 mm. high, entirely brown (when dry), glabrous, passing gradually into the stem, which is narrowed downwards and covered with very minute fascicles of hyphæ, which give it a scurfy appearance; cortex formed of slender, septate, parallel hyphæ which run from base to margin; asci cylindrical, apex rounded, not blue with iodine; pedicel long, slender, about 110 × 8 μ; spores 8, 1-seriate, hyaline, smooth, globose or nearly so, 5–6 μ diameter, or 5–6 × 4 μ; paraphyses slender, numerous, hyaline, not at all or very slightly thickened upwards.

Phialea furfuripes, Phillips, in Grevillea, xix. (1891) p. 73; Sacc. Syll. x. n. 4500.

On rotten wood. Venezuela.

The spores appear to be perfectly globose when quite mature.

PEZIZA STRAMINUM, *Berk. & Broome, in Ann. & Mag. Nat. Hist.* ser. II. vii. (1851) p. 182.

Crowded or scattered, sessile but attached by a central point, hemispherical, then expanding, the margin remaining slightly incurved, up to ¾ mm. across, rather fleshy; disc pale yellow or with a tinge of pink, externally glabrous but covered with crystals of oxalate of lime; excipulum parenchymatous, cells minute; cortex consisting of parallel rows of hyphæ, which pass into short, obtuse, parallel rows of hairs at the margin; asci narrowly clavate, apex narrowed, not blue with iodine; spores 8, irregularly 2-seriate, narrowly fusiform, straight or very slightly curved, smooth, hyaline, for a long time continuous, finally 1-septate, $6–8 \times 1·5\,\mu$; paraphyses slender, very slightly clavate hyaline.

Mollisia stramineum, Phillips, Brit. Disc. p. 196; Massee, Brit. Fungus-Flora, iv. p. 215.

Pseudohelotium stramineum, Sacc. Syll. n. 1247.

Perfectly glabrous, but having a pulverulent appearance, especially when dry. I followed Phillips in placing this species in the genus *Mollisia* in Fungus-Flora, iv. p. 215, but I now consider it to be a true *Helotium*.

PEZIZA ARCHERI, *Berk. in Hook. f. Fl. Tasm.* ii. p. 274 (1860). (Pl. 5. fig. 21.)

Scattered or gregarious, 3–8 mm. across, slightly concave, then often plano-convex and umbilicate, margin often undulate, glabrous, sessile but somewhat narrowed to a broadish point of attachment; disc deep crimson, outside whitish with just a tinge of rose-colour, margin somewhat raised when dry; asci narrowly cylindrical, apex rounded, not blue with iodine, $160 \times 10\,\mu$, 8-spored; spores 1-seriate, perfectly globose, smooth, hyaline, $8\,\mu$ diam.; paraphyses filiform, apex curved. Hypothecium formed of small-celled parenchymatous tissue, the cells gradually becoming larger towards the exterior.

Barlæa ? *Archeri*, Sacc. Syll. x. n. 4478.

On dead leaves, twigs, &c., lying on the ground, also on the naked ground. Tasmania. Specimens since received at Kew from Tasmania, communicated by Rodway, n. 686, are identical with Berkeley's type.

Saccardo has placed the present species in the genus *Barlæa* with a query, but this position is quite correct; the tomentose exterior mentioned by Berkeley only refers to a white tomentum sometimes present at the point of attachment; the exterior of the ascophore is absolutely glabrous.

PEZIZA CERATINA, *Berk. in Hook. f. Fl. Tasm.* ii. p. 275 (1860).

Phialea ceratina, Sacc. Syll. viii. n. 1102.

On leaves of *Eucalyptus*. Tasmania (*Archer*).

This species proves to be identical with *Helotium virgultorum*, Karsten.

Peziza byssigena, *Berk. in Hook. f. Fl. Tasm.* ii. p. 275 (1860).

Phialea byssogena, Sacc. Syll. viii. n. 1104.

On fallen branches. Tasmania (*Archer*).

This species is identical with *Helotium aureum*, Pers.

Peziza (Mollisia) Arundinariæ, *Berk. & M. A. Curt. Syn. Disc. Fung. of U. States, in Bull. Buff. Soc. Nat. Sc.* (1875) p. 297; *Sacc. Syll.* viii. n. 1517.

Scattered or gregarious, superficial, closed and subglobose at first, then becoming almost plane, margin entire, more or less raised when dry, glabrous, $\frac{1}{2}$–$\frac{3}{4}$ mm. across; disc pallid, externally pitch-brown; hypothecium and excipulum formed of slender, interlaced hyphæ, which gradually pass towards the cortex into rows of olive-brown cells, which increase in size as they approach the periphery and margin; asci clavate, apex narrowed, the minute apical pore blue with iodine, about $110 \times 10\,\mu$; spores irregularly 2-seriate, hyaline, fusiform, ends acuminate, 3-septate, $36–40 \times 5\,\mu$; paraphyses numerous, filiform, tips not at all thickened.

Pyrenopeziza Arundinariæ, Sacc. Syll. viii. n. 1517.

Exsicc. Rav. Fung. Carol. fasc. iii. n. 38.

On culms of *Arundinaria*. Carolina (*Curtis*).

The present species is a typical species of *Belonidium*, and will stand as B. Arundinariæ. Saccardo's genus *Belonium*, to which the present technically belongs, cannot stand, the distinctions from Montagne's *Belonidium* being too flimsy, and not even constant. The minute ascophores are attached by a central point, and readily fall away at maturity, leaving a minute, dark, circular patch on the substratum caused by the coloured hyphæ. *Belonidium pullum*, Phil. & Keith, is closely allied to the present, differing in the somewhat shorter spores having the ends acute, and not acuminate.

Peziza (Mollisia) miltophthalama, *Berk. & M. A. Curt. in Grevillea*, iii. (1875) p. 158.

Erumpent; clustered or solitary, rather fleshy; disc plane from the first, pallid or pale primrose-yellow; margin and externally blackish, glabrous, ·5–1 mm. diameter; asci cylindric-clavate, subsessile, apex slightly narrowed and thickened, pore pale blue with iodine, $55–60 \times 6\,\mu$; spores 8, obliquely 1-seriate, hyaline, continuous, very narrowly clavate, $7–8 \times 2\,\mu$; paraphyses very slender, not thickened at the apex; cortex very dense, formed of blackish hexagonal cells 14–16 μ diameter, becoming smaller towards the margin.

Mollisia miltophthalama, Sacc. Syll. viii. n. 1385.

On dead branches of *Cornus flavida*. S. Carolina (*Ravenel*, n. 2474).

Berkeley says "hymenium vermillion"; but in the fairly abundant type-material in the Kew Herbarium I find it as described above, and it is difficult to conceive that it could ever have been red.

PEZIZA (MOLLISIA) OLIVACEO-LUTEA, *Berk. in Grevillea*, iv. (1875) p. 159. (Pl. **5**. figs. 19, 20.)

Ascophore erumpent, then becoming quite superficial and attached by a small point, remaining more or less concave, glabrous, externally blackish-olive; disc pale yellow, $\frac{1}{2}$–$\frac{1}{3}$ mm. across; asci cylindric-clavate, apex slightly narrowed, pore blue with iodine, pedicel very short, 50–60 × 7–8 μ; spores 8, irregularly 2-seriate, continuous, hyaline, cylindric-fusiform, straight, 14–17 × 3–3·5 μ; paraphyses filiform.

Mollisia olivaceo-lutea, Sacc. Syll. viii. n. 1373 (1889).

On dead leaves. Lower Carolina (*Ravenel*, n. 1204).

This is not a good *Mollisia*; the cortex consists of sparsely septate, parallel hyphæ of a dark colour radiating from base to margin, where they become paler; a structure agreeing with that of *Pseudopeziza*, in which genus the species should henceforth be placed.

PEZIZA (MOLLISIA) EXIDIELLA, *Berk. & M. A. Curt. in Grevillea*, iii. (1875) p. 158. (Pl. **4**. figs. 26, 27.)

Gregarious, discoid, and with a very minutely raised margin when moist, thin, soft, and somewhat gelatinous; when dry the margin is raised and wavy, and the substance rigid, about $\frac{1}{2}$ mm. across; glabrous, disc yellow-rufous, becoming dingy purple-brown or blackish when dry; hypothecium and excipulum minutely parenchymatous, cortical cells 5–8 μ diameter; asci narrowly clavate, apex narrowed, not blue with iodine, pedicel slender, about 45 × 6 μ; spores 8, obliquely 1-seriate, continuous, hyaline, narrowly elliptic-oblong, 5–6 × 1·5 μ; paraphyses slender, tips clavate, or in some instances scarcely thickened.

Pezizella exidiella, Sacc. Syll. viii. n. 1200.

On branches of *Cornus Florida*. Lower Carolina (*Curtis*, n. 2474).

Gregarious, regular, yellow-rufous (*Berk.* & *M. A. Curt.*).

The present species is a typical *Orbilia*, and will stand as O. EXIDIELLA.

PEZIZA (MOLLISIA) EUSTEGIÆFORMIS, *Berk. & M. A. Curt. in Grevillea*, iii. (1875) p. 158. (Pl. **4**. figs. 20, 21.)

Gregarious, subglobose and closed at first, soon becoming almost or quite plane, attached by a central point, and springing from a blackish patch of mycelium not more effused than the diameter of the ascophore; externally pitch-brown, disc pallid, about $\frac{3}{4}$ mm. across; hypothecium and excipulum formed of interwoven hyphæ, which pass into dark-brown cortical cells, and run out at the margin into 1–2-septate, brown, obtuse, parallel hyphæ, 40–60 μ long, and forming a dense fringe; asci narrowly clavate, tapering below into a slender pedicel, apex narrowed, pore blue with iodine, about $130 \times 12\ \mu$; spores 8, irregularly 2-seriate, hyaline, narrowly elliptical, ends tapering, 3-septate, $28–31 \times 4–5\ \mu$; paraphyses numerous, filiform, very slightly thickened at the tips.

Belonium ? *eustegiæforme*, Sacc. Syll. viii. n. 2042.

Exsicc. Rav. Fung. Amer. n. 310; Ellis, N. Amer. Fung. n. 668.

On culms of *Arundinaria macrosperma*. Lower Carolina (*Curtis*, n. 1023).

PEZIZA (MOLLISIA) ALLIGATA, *Berk. & Broome, in Journ. Linn. Soc., Bot.* xiv. (1875) p. 107. (Pl. **4**. fig. 25.)

Gregarious or crowded, sessile and attached by a broad base, at first globose and closed, gradually expanding until plane, often irregular when crowded, rather fleshy, honey-colour, quite glabrous, up to 1·5 mm. across; entirely parenchymatous, cells small; asci cylindrical, apex rounded, not blue with iodine, narrowed rather abruptly into a short, slender pedicel, about $110 \times 9–10\ \mu$; spores 8, obliquely 1-seriate, hyaline, smooth elliptical, ends obtuse, often 2-guttulate, $10–13 \times 6–7\ \mu$; paraphyses slender, often curved, but not thickened at the apex.

Pseudohelotium alligatum, Sacc. Syll. viii. n. 1258.

On dead leaves. Peradeniya, Ceylon (*Thwaites*, n. 112.)

Sometimes the ascophore is surrounded by a whitish, narrow zone of mycelium, which springs from the basal cortical cells;

at other times this structure is entirely absent. Externally and the margin quite glabrous, the whitish pulverulent external appearance noted by Berkeley being due to the collapse of the external cells during drying. The fungus is a true *Mollisia*, and will stand as Mollisia alligata.

Peziza (Mollisia) peristomialis, *Berk. & Broome, in Ann. & Mag. Nat. Hist.* Ser. II. xviii. (1856) p. 126, pl. 5. fig. 32.

Ascophore subcylindrical, base somewhat narrowed, solid, glabrous except the margin, which is surrounded by 10–18, spreading, white, acuminate teeth, each consisting of a fascicle of slender hyphæ; 25–35 μ long, by 8–10 μ broad at the base, whitish; disc plane, about ½ mm. high, and not quite so much across; hypothecium and excipulum composed of aseptate, hyaline hyphæ very intricately interwoven; the cortex is similar, and the hyphæ run out to form the marginal teeth; asci broadly clavate or fusoid, widest portion sometimes above, sometimes below the middle, apex narrowed, base stout, about 85–90 × 12 μ; spores obliquely 2-seriate, smooth, hyaline, narrowly elliptical or sometimes almost cylindrical, ends rather acute, straight or very slightly curved, at first multiguttulate, then distinctly 3-septate, 30–35 × 5 μ; paraphyses absent.

Mollisia peristomialis, Phillips, Brit. Disc. p. 201, pl. 6. f. 37.

Cyathicula peristomialis, Sacc. Syll. viii. n. 1284; Massee, Brit. Fung.-Fl. iv. p. 273 (*peristomalis*).

On dead bark of holly. England.

A most exquisite object under a moderate magnifier, resembling some *Actinia* in miniature (*Berk. & Broome*).

Gregarious, subglobose, and closed at first, then becoming elongate and more or less cylindrical, the base often slightly narrowed, but constantly sessile, apex truncate; disc not depressed, surrounded by acute, spreading teeth like the peristome of a moss. Allied to the genus *Belonidium* in the 3-septate spores, but the sum of characters point to the genus *Cyathicula*.

Peziza (Mollisia) apicalis, *Berk. & Broome, in Journ. Linn. Soc., Bot.* xiv. (1875) p. 106. (Pl. 4. figs. 23–24.)

Solitary, or usually in clusters of 2–4, sessile, subglobose and closed when young, then cup-shaped, often irregular from lateral pressure, ¼–⅓ mm. across, pale orange; externally very minutely pulverulent, due to the free ends of the parallel rows of hyphæ forming the cortex; asci narrowly clavate, pedicel slender, 70–80 × 8 μ, apex slightly narrowed, not blue with iodine; spores 8, 1-seriate, hyaline, smooth, globose, 3·5–4 μ diameter; paraphyses filiform, septate, not thickened at the tips.

Growing in the axils of the leaves at the tips of the shoots of *Macromitrium sulcatum*, Brid. Ceylon (*Thwaites*, n. 1219).

The present distinct species will in future be known as MOLLISIELLA APICALIS.

PEZIZA (MOLLISIA) ANDROPOGONIS, *Berk. & M. A. Curt. in Grevillea*, iii. (1875) p. 158. (Pl. **4**. fig. 19.)

Scattered or gregarious, at first subglobose and closed, gradually expanding until quite plane, attached by a central point; externally blackish, glabrous; disc yellowish-bay, $\frac{1}{2}$–$\frac{3}{4}$ mm. across; hypothecium and excipulum formed of delicate, interwoven hyphæ, running out into a dark-coloured cortex of parallel cells; asci clavate, apex rounded, pore blue with iodine, narrowed below into a slender pedicel, wall rather thick, about 100 × 15 μ spores 8, obliquely 2-seriate, hyaline, narrowly elliptical, ends narrowed, 3-septate, straight or sometimes very slightly curved, 19–20 × 5–6 μ; paraphyses slender, septate, often more or less branched, very slightly or not at all thickened at the tips.

Belonium Andropogonis, Sacc. Syll. viii. n. 2035.

On dead culms of *Andropogon*. Lower Carolina (*Curtis*, n. 5045).

This species is supposed to be represented in the following exsiccati:—Ellis, N. Amer. Fung. n. 61; Rabenh.-Winter, Fung. Eur. 3169; Rehm, Ascom. n. 609. The specimens are all of American origin, and furnished by Mr. J. B. Ellis; and, furthermore, so far as I can ascertain by careful examination, show no trace of a Discomycete of any kind, but all agree in having an apparently undescribed species of *Schizothyrella*—a mistake which I leave to one or other of the parties concerned to rectify.

PEZIZA (MOLLISIA) FRACTA, *Berk. & M. A. Curt. in Grevillea*, iii. (1875) p. 158. (Pl. **5**. figs. 22–24.)

Erumpent, scattered, gregarious, or sometimes crowded and forming short lines, about ·5 mm. when quite expanded, at first globose and furnished with a minute pore, externally glabrous, blackish-olive, disc grey; asci cylindrical, apex narrowed, pore blue with iodine, 60–70 × 7 μ; spores irregularly 2-seriate, hyaline, smooth, very narrowly clavate, 9–12 × 2–3 μ; paraphyses very slender, tips scarcely thickened; hypothecium and excipulum consisting of densely interwoven hyphæ, running out into a parenchymatous cortex of brown polygonal cells 9–12 μ diam.

Pyrenopeziza fracta, Sacc. Syll. viii. n. 1467.

On dead stems of *Hydrangea vulgaris*. Virginia (*Ravenel*, n. 3332).

This species is a typical *Pseudopeziza*, and will stand as P. FRACTA.

It is just possible that the spores may become septate at maturity: there are apparent indications of a median septum, but fresh material is necessary to determine the point with certainty.

PEZIZA (HYMENOSCYPHA) VIRIDI-ATRA, *Berk. & M. A. Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 369. (Pl. **4.** figs. 33, 34.)

Soon expanded, discoid, often more or less wavy; substance thin, sessile; disc blackish-green with a tinge of purple, outside similarly coloured and minutely scabrid, up to 8 mm. diameter; excipulum composed entirely of very thin, densely-interlaced hyphæ; asci narrowly cylindrical, apex rounded, base slender and often bent, about 60 × 7 μ; spores 8, 1-seriate, narrowly elliptic-oblong, continuous, smooth, often 2-guttulate, slightly tinted with brown, 5–6 × 2–2·5 μ; paraphyses numerous, rather stout, cylindrical, septate, agglutinated together at the swollen, coloured tips.

Pezicula viridi-atra, Sacc. Syll. viii. n. 1308.

On rotten wood. Cuba (*Wright*, n. 369).

When dry the substance is rigid; the colour blackish purple, which instantly dissolves when treated with dilute potassium hydrate, giving a purple solution. The present species is a typical *Chlorosplenium* and hence must stand as C. VIRIDI-ATRUM (Berk. & M. A. Curt.). Probably Berkeley noticed this affinity when he remarked "not staining the wood."

PEZIZA (HYMENOSCYPHA) LEUCOPSIS, *Berk. & M. A. Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 368. (Pl. **4.** figs. 3, 4.)

Scattered or gregarious, stipitate, closed at first, then expanding until plane and the margin often wavy and drooping;

substance thin, rather tough and flexible, glabrous; disc pallid lilac or pale flesh-colour, externally slightly paler, 4–7 mm. diameter; stem almost equal, slender, glabrous, blackish, 3-4 mm. long; substance composed entirely of thin, hyaline, closely-interwoven hyphæ; asci narrowly cylindric-clavate, apex rounded, 50×4–5 μ; spores 8, obliquely 1-seriate, hyaline, continuous, smooth, narrowly subcylindrical, often slightly curved, 5–6 × 1·5–2 μ; paraphyses very slender, not thickened at the tips.

Phialea leucopsis, Sacc. Syll. viii. n. 1091.

On rotten wood. Cuba (*Wright*, n. 372).

PEZIZA XYLARIICOLA, *Berk. in herb.* (Pl. **5.** figs. 28–31.)

Ascophores in groups of 4–10 springing from a common base; substance tough, formed of interwoven hyphæ, pale brown (when dry), glabrous, 0·5 mm. diameter. Asci narrowly cylindrical, octosporous, 100×6 μ; spores elliptical, smooth, hyaline, 2-guttulate, obliquely 1-seriate, 6×4–4·5 μ; paraphyses filiform.

Growing in clusters on the ascigerous portion of some *Xylaria*. Venezuela.

The present species, which does not appear to have been described by Berkeley, will stand as CENANGIUM XYLARIICOLA (Berk.).

HELOTIUM CROCINUM, *Berk. & M. A. Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 369; *Sacc. Syll.* viii. n. 909 (1889).

Gregarious or crowded, at first obconic, the disc gradually expanding, but the margin remaining for a long time more or less incurved, narrowed below into a very short, stout, stem-like base, quite glabrous, everywhere saffron-yellow, 1–1·5 mm. across. Asci subcylindrical, slightly narrowed at the base, apex not blue with iodine, 110×10 μ; spores 8, 1-seriate or sometimes inclined to be 2-seriate upwards, cylindric-fusiform, often slightly curved, hyaline, becoming distinctly 1-septate, and sometimes slightly constricted at the septum, 18–21 × 4–5 μ; paraphyses linear, sometimes branched. Hypothecium and excipulum composed of slender, interwoven hyphæ; cortex not differentiated.

On dead twigs. Cuba (*Wright*, n. 374).

I have received the same species from Mr. A. P. Morgan, collected at Preston, Ohio; growing on *Quercus*.

PLATYGRAPHA BIVELA, *Berk. & Broome, in Journ. Linn. Soc., Bot.* xiv. (1875) p. 109.

Gregarious or scattered, immersed, covered at first by a white, mealy veil, which is finally ruptured, forming an irregular margin which is erect or incurved, whereas an external margin, formed of the ruptured epidermis of the host plant, is usually revolute; disc brownish, often with a layer of bloom giving it a glaucous appearance; up to 1 mm. across, circular or irregular in outline; asci cylindric-clavate, apex rounded, not tinged blue with iodine, 80–85 × 10–12 μ; spores 8, irregularly 2-seriate, narrowly elliptical, or often slightly widest above the middle and inclined to become clavate, at first hyaline, becoming pale brown at maturity, 5–7-septate; septa thick, 18–20 × 6–7 μ; paraphyses slender, septate, very slightly or frequently not at all thickened at the apex.

Cryptodiscus bivelus, Sacc. Syll. viii. n. 2767.

On bark. Ceylon (*Thwaites*, n. 634).

The ascophores are very frequently grouped in clusters of 2–4 individuals.

PLATYGRAPHA ASTROIDEA, *Berk. & Broome, in Journ. Linn. Soc., Bot.* xiv. (1875) p. 109. (Pl. **5.** figs. 5, 6.)

Ascophores gregarious, immersed, covered at first by a white mealy veil, which is at length ruptured and forms an irregularly torn margin, formed of two layers; disc reddish-brown, 1–2·5 mm. across; asci cylindric-clavate, apex rounded and somewhat thickened, not tinged blue with iodine, narrowed rather abruptly into a short, slender pedicel, about 70–75 × 10–12 μ; spores irregularly 2-seriate, narrowly elliptical, ends narrowed, smooth, hyaline at first, becoming pale brown at maturity, 3–5-septate, 15–17 × 5–6 μ; paraphyses slender, septate, not thickened at the apex, but sometimes bearing short branchlets.

Cryptodiscus astroideus, Sacc. Syll. viii. n. 2766.

Platygrapha albo-rufa, Berk. & Broome, Journ. Linn. Soc., Bot. xiv. (1875) p. 110.

Cryptodiscus albo-rufus, Sacc. Syll. viii. n. 2765.

On bark. Peradeniya, Ceylon (*Thwaites*, nn. 69 & 629).

Distinguished from *Platygrapha subreticulata*, Berk. & Broome, by the longer spores which finally become 5-septate. The margin consists of two membranes: the outer, curving outwards, consists of the ruptured epidermis of the host, which is white on its inner surface owing to a thin layer of the veil of the fungus adhering to it; the inner membrane consists of the veil proper, and stands erect or curves inwards over the border of the disc. No trace of gonidia present.

PLATYGRAPHA STICTOIDES, *Leighton*, *Lichens of Ceylon*, *in Trans. Linn. Soc.* xxvii. (1870) p. 180, pl. 37. f. 37. (Pl. **5.** figs. 1–4.)

Ascophores gregarious, scattered or more frequently arranged in irregular little groups, immersed in the matrix, at first covered by a snow-white veil, which eventually ruptures and forms an irregularly torn persistent margin; circular, elongated, or more or less wavy, ·5–2 mm. across; disc dark grey (when dry); asci cylindrical, apex rounded and not at all blue with iodine, base slenderly stipitate, 90–100 × 8 μ; spores 8, obliquely 1-seriate, elliptic-oblong, ends obtuse, smooth, 3-septate, septa thick, at first hyaline then tinged brown, the contents tinged green, 12–14 × 6 μ; paraphyses very slender, delicately septate, sometimes with a short branch near the apex which is not thickened.

Platygrapha subreticulata, Berk. & Broome, in Journ. Linn. Soc., Bot. xiv. (1875) p. 109.

Cryptodiscus subreticulatus, Sacc. Syll. viii. n. 2764.

On bark. Ceylon; tropical forests south of the island (*Thwaites*, nn. 628 & 630).

Leighton considered the present species to be a lichen, but there are no gonidia, and iodine does not produce a trace of blue coloration on the asci or other hymenial elements. Leighton's type has been examined in the Leighton Lichen herbarium which is located at Kew. The groups of apothecia are sometimes arranged in an irregularly reticulate manner, hence Berkeley's specific name.

PLATYGRAPHA MAGNIFICA, *Berk. & Broome*, *in Journ. Linn. Soc., Bot.* xiv. (1875) p. 110, pl. 5. f. 26. (Pl. **5.** figs. 7–9.)

Scattered or gregarious, immersed in the matrix, and eventually surrounded by an irregular, rigid, raised margin, formed by the torn and upraised epidermis of the host plant; disc at first covered with a thin veil, becoming naked, plane, deep orange colour, 1·5–3 mm. across, circular in outline; hypothecium yellowish-brown; asci very large, clavate, apex slightly narrowed and having the wall thickened, not blue with iodine, narrowed below into a somewhat slender pedicel, about 400 × 30 μ; spores 8, irregularly 2-seriate, hyaline, smooth, narrowly elliptic-fusiform, usually slightly curved, closely multiseptate (27–31), at length breaking up at the septa into thin discs, 110–140 × 11–12 μ; paraphyses very slender, septate, very slightly thickened at the tip.

Platysticta magnifica, Cooke, in Grevillea, xvii. (1889) p. 95.

Lichenopsis magnifica, Sacc. Syll. viii. n. 2862.

On sticks. Ceylon; tropical forests south of the island (*Thwaites*, n. 624).

This species is described in a footnote, and is not n. 973 of "The Fungi of Ceylon," as stated by Saccardo, Syll. viii. p. 697.

This fungus cannot possibly remain in *Lichenopsis* as placed by Saccardo; and as it is not *Platygrapha* according to Montagne's view of that genus, it should in future stand as PLATYSTICTA MAGNIFICA, Cooke.

PATELLARIA LIVIDA, *Berk. & Broome, in Ann. & Mag. Nat. Hist.* Ser. II. xiii. (1854) p. 466.

Gregarious or confluent, hemispherical, then almost plane, slightly narrowed to a very short stem-like base, or almost sessile but attached by a central point only, up to 1 mm. across; disc yellowish-olive, with a buff tinge when dry, margin and externally pale, very minutely scurfy; excipulum densely parenchymatous; asci narrowly clavate, apex narrowed, attenuated below into a slender longish pedicel, thick-walled, 8-spored; spores irregularly 2-seriate above, elliptic-oblong, ends obtuse, smooth, hyaline, at first 4-guttulate then 3-septate, straight or very slightly curved, 24–30 × 5–6 μ; paraphyses numerous, slender, somewhat irregularly curved, often with short branchlets, in other instances all simple and equal.

Dermatea livida, Phillips, Brit. Disc. 340; Rehm, Krypt.-Flora, Disc. 256.

Durella livida, Sacc. Syll. viii. n. 3260.

Dermatella livida, Sacc. Syll. viii. n. 2027.

Lecanidion lividum, Lambotte, Fl. Myc. Belg. 274.

Patellaria constipata, Cooke, Handb. n. 2176.

Exsicc. Cooke, Fung. Brit. n. 578; id. op. cit. ed. II. n. 193; Rehm, Ascom. n. 462 (forma *tetraspora*).

On pine-bark. Britain, Germany, Belgium.

According to Minks the spores eventually become 8-septate.

PATELLARIA SPHÆROSPORA, *Berk. & M. A. Curt. in Cooke's Syn. Disc. U.S., in Bull. Soc. Nat. Sci. Buff.* iii. (1875) p. 26 (name only); *Phillips, in Grevillea,* xviii. (1890) p. 85.

Scattered or crowded, applanate, indistinctly marginate, thin, circular or slightly elongated, 1–2 mm. across, black; excipulum formed of interwoven hyphæ of a dingy olive-brown colour; asci cylindric-clavate, apex rounded, not blue with iodine, base narrowed; spores 1-seriate, or sometimes inclined to become 2-seriate near the apex of the ascus, typically broadly elliptical, ends obtuse, smooth, clear brown, continuous, sometimes 1-guttulate, 9–12 × 7–8 μ; paraphyses numerous, filiform, septate.

Lagerheima sphærospora, Sacc. Syll. x. n. 4671; Massee, Brit. Fungus-Flora, iv. p. 97, ff. 51–54, p. 91.

On rotten wood. N. Carolina, U.S.A. (*Curtis*, n. 4460); New Forest, England (*Miss B. Taylor*).

In many asci the spores are all similar in form as described above; in others some of the spores are normal, others globose, angularly globose, or piriform.

PATELLARIA CLAVISPORA, *Berk. & Broome, in Ann. & Mag. Nat. Hist.* Ser. II. xiii. p. 464 (1854); *Phillips, Brit. Disc.* p. 366, pl. 11. f. 70; *Massee, Brit. Fungus-Flora,* iv. p. 102, ff. 15–20, p. 91.

Gregarious, bursting through the bark when present, at first subglobose, then expanding and becoming marginate, rather fleshy, contracting and slightly concave when dry, pitch-brown, glabrous, 1–1·5 mm. across; excipulum consisting of interwoven hyphæ which become clavate, septate, brown, and arranged more or less parallel at the surface and margin; asci clavate, apex narrowed, 8-spored; spores biseriate upwards, 1-seriate below, narrowly clavate, apex rounded; base tapering and acute, straight, or very slightly bent, hyaline, or with a tinge of green, 3–5-septate, with an indication of constriction at the septa when mature, 30–36 × 5–6 μ; paraphyses numerous, slender, tips clavate and irregularly nodulose, septate, brown, adhering, sometimes branched.

Durella clavispora, Sacc. Syll. viii. n. 3257.

On branches of privet, ash, &c. Britain.

Readily distinguished by the clavate, septate spores, and paraphyses with brown thickened tips.

PATELLARIA STYGIA, *Berk. & M. A. Curt. in Grevillea*, vol. iv. (1875) p. 2. (Pl. 4. figs. 15–17.)

Gregarious, or sometimes crowded, orbicular, plane, marginate, attached by a central point, margin free, glabrous, black, about 1 mm. across; hypothecium dark-coloured, parenchymatous, running out at the surface and margin into large hexagonal cells, 15–20 × 8–12 μ, arranged in rows, external cells almost globose, dark; asci cylindric-clavate, apex slightly narrowed and thick-walled, apex alone blue with iodine, 50×6–7 μ; spores 8, irregularly 2-seriate, cylindrical, ends very slightly narrowed, 1-septate, brown, often very slightly curved, 15–16×4 μ; paraphyses very slender, septate, tips thickened, brown, agglutinated together.

Patella stygia, Sacc. Syll. viii. n. 3215.

On wood. New Jersey; Lower Carolina; Boston (*Sprague*, n. 6234).

This species will stand as KARSCHIA STYGIA, distinguished by the narrow cylindrical spores and the large cortical cells of the ascophore.

PATELLARIA BLOXAMI, *Berk. in herb.*; *Phillips, Brit. Disc.* p. 361. (Pl. 4. figs. 13–14.)

Gregarious, sessile, fixed by a central point, applanate, glabrous, at first with a slightly upraised margin, then plane or slightly convex, black, about ⅔ mm. across; excipulum minutely parenchymatous, blackish-olive, cells becoming arranged in rows and almost quadrate towards the exterior and margin; asci cylindric-clavate, not much narrowed at the base, apex slightly narrowed and thick-walled, everywhere deep, clear blue with iodine, 50–60 × 7–8 μ; spores 8, irregularly 2-seriate, elliptical or fusoid, 1-septate, brown, 10–15×5–7 μ; paraphyses very slender, septate, tips thickened, brown, more or less agglutinated together.

Karschia Bloxami, Sacc. Syll. viii. n. 3208.

On rotten wood. England (*Bloxam*).

Allied to *Karschia lignyota*, but readily distinguished by having the two cells of the spore of equal size.

PATELLARIA ATA, *Berk. in herb.* (Pl. 4. figs. 11, 12.)

Superficial, attached by a central point, expanded and slightly concave; substance thin, glabrous, blackish brown (when dry), 1·5 mm. across, irregularly contracted when dry; hypothecium and excipulum composed of rather stout, hyaline, interwoven hyphæ, which pass into a dark-coloured small-celled parenchymatous cortex; asci clavate, apex narrowed, not blue with iodine, about 160 × 16–17 μ; spores 8, irregularly 2-seriate, hyaline, narrowly elliptic-fusiform, at first multiguttulate, then 7–9-septate, very slightly curved, 50 × 60 μ; paraphyses numerous, very slender, tips not thickened.

On small branches. Pangeronga, Java (*Kurz*, n. 381).

A very fine species, which will now stand as DURELLA LATA.

PATELLARIA TASMANICA, *Berk. in Hook. f. Fl. Tasm.* ii. p. 276 (1860). (Pl. **4**. fig. 18.)

Gregarious, minute, applanate, at first slightly concave, then plane, glabrous; disc bay, often with a tinge of olive-green, finally entirely blackish, up to ½ mm. across; hypothecium dark, cortex parenchymatous, cells small, olive-brown; asci narrowly cylindric-clavate, apex slightly narrowed, about 100 × 7–8 μ; spores 8, 1-seriate, and inclined to become 2-seriate, hyaline, continuous, narrowly cylindrical, ends entirely narrowed, often a little bent, 14–16 × 3·5–4 μ; paraphyses numerous, slender, septate, not thickened upwards.

Patinella tasmanica, Sacc. Syll. viii. n. 3162.

On dead wood. Tasmania (*Archer*).

PATELLARIA AUREO-COCCINEA, *Berk. & M. A. Curt. MS. in herb.* (Pl. **4**. figs. 5–7.)

Gregarious, sessile, attached by a narrowed base, subglobose and closed when young, then expanded, but the golden-yellow fringed margin still incurved; disc pallid, externally blackish-brown, glabrous, about ½ mm. across, closed, and often laterally compressed when dry; hypothecium and excipulum formed of slender interwoven hyphæ, these run out into a reddish-brown, small-celled, parenchymatous cortex, which changes at the margin into a thick-set golden-yellow fringe formed of straight, rather closely septate smooth hairs, 80–150 μ long and 5–8 μ thick at the base, and slightly tapering towards the apex; asci cylindric-clavate, apex slightly tapering, apical pore blue with iodine, 75–80 × 7 μ; spores 8, irregularly 2-seriate, straight, hyaline, narrowly fusiform, 1-septate, 23-25 × 3·5 μ; paraphyses slender, septate, tips not thickened.

On dead culms of *Andropogon scoparius*, lying on the ground.

S. Carolina (no collector's name); Newfield, N. Jersey, U.S.A. (*Ellis*).

The colours given above are from the dried plant, and may in all probability require modification when described from living material. The fungus evidently belongs to Saccardo's genus *Helotiella*, and will stand as HELOTIELLA AUREO-COCCINEA.

PATELLARIA LURIDA, *Berk. & M. A. Curt. in herb.* (Pl. **4.** figs. 8–10.)

Gregarious or crowded, sometimes confluent, erumpent; disc plane, often slightly wrinkled, dingy grey then blackish, persistently surrounded by the raised and torn epidermis, circular or somewhat irregular, up to $\frac{1}{2}$ mm. across; hypothecium and excipulum formed of very slender, interwoven hyphæ, which pass into a dark-coloured, indistinctly parenchymatous cortex; asci clavate, gradually tapering downwards into a long, slender pedicel, apex rounded, not at all blue with iodine, $110–120 \times 15\,\mu$; spores 8, irregularly 2-seriate, hyaline, continuous, narrowly elliptic-oblong, ends obtuse, straight or very slightly curved, $14–16 \times 4\,\mu$; paraphyses slender, not thickened upwards.

On young branches of *Acer rubrum*. Pennsylvania, U.S.A. (n. 3815).

Not previously described, so far as I am aware, although the herbarium material is in excellent condition. The specimens are marked "*Cenangium*" by Curtis, but the species must stand as PATINELLA LURIDA.

PATELLARIA RECISA, *Berk. & M. A. Curt. in Cooke's Syn. Disc. U.S.*, pt. ii., *in Bull. Soc. Nat. Sci. Buff.* iii. p. 21 (1875).

This species proves to be identical with *Vibrissea Guernisaci*, Crouan.

On small branches. New England (*Frost*); Boston (*Murray*, n. 6231).

PATELLARIA CONGREGATA, *Berk. & M. A. Curt. MS. in herb. Berk.*

On oak. Pennsylvania (*Michener*, n. 4308).

This species is a synonym of *Durella compressa*, Tul. The name may possibly be published somewhere, although I have not hitherto found it.

CENANGIUM CONCINNUM, *Berk. & M. A. Curt. in Grevillea*, iv. (1875) p. 5. (Pl. **4.** figs. 35, 36.)

Gregarious, sessile, glabrous, substance rather thick and firm, at first closed, then gradually expanding until saucer-shaped, finally plane, or even very slightly convex, usually with the extreme margin upturned, up to 2 mm. across; disc blackish, externally paler, and with the margin irregularly raised when dry; substance entirely composed of rather stout, interwoven hyphæ, which become thickened, brown, and arranged in a parallel series at the margin; asci clavate, apex rounded, pore blue with iodine, wall rather thick, about 110 × 11–12 μ; spores 8, irregularly 2-seriate towards the apex of the ascus, obliquely 1-seriate below, hyaline, smooth, elliptic-fusiform, ends acute, 3-septate, 19–22 × 6–7 μ; paraphyses very numerous, filiform, more or less agglutinated together at the tips, which are not at all thickened.

Scleroderris concinna, Sacc. Syll. viii. n. 2460.

Exsicc. Ravenel, Fungi Amer. exs. n. 313.

On small branches of *Quercus falcata* and *Laurus Benzoin*: Lower Carolina (*Curtis*, nn. 2295, 3828, 6172); South Carolina (*Ravenel*, n. 2358, "on oak twigs"). On *Laurus Sassafras*: Alabama (*Peters*, n. 5238).

TYMPANIS RHABDOSPORA, *Berk. & M. A. Curt. in Grevillea*, iv. (1875) p. 3.

Godronia rhabdospora, Sacc. Syll. viii. n. 2487.

On bark of *Acer*. New England (*Sprague*, n. 5831).

This species proves, on examination, to be synonymous with *Tympanis conspersa*, Fries, as defined in Brit. Fung.-Fl. iv. 128, from specimens sent by Fries to Berkeley, which also agree with Fries' Scler. Suec. nn. 12 & 171. The drawing accompanying the specimen called *Tympanis rhabdospora* in Berkeley's herbarium shows that the numerous minute spores in the ascus were mistaken for granular protoplasm, and that the slender paraphyses were, in turn, mistaken for filiform spores.

TYMPANIS GYROSA, *Berk. & M. A. Curt. in Grevillea*, iv. (1875) p. 3; *Sacc. Syll.* viii. n. 2403. (Pl. **4**. figs. 37, 38.)

Densely crowded in small groups of 6–12 individuals, slightly concave and irregular from mutual pressure when moist, laterally compressed and completely concealing the disc when dry, brownish-black, glabrous, sessile, 1–2 mm. across; substance formed of rather stout, interwoven hyphæ which are deep brown in colour at the cortex; asci clavate, apex rounded, and not at all blue with iodine, wall thick especially upwards, 70–80 × 12 μ;

spores 8, irregularly 2-seriate upwards, 1-seriate below, elliptical, ends rather acute, 3-septate, second cell from the apex often slightly larger than the remainder, smooth, pale brown, 16–19 × 7–8 μ; paraphyses numerous, septate, rather stout, often branched, agglutinated together at the scarcely thickened tips by a brown substance.

On bark, Virginian Mountains (*Curtis*, n. 3338); on apple-tree bark, New England (*Russell*, n. 5940).

The present species is a typical *Scleroderris*, and must take the name SCLERODERRIS GYROSA. Remarkable for the ascophores becoming laterally compressed until the opposite sides meet, thus completely concealing the disc, and looking exactly like some *Hysterium*. In this condition the ascophore is either straight or more or less curved.

PHACIDIUM PLURIDENS, *Berk. & M. A. Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 371. (Pl. **5**. fig. 16.)

Ascophores gregarious on large discoloured spots, which are not bounded by a darker margin; disc circular, somewhat convex, blackish, eventually rupturing the epidermis into a variable number of acute teeth (usually 4–7), about 1 mm. diameter; asci cylindrical, apex rounded, not blue with iodine, with a short, slender, and usually oblique pedicel, about 95–100 × 9 μ; spores 8, filiform, nearly as long as the ascus, arranged in a parallel fascicle; paraphyses slender, only very slightly or not at all thickened at the tip.

Coccomyces pluridens, Sacc. Syll. viii. n. 3062 (1889).

On the leaves of *Clusia parasitica*. Cuba (*Wright*, nn. 531, 532, 533).

The specimen in the Kew copy of Wright's Fungi Cubenses, n. 713, which is called *Phacidium pluridens*, Berk., is something quite different to that species.

PHACIDIUM ELEGANS, *Berk. & M. A. Curt. in Grevillea*, iv. (1875) p. 7. (Pl. **5**. figs. 12, 13.)

Scattered, black, subcircular, hypothecium thin, epithecium adnate to the epidermis, which splits at maturity into usually three acute teeth; disc dingy, not at all erumpent, 0·5–1 mm. diam.; asci broadly subcylindrical, almost or quite sessile, wall thick, not blue with iodine, 85–95 × 15–18 μ; spores 8, hyaline, irregularly biseriate, elliptical or subclavate, at first 5–7-septate, then muriform, 20–24 × 7–9 μ; paraphyses slender, apex slightly incrassated.

Dothiora elegans, Sacc. Syll. viii. n. 3151 (1889).

Exsicc. Rav. Fung. Carol. n. 51 (on *Pinus Taeda*).

On sheaths of living pine trees. Lower Carolina (*Ravenel*, n. 3678).

This species belongs to the genus *Tridens*; differing from *Phacidium* in the muriform spores, and from *Dothiora*, in which it is placed by Saccardo, in not being erumpent.

The species will stand as TRIDENS ELEGANS.

PHACIDIUM LIMITATUM, *Berk. & M. A. Curt. in Journ. Linn. Soc., Bot.* x. (1869) p. 371. (Pl. **5**. figs. 14, 15.)

Ascophores gregarious, seated on pale spots which are bounded by a thin black line, up to 1 mm. across, epidermis usually splitting into three acute teeth; disc plane, pallid; asci narrowly cylindrical, apex rounded, not blue with iodine, pedicel suddenly narrowed, usually oblique, 100–110 × 8 μ; spores hyaline, filiform, multi-septate, nearly as long as the ascus, arranged in a parallel fascicle; paraphyses slender, septate.

Coccomyces limitatus, Sacc., Syll. viii. n. 3063.

On dead leaves of *Clusia parasitica*.

PHACIDIUM ELEGANTISSIMUM, *Berk. & M. A. Curt. in Grevillea*, iv. (1875) p. 5; *Sacc. Syll.* viii. n. 2906. (Pl. **5**. figs. 10, 11.)

Epiphyllous, forming scattered or confluent white patches 2–4 mm. diameter, bounded by a dark line; ascophores seated on the patches, numerous, often arranged in irregular concentric rings, epidermis usually split into three acute teeth; disc plane, dingy, persistently immersed in the substance of the matrix; asci clavate or broadly cylindric-clavate, with a very short, abrupt pedicel, apex rounded, not blue with iodine, wall thick; spores 8, hyaline, irregularly grouped in a mass, elliptic-oblong, ends obtuse, at first 3-septate, afterwards muriform, vertical septa 1–3, 20–23 × 8–10 μ; paraphyses slender.

On leaves of *Ilex opaca*, Alabama (*Peters*, n. 4572); on the same host from S. Carolina (*Ravenel*).

Some of the Alabama specimens are quite mature, and contain fruit, from which the above description is prepared. The fungus is in reality a *Phacidium* in appearance, but having muriform spores and an immersed disc, requires the creation of a new genus for its reception. The following is proposed:—

TRIDENS, gen. nov.

Ascomata immersa, disciformia, immarginata, excipulo atro epidermidi concreto et cum illo in laciniæ acutas e centro fissa. Asci clavati, octospori; sporæ hyalinæ, oblongæ, muriformes; paraphyses filiformes, clavulatæ.

Est *Phacidium* dictyosporum.

T. ELEGANTISSIMUM. (See p. 112 for *T. elegans.*)

EXCIPULA NIGRO-RUFA, *Berk. in Hook. f. Fl. New Zeal.* ii. p. 202, tab. 106. f. 11 (1855).

Scattered or gregarious, sessile, globose and closed at first, then opening by a minute pore, finally saucer-shaped, the entire margin remaining erect or slightly incurved, glabrous, $\frac{1}{2}$–$\frac{1}{3}$ mm. diameter; disc reddish-brown, externally blackish; hypothecium and excipulum formed of very slender, branched, septate hyphæ, which pass at the cortex into brownish, grumous cells; asci broadly cylindric-clavate, apex narrowed and not blue with iodine, 75–80 × 12 μ; spores 8, irregularly 2-seriate, hyaline, elliptic-oblong, sometimes slightly curved, 3–4-transversely-septate, afterwards with one or more vertical or oblique septa, 27–30 × 7–8 μ; paraphyses numerous, very slender, hyaline, septate, not at all thickened at the tip.

Scleroderris nigro-rufa, Sacc. Syll. viii. n. 2469.

On the under surface of leaves of *Pittosporum crassifolium.* Hawkes Bay, New Zealand (*Colenso*).

EXCIPULA GREGARIA, *Berk. in Hook. f. Fl. New Zeal.* ii. p. 202 (1855).

Erumpent; gregarious or scattered; disc pallid, externally blackish, glabrous, about $\frac{1}{2}$ mm. across; cortex parenchymatous, cells small; asci cylindric-clavate, apex rounded, not blue with iodine, narrowed below into a slender pedicel, 100 × 9–10 μ; spores 8, irregularly 2-seriate in the upper part of the ascus, 1-seriate towards the base, hyaline, smooth, elliptical or sometimes inclined to be narrowly egg-shaped, or obovate, 10–12 × 4–5 μ; paraphyses numerous, very slender, tips very slightly or frequently not at all thickened.

Ephelina gregaria, Sacc. Syll. viii. n. 2427.

On the upper surface of living leaves of a species of *Gnaphalium.* New Zealand (*Colenso*, nn. 5056 & 5272).

This species is a typical *Pseudopeziza*, and will stand as P. GREGARIA.

SPHINCTRINA TIGILLARIS, *Berk. in Ann. & Mag. Nat. Hist.* Ser. III. xv. (1865) p. 450. (Pl. **5**. figs. 17, 18.)

Entirely black, stem very slender, head broadly elliptical, whole fungus up to 1 mm high; asci narrowly cylindrical, soon deliquescing; spores obliquely 1-seriate, hyaline, narrowly elliptical, with one thick, median septum, 5–6 × 2 μ.

On an old *Polyporus* growing on a beam in King's Cliffe Church (*Berkeley*). On wood, Batheaston (*Broome*).

The two following species were founded by Schweinitz, and not by Berkeley, but as there is ample material of each in the Kew Hebarium collected by Schweinitz, and furthermore as the species are not at all well understood, it has been considered advisable to append fuller diagnoses.

PEZIZA CRUENTA, *Schweinitz, Syn. Fung. Am. Bor.* n. 943 (1834); *Grevillea*, xxii. (1894) p. 99. (Pl. **5**. figs. 25–27.)

Gregarious, sometimes confluent, sessile, fixed by a central point, at first closed, then becoming widely expanded, margin often wavy or fimbriate, slightly raised, up to 1 mm. across; substance thin, somewhat gelatinous when moist, translucent and rigid when dry; disc slightly concave, crimson or orange-red, sometimes pale orange (when dry), externally paler, the margin and for a short distance below furnished with small, projecting clusters of obtuse hyphæ 25–35 × 5–6 μ, these tufts are usually agglutinated together by amorphous, honey-coloured lumps; hypothecium and excipulum minutely parenchymatous, cells of cortex polygonal, 7–9 μ diameter; asci clavate, apex rounded, not blue with iodine; pedicel slender, usually crooked, about 50 × 6 μ; spores 8, irregularly 1-seriate or sometimes 2-seriate above, hyaline, continuous, cylindric-oblong, ends obtuse, 5–7 × 1·5–2 μ; paraphyses numerous, hyaline, slender, tips capitate, piriform, or sometimes only very slightly thickened.

Pezizella cruenta, Sacc. Syll. viii. n. 1183.

Peziza (*Mollisia*) *fibriseda*, Berk. & M. A. Curt. in Grevillea, iii. (1875) p. 157.

Pseudohelotium fibrisedum, Sacc. Syll. viii. n. 1243.

Peziza (*Mollisia*) *saccharifera*, Berk. in Grevillea, iii. (1875) p. 157.

Pseudohelotium sacchariferum, Sacc. Syll. viii. n. 1242.

Peziza rufula, Schweinitz, Syn. Fung. Amer. Bor. n. 495 (1834).

Peziza regalis, Cooke & Ellis, in Grevillea, vi. (1878) p. 91.

Pezizella regalis, Sacc. Syll. viii. nn. 1177, 1182.

Exsicc. Ellis, N. Amer. Fung. n. 438; Ellis & Everh. N. Amer. Fung. ser. ii. n. 2326.

On bark of *Ulmus americana*: Virginian Mountains (n. 3311, no collector's name on label). On *Liquidambar*: Alabama (*Peters*, n. 5208). On bark of apple-tree: Newfield, N. Jersey (*Ellis*, n. 2778). On wood: Bethlehem, U.S.A. (*Schweinitz*).

The present species is a true *Orbilia*, and will stand in future as O. RUFULA.

Soft and inclined to be gelatinous when moist, rigid and somewhat pellucid when dry; margin usually raised when dry, often incurved, leaving a narrow slit or often a triangular opening. The margin is irregular, due to the projecting tufts of hairs, as is also the outside for some distance down; the amorphous lumps adhering to and probably secreted by the tufts of hyphæ give the appearance of being "externally clothed with sugar-like granules."

PEZIZA CHLORA, *Schweinitz*, *Syn. Fung. Carol. Sup.* n. 1235 (an extract from *Soc. Nat. Cur. Lips.* 1822); *Grevillea*, xxii. (1894) p. 100.

Gregarious, sessile, soft and rather fleshy, at first globose and closed, then expanding but remaining slightly concave, and the margin more or less persistently incurved; usual colour of the entire fungus pale yellowish-green, but sometimes passing from pale yellow to deep orange; externally glabrous but frequently vertically striate, especially at the margin, 1–2 mm. across; hypothecium and excipulum formed of slender, closely septate, branched, interwoven hyphæ, these become thicker and coloured to form the cortex; asci narrowly clavate, apex rounded, not blue with iodine, base narrowed into a slender, crooked pedicel; spores 8, obliquely 1-seriate, hyaline, continuous, sausage-shaped, often slightly curved, 5–6 × 1·5 μ; paraphyses hyaline, slender, septate, slightly clavate at the tip.

Chlorosplenium Schweinitzii, Fries, Summa Veget. Scand. p. 356 (1846).

Peziza crocitincta, Berk. & M. A. Curt. in Grevillea, iii. (1875) p. 160; Grevillea, i. tab. i. f. 5 (the orange form).

Pezizella crocitincta, Sacc. Syll. viii. n. 1193.

On decayed wood, inside bark, &c.

The present species appears to be not uncommon in the United

States, being represented in the Kew Herbarium from Carolina (*Schweinitz*); North Greenbush (*C. A. Peck*); Cotoosa Springs, Georgia (*Ravenel*, n. 1730); Pennsylvania (*Dr. Michener*, n. 3602); Newfield, N. Jersey (*Ellis*, nn. 2499, 2886).

The present species is a *Chlorosplenium*, hence the name must be CHLOROSPLENIUM CHLORA. The range of colour from yellowish-green through clear yellow to orange or saffron is often shown in different individuals of the same group. When dry the margin is incurved and grooved.

EXCLUDED SPECIES.

CORDIERITES MUSCOIDES, *Berk. & M. A. Curt. in Grevillea*, iv. (1875) p. 2; *Sacc. Syll.* viii. n. 3321.

On wood. Pennsylvania (*Michener*, 4314).

This is not a Discomycete, It consists of an erect, branched, sterile stroma 4–7 mm. high, formed of more or less parallel, slender, coloured hyphæ, externally downy.

PEZIZA (FIBRINA) POMICOLOR, *Berk. & Rav. in Grevillea*, iii. (1875) p. 157.

Pseudohelotium pomicolor, Sacc. Syll. viii. n. 1254.

On bark of *Taxodium distichum*. S. Carolina (*Ravenel*, n. 1417).

This does not belong to the Discomycetes; it is probably the infant condition of some *Corticium*, but is quite sterile.

PEZIZA SOLENIIFORMIS, *Berk. & M. A. Curt. in Grevillea*, iii. (1875) p. 160, et xxii. (1894) p. 106.

Pezizella soleniformis, Sacc. Syll. viii. n. 1159.

Dead wood. Alabama (*Peters*, n. 6100).

This species is a genuine *Cyphella*, having globose, smooth, hyaline spores, 4–5 μ diameter; and will in future stand as CYPHELLA SOLENIIFORMIS.

PEZIZA (HYMENOSCYPHA) EXARATA, *Berk. in Grevillea*, iii. (1875) p. 160.

Phialea exarata, Sacc. Syll. viii. n. 1107.

On dead wood. Lower Carolina (*Curtis*, n. 2119).

This fungus proves to be a species of *Guepinia*.

HELOTIUM SCLEROTIOIDES, *Berk. Outl.* p. 371 (1860); *Phillips, Brit. Disc.* p. 171; *Sacc. Syll.* viii. n. 960.

Examination of the type specimen shows this to be a true sclerotium.

HELOTIUM MELLEUM, *Berk. & Broome*, *Fungi of Ceylon*, n. 957, *in Linn. Soc. Journ.*, *Bot.* xiv. (1875) p. 107; *Sacc. Syll.* viii. n. 1002.

This is a corticolous lichen, and must not be confounded with *Helotium melleum*, Berk. & Broome, in Ann. & Mag. Nat. Hist. Ser. IV. vol. xv. (1875) p. 38; Sacc. Syll. viii. n. 948 (as *Helotium Fergussoni*), which is a different species.

PEZIZA ALBO-TECTA, *Berk. & M. A. Curt. in Linn. Soc. Journ.*, *Bot.* x. (1869) p. 367.

This is a lichen.

PEZIZA TELA, *Berk. & M. A. Curt. in Grevillea*, iii. (1875) p. 156.

This species proves to be a *Cyphella*, and is described in Journ. Mycol. vol. vi. (1891) p. 179, pl. 7. ff. 12–13 (1891), as *Cyphella tela*, Massee.

PEZIZA HERPOTRICHA, *Berk. in Hook. Journ. Bot.* vol. iii. (1851) p. 16, tab. 1. f. 2.

This is an epiphyllous lichen.

PEZIZA BLOXAMI, *Berk. & Broome, in Ann. & Mag. Nat. Hist.* Ser. II. vol. vii. (1851) p. 181.

A very doubtful production, superficially resembling a *Tapesia*, but no trace of asci can be found in the ample material in Herb. Berk. Kew. Possibly a *Cyphella*, but, if so, immature.

PEZIZA (PATELLIA) ADAMSONI, *Berk. in Journ. Linn. Soc.*, *Bot.* xiii. (1873) p. 176.

This is a lichen.

PEZIZA (GEOPYXIS) SUBGRANULATA, *Berk. & M. A. Curt. in Journ. Linn. Soc.*, *Bot.* x. (1869) p. 366.

I cannot find a fungus agreeing with Berkeley's description, having granulated spores. *Humaria granulata*, Sacc., is abundant on the piece of dung on which the type is supposed to be present.

PEZIZA (HUMARIA) RUBERRIMA, *Berk. & Broome, in Journ. Linn. Soc.*, *Bot.* xiv. (1875) p. 104.

This supposed *Peziza* is the immature, collapsed, state of a minute species of *Lycogala*.

EXPLANATION OF THE PLATES.

Plate 4.

Fig. 1. *Peziza Thozetii*, Berk., nat. size.
2. Upper portion of ascus of same, containing two spores; also tips of two paraphyses, ×400.
3. *Peziza leucopsis*, Berk., nat. size.
4. Ascus and paraphyses of same, × 400.
5. *Patellaria aureo-coccinea*, Berk. & M. A. Curt.; ascus and paraphysis, × 400.
6. Spore of same, × 400.
7. Ascophore of same, × 35.
8. *Patellaria lurida*, Berk. & M. A. Curt., × 10.
9. Section of same, × 10.
10. Ascus of same, × 400.
11. *Patellaria lata*, Berk.; ascus and paraphyses, × 400.
12. Spores of same, × 400.
13. *Patellaria Bloxami*, Berk.; ascus and paraphyses, × 400.
14. Spores of same, × 400.
15. *Patellaria stygia*, Berk. & M. A. Curt.; cortical cells of ascophore, × 400.
16. Ascus and paraphysis of same, × 400.
17. Spores of same, × 400.
18. *Patellaria tasmanica*, Berk.; ascus and paraphysis, × 400.
19. *Peziza Andropogonis*, Berk. & M. A. Curt.; ascus and paraphysis, × 400.
20. *Peziza eustegiæformis*, Berk. & M. A. Curt.; ascus and paraphyses, × 400.
21. Portion of cortex and marginal fringe of same, × 400.
22. *Peziza ilicincola*, Berk. & Broome; coloured cortical cells showing the hyaline, spine-like outgrowths, × 400.
23. *Peziza apicalis*, Berk. & Broome; groups of plants seated in the axils of the leaves at the apex of a shoot of *Macromitrium sulcatum*, × 25.
24. Ascus and paraphyses of same, × 400.
25. *Peziza alligata*, Berk. & Broome; ascus and paraphyses. × 400.
26. *Peziza exidiella*, Berk. & M. A. Curt.; group of plants, × 25.
27. Ascus and paraphyses of same, × 400.
28. *Peziza nitidula*, Berk. & Broome; plants × 25.
29. Ascus, paraphyses, and free spores of same, × 400.
30. *Peziza furfuripes*, Berk. & M. A. Curt.; a group of plants, × 20.
31. Ascus, paraphyses, and free spores of same, × 400.
32. *Peziza Carmichaeli*, Berk.; ascus and paraphyses, × 400.
33. *Peziza viridi-atra*, Berk. & M. A. Curt.; a single plant, nat. size.
34. Ascus and paraphyses of same, × 400.
35. *Cenangium concinnum*, Berk. & M. A. Curt.; ascus and paraphysis, × 400.
36. Free spores of same, × 400.
37. *Tympanis gyrosa*, Berk. & M. A. Curt.; ascus and paraphyses, × 400.
38. Free spores of same, × 400.

G. Massee del.
A. T. Hollick lith.

West, Newman imp.

TYPES OF FUNGI.

G. Massee del.
A. T. Hollick lith.

West, Newman imp.

TYPES OF FUNGI.

PLATE 5.

Fig. 1. *Platygrapha stictoides*, Leighton ; a group of ascophores forming an irregular reticulation, nat. size.
2. A single ascophore of same, × 7.
3. Ascus and paraphyses of same, × 400.
4. Spore of same, × 800.
5. *Platygrapha astroidea*, Berk. & Broome ; ascus and paraphyses, × 400.
6. A single ascophore of same, × 7.
7. *Platygrapha magnifica*, Berk. & Broome ; plants on bark, nat. size.
8. Ascus and paraphyses of same, × 400.
9. Free spore of same breaking up into its component cells, × 400.
10. *Phacidium elegantissimum*, Berk. ; the fungus on portion of a leaf of *Ilex opaca*, nat. size.
11. Spores of same, × 400.
12. *Phacidium elegans*, Berk. & M. A. Curt. ; ascus and paraphysis, × 400.
13. Free spore of same, × 400.
14. *Phacidium limitatum*, Berk. & M. A. Curt.; ascophore emerging through the torn epidermis, which has been split into three teeth, × 20.
15. Ascus and paraphysis of same, × 400.
16. *Ascidium pluridens*, Berk. & M. A. Curt. ; ascophore emerging through the torn epidermis, which is split into several acute teeth, × 20.
17. *Sphinctrina tigillaris*, Berk., × 10.
18. Ascus and spores of same, × 400.
19. *Peziza olivaceo-lutea*, Berk. ; ascus and paraphysis, × 400.
20. Spores of same, × 400.
21. *Peziza Archeri*, Berk. ; ascus with perfectly globose, hyaline spores, also two paraphyses curved at the tip, × 400.
22. *Peziza fracta*, Berk. & M. A. Curt. ; group of fungi on a branch, nat. size.
23. Two plants of the same species in different stages of development, × 60.
24. Ascus and spores of same, × 400.
25. *Peziza cruenta*, Schweinitz, on bark, nat. size.
26. The same slightly magnified.
27. Ascus and paraphyses of same, × 400.
28. *Peziza xylariicola*, Berk., growing on a species of *Xylaria*, nat. size.
29. Section of ascophore, slightly magnified.
30. Asci and paraphyses of same, × 400.
31. Free spores of same, × 400.

A Revision of the Genus *Hypericophyllum*, with Notes on certain allied Genera of Compositæ. By N. E. Brown, A.L.S.

[Read 20th June, 1901.]

(Plate 6.)

The genus *Hypericophyllum* was founded by Steetz upon a remarkable plant (*H. compositarum*, Steetz) collected by Peters in Portuguese East Africa, which, owing to the want of sufficient material, has been the subject of considerable confusion, three other species having been mistaken for it, and a specimen of the true *H. compositarum* redescribed as a new species. Further, Bentham (Journ. Linn. Soc., Bot. xiii. (1873) p. 450, and in Bentham & Hooker, Genera Plantarum, ii. p. 397) united *Hypericophyllum* (together with *Chætymenia*, Hook. & Arn., and *Espejoa*, DC.) with the genus *Jaumea*, Pers., and thus the marked peculiarities of the genus have been lost sight of. For an examination of the Kew material demonstrates that the view taken by Bentham of the identity of these four genera is quite untenable, since they all possess characters that entitle them to rank as distinct from each other. The genus *Hypericophyllum* is certainly very distinct from *Jaumea*, not only in distribution, habit, and appearance, but by the presence of glands in its leaves and tissues, its flat receptacle, 4–5-angled achenes, and remarkable pappus, the hooked bristles of which appear to be unique in the Order. It is therefore proposed to restore this and the other three genera to their former generic rank, the following being a key to their distinctive characters:—

Heads discoid or radiate, many-flowered; receptacle conical; achenes linear-oblong, 10-ribbed, glabrous; pappus of straight, slightly flattened ciliate bristles, or of 1–3 minute setæ or none; corolla very much longer than the pappus; leaves fleshy, linear-subterete, without glands.—Shores of Montevideo, Patagonia, and California. Jaumea, Pers.

Heads discoid, 3–7-flowered; receptacle small, flat; ovary and achenes very stout, compressed-obconical, with 1 obscure rib down the middle of each of the two broad faces, very densely covered with adpressed hairs; pappus of several broad lanceolate membranous scales, with a rather stout midrib; corolla very slightly exceeding the pappus; leaves herbaceous.—Mexico and Nicaragua.................... ESPEJOA, DC.

Heads radiate, many-flowered; receptacle flat; achenes linear-cuneate, sharply 4-angled, pubescent; pappus of many straight bristles as long as the corolla-tube, furnished with a half-adnate membranous wing or tooth on each side at the base; leaves herbaceous, obscurely pellucid-dotted.—Mexico .. CHÆTYMENIA, Hook. & Arn.

Heads discoid, many-flowered; receptacle flat; achenes narrowly cuneate, 4–5-angled, pubescent or subglabrous; pappus of many rigid bristles, hooked at the apex, shorter than or subequalling the corolla-tube, ciliate or glabrous; leaves herbaceous, with immersed glands, sometimes pellucid-dotted.—Tropical Africa............ HYPERICOPHYLLUM, Steetz.

With regard to the species of *Hypericophyllum* some confusion has arisen on account of the absence of good material at the time when the Compositæ were worked up for the 'Flora of Tropical Africa.' When the 3rd volume of that work was published, the only representative of the genus *Hypericophyllum* at Kew was a mere scrap of a flowering branch, collected in Zanguebar by Captain Burton, which, probably by reason of the absence of the characteristic stem-leaves, was mistaken for *H. compositarum*, Steetz, an identification that has led to some confusion amongst the other members of the genus. As there is now good material of five distinct species of *Hypericophyllum* at Kew, I give the following brief synopsis of them:—

I. Leaves cordate and as broad or broader at the base than at the middle part, glabrous.

1. H. COMPOSITARUM, *Steetz, in Peters, Mossamb. Bot.* p. 499, t. 50. Bracts of the involucre not ciliate. Flowers much longer than the involucre. Pappus-bristles about as long as the corolla-tube, slender, ciliate, some of them nearly or quite straight at the apex.—*Jaumea Johnstoni*, Baker, in Kew Bulletin, 1898, p. 153.

Portuguese East Africa.—On hills, near water, between Unangu and Lake Shirwa, 3000–4000 ft., *Johnson*, 27! Boror, Rios de Sena, *Peters*. British Central Africa.—Nyasaland: Masuku Plateau, 6500–7000 ft., *Whyte*! between Mpata and the commencement of the Tanganyika Plateau, 2000–3000 ft., *Whyte*! Nyika Plateau, 6000–7000 ft., *Whyte*, 228!

Jaumea Johnstoni, Baker, was not founded upon the specimen from Archdeacon Johnson, but upon those of Whyte, collected under the auspices of Sir Harry H. Johnston.

II. Leaves much narrower at the base than at the middle part.

A. Flowers much longer than the involucre.

2. H. ANGOLENSE, *N. E. Brown*. Leaves oblanceolate, obtuse, scabrid-pubescent on both sides. Outer involucral-bracts ciliate. Pappus-bristles rigid, much shorter than the corolla-tube, subciliate at the base.—*Jaumea angolensis*, O. Hoffm. in Bol. Soc. Brot. x. p. 178; Hiern, Cat. Afr. Pl. Welw. i. p. 589. *J. compositarum*, Klatt, in Ann. Naturhist. Hofmus. Wien, vii. (1892) p. 103, not of Benth. & Hook. f. *J. Oliveri*, Vatke, ex Baker, in Kew Bull. 1898, p. 153, under *J. Johnstoni*.

Angola.—Huilla: in marshy places along the River Lopollo, *Welwitsch*, 3965! Malange, *Theusch*, 470!

3. H. ELATUM, *N. E. Brown*. A glabrous herb. Leaves elliptic or elliptic-lanceolate, obtuse or subacute. Involucral-bracts not ciliate. Pappus-bristles glabrous.—*Jaumea elata*, O. Hoffm. in Engl. Jahrb. xxviii. (1900) p. 506. *J. compositarum*, Benth. & Hook. f. ex Oliver & Hiern, in Fl. Trop. Afr. iii. p. 395.

German East Africa.—Zanguebar, *Burton*! Mainland opposite the island of Zanzibar, *Kirk*! Portuguese East Africa.—In the swamps at Dondo, near Beira, *Hon. Mrs. Evelyn Cecil*, 244! British Central Africa.—Urungu: Fwambo, *Carson*, 96 of 1894 collection! Nyasaland: without precise locality, *Whyte*, 8!

4. H. SCABRIDUM, *N. E. Brown*, n. sp. (Pl. **6.**) Herba 3–4-pedalis, habitu *H. elati*. Caulis scabrido-pubescens. Folia

M. Smith del.
J. N. Fitch lith.

West, Newman imp.

HYPERICOPHYLLUM SCABRIDUM N.E. Brown, n. sp.

opposita, sessilia, inferiora 4–6 poll. longa $1\frac{1}{4}$–$2\frac{3}{4}$ poll. lata, superiora minora, elliptica vel lanceolata, obtusa vel subacuta, basin versus rotundatum vel obtusum angustata, integra vel repando-dentata, 5-nervia, utrinque scabridula. Involucri squamæ ovatæ, orbiculato-ovatæ vel raro lanceolatæ, obtusæ vel acutæ, plus minusve scabridulo-pubescentes, marginibus minute ciliatis vel subglabris; squamæ interiores $4\frac{1}{2}$–5 lin. longæ, $1\frac{1}{4}$–4 lin. latæ; squamæ exteriores breviores. Flores quam involucrum subduplo longiores, aurantiaci; corollæ tubus 4 lin. longus, lobi 1 lin. longi, lanceolato-oblongi, subobtusi. Achænia 4-angularia, pubescentia, pappi setæ 1–2 lin. longæ, rigidæ, apice uncinatæ vel circinatæ; basi ciliatæ.

British Central Africa.—Nyasaland: between Kondowe and Karonga, 2000–6000 ft., *Whyte*! Manganja Hills, 1000 ft. alt., *Kirk*! Shire Highlands, near Blantyre, not at all plentiful, *Buchanan*, 73! 439!

A scabrid-pubescent herb. Leaves elliptic or lanceolate, obtuse or subacute. Involucral-bracts more or less pubescent on the back and often minutely ciliate. Pappus-bristles ciliate at the base. The nerves of the involucre-scales are much less numerous in this species than they are in *H. elatum*, N. E. Br.

AA. Flowers scarcely exceeding the involucre.

5. H. congoense, *N. E. Brown*. Stem slightly scabrid. Leaves lanceolate or elliptic-lanceolate, bearing a few short very scattered bristles on both sides, scabrid-ciliate on the margins. Involucral-bracts glabrous, not ciliate. Pappus-bristles rigid, much shorter than the corolla-tube, glabrous.—*Jaumea congensis*, O. Hoffm., in Comptes-rend. Soc. Bot. Belg. xxxix. (1900) p. 33.—*J. compositarum*, Durand & Schinz, Etud. Fl. du Congo, p. 182, non Benth. & Hook. fil.

Congo Free State.—By the River Congo above Stanley Pool, *Johnston*!

The plant described by Klatt in Bull. Herb. Boiss. iii. (1895) p. 425, under the name of *Jaumea altissima*, is unknown to me; but, judging from the description, it cannot be either a *Jaumea* or a *Hypericophyllum*.

DESCRIPTION OF PLATE 6.

Hypericophyllum scabrum, N. E. Br.

Fig. 1. A bract from the involucre. Fig. 2. A flower. Fig. 3. Pappus-bristles. Fig. 4. Three stamens. Fig. 5. Apex of the style. All enlarged.

The Flora of Tibet or High Asia; being a Consolidated Account of the various Tibetan Botanical Collections in the Herbarium of the Royal Gardens, Kew, together with an Exposition of what is known of the Flora of Tibet.

By W. Botting Hemsley, F.L.S., F.R.S., Keeper of the Herbarium and Library, assisted by H. H. W. Pearson, M.A., F.L.S. (Contributed by permission of the Director.)

(With Map.)

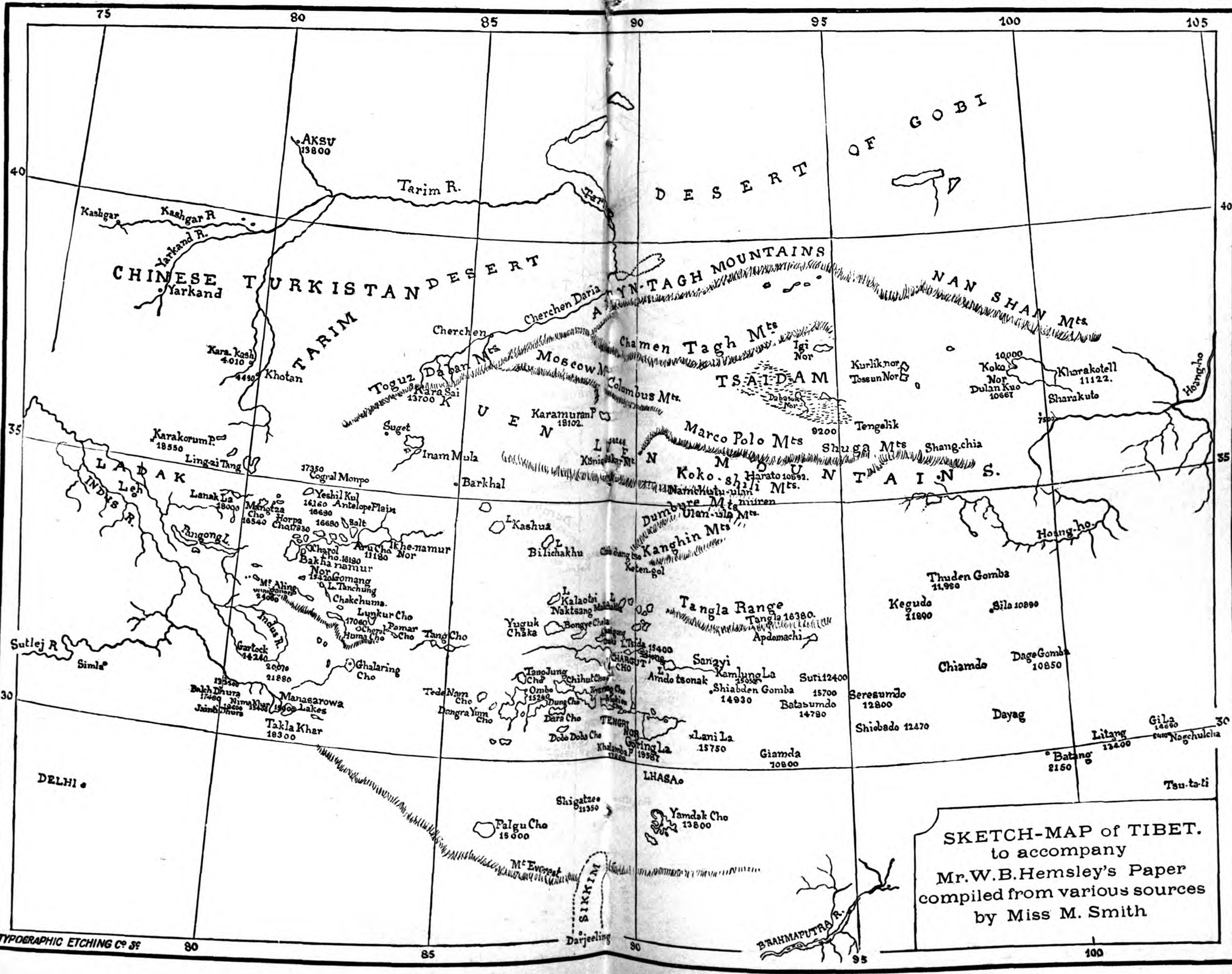
[Read 16th January, 1902.]

INTRODUCTION.

On June 1, 1899, we* exhibited to the Society a selection of High-level Plants from various parts of the world, and made some remarks on their general characteristics, on the greatest altitudes reached by flowering plants in different latitudes, and on the conditions under which plants exist in such situations. That exhibition was intended as preliminary to an account of several collections of dried plants from high levels in Asia and South America, received at Kew during the last three or four years. Our final account of the Andine collections has already been presented to the Society, and has appeared in the present volume, pp. 78–90; and we now have the honour of reading some portions of a much more extended paper on the Flora of Tibet. Acting on the suggestion of the President on the occasion of our exhibition, we propose treating more in detail of the High-level Plants of the World at some future time.

Although these collections are small, they are of great value and interest on account of the information accompanying the specimens concerning the altitude at which they were gathered, the colour of their flowers, and other particulars, only obtainable on the spot. They are also valuable as representing, in most

* It should be explained that Mr. Pearson was joint author of this paper in the form it was first presented to the Society, but in consequence of a change in his appointment he was unable to take part in the additional work involved in reconstructing it on the present plan.


SKETCH-MAP of TIBET.
to accompany
Mr. W. B. Hemsley's Paper
compiled from various sources
by Miss M. Smith
TYPOGRAPHIC ETCHING Co Sc
DESERT OF GOBI
CHINESE TURKISTAN
TARIM DESERT
ALTYN-TAGH MOUNTAINS
NAN SHAN Mts.
KUEN LUN MOUNTAINS.
Chamen Tagh Mts
Moscow Mts
Columbus Mts.
Marco Polo Mts
Shuga Mts
Koko-shili Mts.
Dumbure Mts
Kanghin Mts
Tangla Range
Toguz Daban Mts
TSAIDAM
LADAK
Aksu
13800
Tarim R.
Kashgar
Kashgar R.
Yarkand R.
Yarkand
Cherchen
Cherchen Daria
Khotan
Kara Sai
13700
Karamuran P.
18102
Suget
Inam Mula
Barkhal
Karakorum P.
18550
Ling-zi Tang
Cogral Monpo
Yeshil Kul
Antelope Plain
Leh
Lanak La
Pangong L.
INDUS R.
Indus R.
L. Kashua
Bilichakhu
Keten-gol
Igi Nor
Kurlik nor
Tossun Nor
Koko Nor
Dulan Kuo
10667
Kharakotell
11122.
Sharakuto
Hoang-ho
Tengelik
Shang-chia
Tangla 16380.
Apdomachi
Thuden Gomba
11980
Kegudo
11800
Sila 10890
Chiamdo
Dage Gomba
10850
Seresumdo
12800
Dayag
Shiobado 12470
Litang
Batang
2150
Gi La
Nagchulcha
Tsu-ta-ti
Sutlej R.
Simla
Gartock
14240
Manasarowa Lakes
Takla Khar
18300
Ghalaring Cho
Tang Cho
Lunkur Cho
Dangra Yum Cho
Dara Cho
Dobo Dobo Cho
TENGRI NOR
Goring La
Lani La
15750
Giamda
10800
LHASA
Shigatze
Yamdok Cho
13800
Palgu Cho
15000
Mt Everest
SIKKIM
Darjeeling
BRAHMAPUTRA R.
DELHI
Kamlung La
Shiabden Gomba
14930
Batasumdo
14780
Amdo tsonak
Sanayi
75
80
85
90
95
100
105
40
35
30

instances, the whole vascular flora of the districts, or rather routes, traversed by the various travellers, whose aim it was to collect a specimen or specimens of all the different kinds of plants observed. It should be borne in mind, however, that the conditions under which these arduous journeys were made prevented systematic botanical exploration beyond a very narrow strip of the country traversed in each case.

History of Botanical Discovery in Tibet.

Before entering into particulars of the collections to be enumerated, we will briefly sketch the history of botanical discovery in Tibet, and we shall perhaps be excused for repeating here some facts that have appeared in the Society's publications of comparatively recent date.

We have happily still among us two of the pioneers in the botanical investigation of Tibet, namely, Sir Joseph Hooker and Sir Richard Strachey. It would be superfluous for us to dilate upon the services to Geographical Botany rendered by Sir Joseph Hooker during his long period of activity; yet we may say that we are greatly indebted to his work in what follows.

As most of the Fellows of our Society are aware, Sir Richard Strachey published so recently as 1900 ('Geographical Journal,' xv.) a Narrative of his journey, in company with J. E. Winterbottom, to Lake Manasarowar, in Western Tibet, upwards of fifty years ago. This Narrative contains relatively more botanical information from direct observation than those of all the other travellers combined. In this connection it may be mentioned, as a curious coincidence, that Winterbottom's own set of his dried plants, together with his original notes, which had lain aside untouched since his death in 1854, was presented in 1900 to Kew, by his relatives Miss J. Pain and Mrs. Gnosspelius.

Strachey and Winterbottom did not penetrate far into Tibet Proper, yet far enough to obtain materials sufficient to afford a very good idea of the character of the flora of this elevated and very dry region. Nothing, so far as we are aware, was published at the time on the plants, though a very elaborate table showing their distribution, altitudes, colour of flowers, and other particulars, was printed and privately circulated. Concerning this collection, Hooker and Thomson ('Flora Indica,' Introduction, p. 66) say: "The beautiful preservation of the specimens, and the fulness and accuracy with which they are ticketed, renders this herbarium the most valuable for its size that has ever been distributed from India." All the plants of this collection are taken up in Hooker's 'Flora of British India,' though a number of them are not found within its technical limits. A separate list of them has also been published by Mr. J. F. Duthie, Director of the Botanical Department of Northern India, in E. F. T. Atkinson's work entitled 'Gazetteer of the North-west Provinces of India,' vol. x. 1882; and Sir Richard Strachey himself contributed an abstract of the Tibetan portion of the collection to my paper on Thorold & Bower's and Rockhill's Tibetan plants in the Society's Journal (vol. xxx. pp. 101–140).

The Brothers Schlagintweit should also be mentioned, because, although they collected little in Tibet, and few of their plants have come under our notice, we make use of some of their observations on climate and altitudes and distribution. They travelled in the Karakorum region in 1855 to 1857, and penetrated Tibet, a little to the north of the country visited by Strachey and Winterbottom, passing through Gartok and north-westward, by way of Yarkand, to Kashgar. Their collections and observations were made in the most methodical and detailed manner. We shall discuss more particularly their data on the greatest altitudes attained by Flowering Plants.

Dr. Thomas Thomson, whose book of travels is entitled 'Western Himalaya and Tibet,' did not enter Tibet Proper, not having crossed the Karakorum range of mountains. The explanation of the title is that a part of the North-western Himalaya and Karakorum mountains was formerly designated Tibet, or Little Tibet, or, in part, Baltistan. We shall have something more to say in this connection later on.

Victor Jacquemont, who travelled in the same region between 1828 and 1832, also did not get beyond Little Tibet, or Western Tibet, as it is usually designated in the 'Flora of British India.'

Sir Joseph Hooker crossed into Tibet to the north of Sikkim by way of the Donkia Pass, and reached and ascended Mount Bhomtso, the height of which he estimated to be 18,590 ft. above the level of the sea. Flowering plants were collected almost to the summit.

The writings of the earlier European travellers, Marco Polo, Huc, Turner, Bogle and Holland, as well as the later native Indian travellers, such as Sarat Chandra Das *, contain no definite botanical information.

For the resumption and continuation of botanical work in Tibet and the adjoining countries, we are largely indebted to Russian explorers and French missionaries, especially during the last quarter of the last century. Foremost among the Russians was the late General N. M. Przewalski. He began his extensive travels in 1871, and between this date and 1885 he crossed Tibet from the north almost to the south and from east to west, besides making many detours; and he systematically collected objects of natural history throughout these journeys. Mr. G. N. Potanin, Dr. P. J. Piasezki, and Mr. A. Regel are other Russian travellers who made large botanical collections in Chinese Turkestan, Mongolia, and China, and, to a lesser extent, in Tibet. The combined collections of the first three travellers were taken in hand by the late Mr. C. J. Maximowicz, and the first part of his elaboration of the Tibetan part appeared in 1889, under the title of 'Flora Tangutica.' Unfortunately the talented author did not live to publish any more. This part contains the Thalamifloræ and Discifloræ; in other words, the natural orders Ranunculaceæ to Rhamnaceæ, in the sequence of Bentham and Hooker's 'Genera Plantarum.' The enumeration is preceded by an Introduction in Russian and Latin, to which we are largely indebted for general information on Tibet and the neighbouring countries. Maximowicz also published the first part of a 'Flora Mongolica,' which is of the same extent and of the same date as the 'Flora Tangutica.' He had previously published a general account of the collections, mainly from a geographical point of view. To this we shall have occasion to refer again.

The history of the collections on which this paper is based is contained in the "Itineraries" and other sections.

* Ugyen Gyatscho, who accompanied Das, made a botanical collection between Phari and Lhasa. It is in the Calcutta Herbarium, and has not yet been published as a whole, but, judging from the number of new Labiatæ from that region published by Dr. D. Prain (Journ. As. Soc. Beng. lix. 2, pp. 294–318), it contains a considerable number of novelties, though perhaps mostly belonging to the Himalayan Flora as distinguished from the Tibetan.

Boundaries and Physical Characteristics of Tibet.

Tibet is a somewhat vague geographical term for a large area in Central Asia, and, under the circumstances, we consider that we cannot do better than follow Maximowicz, except that we take the Himalaya Mountains as the southern boundary. It is remarkable as being on the whole, for its area, the highest country in the world. It is equally remarkable for its extreme dryness, especially in the western, northern, and central parts, and likewise for its high snow-limit, as compared with the southern slopes of the Himalaya Mountains. It forms an unequal-sided quadrangle between 30° and 36° N. latitude in the west, and 28° and 39° in the centre and east, including Tsaidam, and 80° and 102° E. longitude *; but Maximowicz did not include the country south of the thirty-first parallel, where there is a settled population. It is bounded on the east by China Proper; on the south by the Himalaya Mountains; on the west by the Himalaya and Karakorum Mountains; and on the north by the Keria, Toguz Daban or Kuen Luen, Altyn Tag, and Nan Shan Mountains. Chinese or Eastern Turkestan, in the western part, and Mongolia, in the eastern part, are the countries immediately to the north. None of these boundaries is strictly defined. For example, the eastern boundary varies in different latitudes between 99° in the Batang region in the south, and 102° in the Kuku Nor region in the north.

We have already explained some of the discrepancies concerning the western boundary, and the eastern is equally uncertain. For instance, in what we may term the south-eastern corner of Tibet and the adjoining part of China Proper the boundaries vary in different maps; Batang and Litang being sometimes included in Szechuen and sometimes in "Chinese Tibet." And even the more eastern district of Moupine, or Mupin (about 102° 30′ and 30° 30′), where the Abbé David laboured, is termed Chinese Tibet. But here, as well as at Tachienlu, where Mr. A. E. Pratt made a large collection of plants, partly worked out by us, the vegetation is luxuriant and varied, and belongs to the Himalayan or Indo-Chinese Flora.

Maximowicz describes (from the data supplied by the various

* From this point throughout this paper it has been considered sufficient to give the degrees of longitude and latitude in figures, without any further indication, and always, where the two are combined, placing longitude first. One has only to remember that the extremes are: longitude 80°–102°, and latitude 28°–39°.

travellers, he is careful to state) Mongolia and North Tibet as elevated plateaux, forming three terraces, separated from each other by chains of mountains running from west to east. Mongolia, the lowest of these terraces, is from 2000 to 4000 ft. above the level of the sea, followed by a second at 10,000 ft., and separated from Mongolia by the Nan Shan chain, which is called Tsaidam. The third is separated from the second by the Tan La chain, and rises to a height of 15,000 ft. This is North Tibet, properly so-called; but Tsaidam is commonly included in Tibet, as it partially is in the present paper, though we have few plants from that part. The Tibetan plain at 14,000–15,000 ft. and upwards above sea-level may be divided into two unequal parts by an imaginary diagonal line from the desert of Odontala in the north to Tengri Lake in the south. The rivers and rivulets to the west of this line drain into numerous, often large salt-lakes. To the east of this line, as well as the country south of Lhasa, the drainage is to the sea, chiefly to the east by the feeders of the Hoangho and the Yangtze and the upper Brahmaputra, while a relatively small south-western portion is drained by the Sutlej and Indus. The western plain or plateau consists of vast wide valleys between lofty parallel mountain-chains running from the west to the east, and rising to 20,000 ft. and upwards. With few exceptions the mountain-chains are naked and arid in the extreme; but some of the higher peaks are permanently covered with snow. The valleys and inequalities of the plain are largely filled or covered with a deposit called loess, the product of erosion, wind-borne to its present position. In places the loess deposit is of great thickness, the result of centuries of almost incessant dust-storms, and intersected by streams and rivers, more especially in North China; and where there is sufficient moisture it is exceedingly fertile. The composition of loess varies, but it is more or less calcareous and argillaceous and of a friable nature. In some districts it is mixed with sand; in others gravel predominates. We sometimes find the word loess translated by mud, but it would be mostly dry mud within our limits, and loam is perhaps a more intelligible rendering of the word.

Climate *.

The data concerning the climate of Tibet are very incomplete, but sufficient to give an idea of the general characteristics. In

* Temperatures have throughout been converted to Fahrenheit's thermometer, and the + and – refer to the zero, and not to the freezing-point.

the first place we give a free translation of Maximowicz's account, relating chiefly to the Eastern and Northern parts.

The winter in Tibet, observed three times in different years and months, and therefore the best known season, is cold, practically snowless, and characterized by a very dry, tempestuous atmosphere. The mean temperature of December and January is between +6°·6 and +2°·3 Fahr., but the nocturnal temperature in October falls to −9°·4, in November and December to −22°·0. In January the lowest temperature was observed, −28°·3, and soon afterwards the mercury froze; at 1 P.M. it varied from −0°·4 to +11°·6, and even higher; on sunny days occasionally +39°·0 was reached, and once even +46°·0 in consequence of the presence in the air of a copious dust heated by the sun's rays. During the day the wind, often violent, always blew from the west. Thus, both in October and November there were ten stormy days, in December fourteen, in January eighteen. Swamps and rivulets were frozen in Octeber; the larger rivers in November; the lakes are so salt that they never become ice-bound. Later on, on account of the extreme dryness of the air, the ice on the swamps evaporates, the greater part of it disappears, and they are dried up; similarly the rivers become waterless. Herbs also become so dried up that they crumble when touched and are ground to powder beneath the feet. The Yak and other wild animals were observed to lick up their food rather than detach it by their teeth.

Snowstorms are very frequent, and always tempestuous on account of the west wind. Nevertheless, snow falls sparingly and in very small quantities and usually disappears on the following day, dissipated by the wind-blast and the heat of the ground. Hence level places and the flanks of the mountains looking south were destitute of snow, and only on the northern slopes did the snow remain for any length of time. The inhabitants state that in some years the snowfalls are heavy, but they do not remain long, or all the animals would perish.

The limit of perpetual snow in Tibet seems to correspond to the lowest limit of the glaciers, and lies at 16,500–17,000 ft.; it is evidently much higher than in Amdo around the upper Hoangho and on the south side of Nan Schan, where perpetual snow begins at 15,700 ft., whilst on the northern slope of the same range it descends to 14,700 ft.

Spring in Tibet is cold and tempestuous, and disturbed by frequent snowstorms.

As in spring, so in summer, frequent and sudden changes of the weather occur—from heat to cold, from clear to cloudy; and the state of the weather is so changeable that the inhabitants assert that each village in Tibet has its own weather. For instance, in the desert of Odontala (35° N. lat.), on the second of June, after a warm day, there arose a tempest with a heavy fall of snow, and after this the temperature fell to $-9°\cdot4$. On other days, at 1 P.M. the air-temperature in the shade was $33°\cdot2$, and later $69°\cdot6$. In the open it was very hot, but any cloud rising in the clear sky caused a lowering of temperature and often snow or hail. On clear nights in July the temperature falls to $22°\cdot5$. The sky is usually cloudy. Rain or snow falls every day; thunderstorms occur frequently. With the constantly falling rain the streams are quickly swollen. A river which in winter is scarcely 60 ft. wide, in summer spreads to a breadth of 300 ft.; the Murussu, with a bed 650 ft. wide in winter, becomes swollen in summer to 4800 ft., and at the same time the water, which in winter is clear and limpid, becomes thick and muddy. All Tibet becomes, as it were, an immense swamp. No journey whatever can be undertaken, because the only material by which, in these regions, a fire is kindled for cooking food, drying wet garments, and warming men numbed with cold—the dried dung of oxen—is softened and dissolves.

Autumn is calm, dry, and rather warm; tempests are rare, but when they do occur they arise in the west. The characteristics of summer seem to prevail throughout Tibet; but in the alpine region of the Keria range rains were observed at least daily, and the mountains were enveloped in clouds.

The province of Amdo, on the north-eastern boundary of Tibet, where the plains are more than 12,000 ft. high, rising above the course of the upper Hoangho and its affluent streams, has almost the same climate as Tibet. During the month of June, for instance, snow falls every day—indeed, according to the inhabitants, on some plains it never rains throughout the summer, but snows. Cold and storms prevail at the same time that spring is flourishing in the depth of the valleys. Nevertheless a temperature of 80° was observed in July even on these elevated plains. In the deep river-valleys the air-temperature is cooler. A calm winter has a fairly copious snowfall, but even then only the northern slopes of the mountains are covered with snow for any length of time; recent snow, even in February, quickly disappears. At the end of November the Hoangho was frozen; the ice, however, was not permanent and was already melted in February. The temperature at 1 P.M. in February was 54°·9, March and April 77°·5. During the night in February it fell to −11°·2, in April to 19°·4.

The dryness of the air, the violent winds, and the cold nights much retard the growth of herbs and trees. In Amdo, in the valley of the stream Rako Gol, flowing into the Sining, the first herb, the dwarf *Gentiana squarrosa*, opened its flowers at the beginning of April, and the leaves of trees and shrubs began to unfold about the same time. In the highest gorge of the River Yedsin so late as June 1st only ten species of flowering plants were collected; and in elevated exposed places at that date not even traces of vegetation were visible. In the zone of alpine meadows flowers were produced from the end of June to the end of August. On the Nan Schan Mountains the thickets and, by the middle of August, the meadows have an autumnal appearance.

In the desert of Odontala, North-east Tibet, the first flowers opened in the beginning of June, but in a cautious manner, as they scarcely appear above ground; indeed, up to this time they have been covered by their leaves. In the Mur-ussu valley flowering herbs are found in the middle of June, but shrubs are still naked, and only in the beginning of July do they begin to put forth leaves.

Tsaidam, situated 3000–4000 ft. lower, has a much less severe climate; the temperature is warmer, the snow and rain less abundant, the sky usually clear and storms less frequent, but the air is often full of dust as in Mongolia. In the summer clouds of obnoxious insects appear, and to such an extent that the whole region becomes a desert and the inhabitants, with their flocks and herds, go up into the mountains.

Maximowicz, to whom we are indebted for the greater part of the foregoing remarks on the topography and climate of Tibet, refers, as already mentioned, more particularly to the north-eastern part—the part from which we have the least material. For the west we have Strachey and Schlagintweit's observations and data, besides the results obtained by the more recent travellers. We may here quote a few sentences from General Sir R. Strachey (Journ. Linn. Soc., Bot. xxx. (1894) p. 101):—

"The climate of these parts of Tibet is very extreme. The air is very dry, and the sun's power in the rarefied and usually cloudless sky very great. The vegetation is meagre in the last degree; and in the tract that I visited, which, being much nearer to the Himalaya than the region through which Capt. Bower passed, is no doubt better supplied with moisture, I estimated that not one-twentieth part of the surface was covered with vegetation. The comparison of Mr. Thorold's collection of plants with that made by Mr. E. Winterbottom and myself in 1847 will be of considerable interest."

Messrs. Schlagintweit's meteorological observations did not cover more than two or three seasons, and in many districts less; but they afford some idea of the climate of Western Tibet and the adjoining countries. They calculated the annual mean temperature at 16,500 ft. as follows:—

Outer Himalaya, southern slopes	32°	Fahr.
Inner Himalaya, southern slopes	29·5°	,,
Western Tibet, and northern slopes of the Himalaya and Karakorum chains	31°	,,
Kuen Luen, both sides of the crest	20·5°	,,

The mean decrease of temperature for altitude, the result of a great number of observations, was 1° Fahr. for 390 ft. The decrease of temperature in latitude is analogous to that in Central Europe, namely 2° Fahr. for 1° of latitude; but in High Asia, when the isothermal lines are reduced to the level of the sea, there is a decided decrease of temperature from west to east. The conditions of atmospheric moisture are exceedingly irregular over the different parts of High Asia. In Tibet the annual amount of rain varies between two and six inches only, whilst in Sikkim, in the eastern Himalaya, it exceeds 120 inches a year. This is of special importance with regard to the vegetation. The difference in the relative humidity of the atmosphere was found to be much greater in Tibet than previous data might have led us to expect. The dryness was frequently so great that only 1 to 1½ per cent. of relative humidity was obtained

In a comparatively recent summary of the rainfall of the earth, Supan gives the total amount of precipitation in the Pamirs, at Leh, and at Urga. The observations in the Pamirs were made at a Russian military post, near the confluence of the rivers Murghab and Ak Baital, in about 73° 6′ and 38° 8′, at an altitude of a little over 12,000 ft., and extended over one year only. The total for the year was rather less than 1·9 inch.

During the months of August and October there was no precipitation whatever, and during three other months less than a millimetre per month. The relative humidity for the year was 39; the lowest, 19, in August, and the highest, 56, in January. The mean temperature for the year was 30°·02 Fahr. January was the coldest month, with a mean of −12°·8; and July the hottest, with a mean of +62°·2. The extreme highest temperature was +81°·5, and the lowest −47°·2, giving a range of 128°·7 Fahr.

The annual rainfall at Leh, in about 77° 30′ and 34° 25′, at an altitude of 11,278 ft., is given as 81 millimetres, equal 3·1 inches.

Urga is in north-west Mongolia, in about 107° and 48°, and a degree south of Kiachta, at an altitude of 4376 ft. Here the average fall of five years' observations is a trifle over 7·5 inches.

The average annual rainfall of Kashgar (1894–6) was 4·45 inches. This is in about 76° 2′ and 39° 27′, at an altitude of 4000 ft.

Captain M. S. Wellby's 'Through Unknown Tibet,' pp. 429–431, contains some Meteorological Observations, which we reproduce in a condensed form. Wellby and Malcolm's route across Tibet was between 34° and 36° of latitude and then by the north shore of lake Koko Nor, and was accomplished between May and October. During nearly four months they were at an average elevation of 16,000 ft. The distance traversed between Leh, in Ladak, and Tankar on the Chinese frontier was nearly 2000 miles, and it took nearly five months and a half.

The meteorological data are for the months of May to October:

May: Fourteen fine days; five snow or sleet. North winds prevailed till the middle of the month; thenceforward west and south-west. Minimum night temperature 10° Fahr.

June: Twenty-six fine days. Snow on four days. Winds variable throughout. Coldest night 7° Fahr.; warmest 33°. Maximum in sun 110°; in tent 78°.

July: Twenty-one fine days. Snow, sleet, or rain on ten days. Prevailing wind north-west. Coldest night (10th) 6° Fahr. Warmest night 1° of frost. Average night minimum 21° Fahr.

August: Eleven fine days and eighteen on which rain or snow fell. Winds variable. Several severe storms. Coldest night 18° Fahr.; warmest 40°; average night 34°.

September: Twenty fine days and ten cloudy with snow or rain. Prevailing wind west. Coldest night 7° Fahr.;

warmest 35°. Average frost at night 12°. Temperature at 7 P.M. on the 27th reached 64° Fahr.

October: Bayan Gol, camp 127, to Tankar, camp 141; about 97° 45′ and 36°. From here the course was north-east and around the north coast of Koko Nor. Twenty-seven fine days; two cloudy; two with snow. Coldest night 5° Fahr.; warmest 30°; average night 22°. Cultivation is practised in long. 101°.

Mr. Rockhill, whose route in 1892 was between 90° and 102° and 29° and 37°, compiled a table of mean monthly temperatures reproduced below. The Tibetan part of the journey was made during the months of February to September, and the general direction was southward. See "Itineraries," p. 148.

Mean corrected Monthly Temperatures from January to October, 1892. Fahrenheit.

	7 A.M.	2 P.M.	7 P.M.	Mean.
January	1·2°	30·4°	17·7°	6·4°
February	17·5	39·0	27·0	27·8
March	18·9	39·0	26·3	28·1
April	28·1	52·4	32·5	37·1
May	40·9	61·5	44·3	48·9
June	35·7	56·2	38·3	43·4
July	42·6	54·6	44·2	47·1
August	41·7	63·8	49·5	51·6
September	50·7	64·0	50·8	51·1
October	47·3	48·0	47·5	47·7

Some further information on climatology will be found in the extracts from the narratives of the various travellers whose itineraries are sketched below. These, we may add, are limited to the travellers whose botanical collections have been investigated by ourselves, or whose observations we have repeated.

I cannot conclude this introductory part without a few words respecting the authorship and the assistance received from various persons. Although Mr. Pearson is not responsible for any part of the paper in its present form, except for the approximate correctness of many of the statistics, and for the translation of Maximowicz's data relating to vegetation and climate, he is really joint author of the enumeration of the plants. I am also greatly indebted to him for collecting data embodied in various other parts of this paper. Thanks are due to Miss Hemsley and Mr. S. A. Skan for help in transcribing, in constructing the lists and tables, and in checking the figures and calculations. I also thank the Trustees of the Bentham Fund for reimbursing me with the sum expended on clerical assistance.

ITINERARIES.

Captain (Lieut.-General Sir) RICHARD STRACHEY and Mr. JAMES EDWARD WINTERBOTTOM. 80°—81° 40′; 30° 30′—31° 5′. 1848.

Left Almora August 8, 1848, travelling by way of Milam (80° 8′ and 30° 25′), which is at an altitude of 11,400 ft. Thence their route lay through Shelong, Unta Dhura, Jainti Dhura (18,600 ft.), Topidhunga, Kyungar, and Laptel to the Balch Dhura Pass, 17,490 ft. From Balch Dhura they proceeded in a north-easterly direction, through Tisum, as far as the Sutlej river (80° 24′ and 31° 4′), and then in a south-easterly direction across the plain of Gugé by way of Gam, Ligchephu, Nima Khar, and Jungbwa Tol to Lagan Tunkang, the south-eastern extremity of lake Rakas Tal, in about 81° 17′ and 30° 36′. Thence northward, between the lakes, to Ju Kiuo (81° 21′ and 30′ 46′), the north-west point of lake Manasarowar, where the lakes are connected by a narrow channel. The altitude of these lakes, which are the source of the Sutlej, is 15,000 feet. The return journey was by the same route as far as the south-western angle of lake Rakas Tal; thence southward to the valley of the Karnali river, and north-westward to Sing Lapcha, Lama Chorten, Tazang, and south-westward to Chirchun (80° 14′ and 30° 40′) across the Jainti Dhura and southward to Milam, where they arrived September 26, 1848.

General Strachey's Narrative contains so much of interest to the botanist, that we extract freely and somewhat copiously from it; partly in his own words, partly very much condensed, and partly isolated facts. A few of the names of plants employed by him may designate species which we have under different names, though we have endeavoured to secure uniformity.

As an introduction to the flora of the drier region of Tibet Proper we reproduce his list of plants collected in the neighbourhood of Milam :—

Plants found at and near Milam at 11,000 to 13,000 ft.

Clematis orientalis.
Thalictrum platycarpum.
Ranunculus sp.
Aconitum Napellus.
„ heterophyllum.
Berberis vulgaris.
Draba lasiophylla.
Sisymbrium himalaicum.
Brassica campestris.
Lepidium capitatum.
Silene inflata.
Stellaria decumbens.
Arenaria serpyllifolia.
„ holosteoides.
Impatiens Thomsoni.
Thermopsis barbata.
Caragana crassicaulis.
Guldenstædtia himalaica.
Astragalus himalayensis.
„ multiceps.
Cicer songaricum.
Potentilla fruticosa.
„ ambigua.
„ bifurca.
Rosa Webbiana.
„ sericea.
Pyrus Aucuparia.
Cotoneaster microphylla.
Saxifraga flagellaris.
„ Stracheyi.
Ribes Grossularia.
„ glaciale.
Sedum asiaticum.
„ trullipetalum.
„ Ewersii.
Epilobium latifolium.
„ roseum.
„ origanifolium.
Pituranthos nudus.
Seseli trilobum.
Pleurospermum Candollei.
„ stellatum.
Heracleum Brunonis.
Lonicera glauca.
„ obovata.
„ alpigena.
Galium triflorum.
Nardostachys Jatamansi.
Erigeron alpinus.
Anaphalis Royleana.
Allardia tomentosa.
Tanacetum tibeticum.
Artemisia scoparia.
„ biennis.
„ sacrorum.
Cousinia Thomsoni.
Crepis glauca.
Lactuca rapunculoides.
Campanula cashmiriana.
„ aristata.
Androsace Chamæjasme.
Gentiana cachemerica.
Pleurogyne carinthiaca.
Polemonium cæruleum.
Eritrichium strictum.
Verbascum Thapsus.
Scrophularia lucida.
Veronica ciliata.
„ biloba.
Pedicularis megalantha.
„ tubiflora.
Orobanche Epithymum.
Elsholtzia eriostachya.
Origanum vulgare.
Nepeta spicata.
„ discolor.
Scutellaria prostrata.
Axyris amaranthoides.
Polygonum islandicum.
„ aviculare.
„ tubulosum.
„ glaciale.
„ polystachyum.
Rheum Webbianum.

Hippophaë rhamnoides.
Parietaria debilis.
Ephedra vulgaris.
Juniperus communis.
,, Pseudo-Sabina.
,, macropoda.
Allium Victorialis.
Potamogeton pectinatus.
Scirpus setaceus.
Scirpus Caricis.
Hierochloa laxa.
Deyeuxia scabrescens.
Avena ænea.
Danthonia cachemyriana.
Bromus tectorum.
Agropyron longearistatum.
,, semicostatum.
Elymus sibiricus.

As the distance from Milam was increased, the vegetation became more and more scanty and the last bushes worthy of the name (*Juniperus communis*) were passed a few miles south of Shelong, 12,800 ft. The height of the Pass of Unta Dhura is 17,530 ft.; and vegetation reappeared on the north face, after a descent of about 500 ft., with *Cheiranthus himalayensis*, *Elsholtzia eriostachya*, and dense, cushion-like masses of *Thylacospermum rupifragum*, a foot or more in diameter. The vegetation of the ascent to the Pass of Kyungar (17,500 ft.) was very sparse, but a few plants were noticed almost to the very top, namely, *Eritrichium spathulatum*, *Microula Benthami*, *Urtica hyperborea*, *Taraxacum officinale*, *Ranunculus hyperboreus*, *Arabis alpina*, and *Thalictrum minus*. The only fern of these regions is *Cystopteris fragilis*. The Balch ridge rises to upwards of 18,000 ft.; but this range hardly comes within the limits of perpetual snow, and phænogamous vegetation exists to the very summit, within a few feet of which *Allardia tomentosa* was growing freely. Here also were found two species of *Saussurea* (so numerous at high elevations), namely, *S. Hookeri* and *S. bracteata*, and *Nepeta bracteata* and *Arenaria musciformis*. On the descent from the Balch Dhura Pass, which we take as the entry into Tibet Proper, at about 17,000 ft., vegetation reappeared somewhat freely; and by the side of a small stream, which to the north of the Indian watershed is essential to any approach to vigorous vegetation, several new plants were found, among them: *Gentiana nubigena*, *Draba lasiophylla*, *Pedicularis versicolor*, *P. rhinanthoides*, *P. cheilanthifolia*, and some grasses and sedges, including *Trisetum subspicatum*, *Deschampsia cæspitosa*, and *Carex ustulata*. At Tisum (14,690 ft.) *Stracheya tibetica* was discovered, and among other new plants were the following:—*Alyssum canescens*, *Stellaria graminea*, *Potentilla Anserina*, *Saussurea glanduligera*, *Crepis glomerata*, *Parnassia ovata*, *Scopolia prœalta*, *Salsola Kali*, and a few grasses, such as *Stipa purpurea*, *S. orientalis*, *S. sibirica*, *Festuca valesiaca*, *F. nitidula*, *F. sibirica*, and *Elymus sibiricus*. In the valley which they descended, *Triglochin palustre* was met with, and this was afterwards found at an elevation of 15,000 ft. associated with *T. maritimum*, *Crambe cordifolia*, *Glaux maritima*, and *Eurotia ceratoides*. At the head of a ravine near the Sutlej (14,820 ft.) they found *Chamærhodos sabulosa*, *Aster molliusculus*, *Deyeuxia compacta*, *Stipa Eversii*, *E. mongholica*, *Oryzopsis æquiglumis*, and *Lasiogrostis mongholica*. Lower down (13,350 ft.) the largest shrub was *Myricaria elegans*, here growing to a height of five or six feet with stems often three or four inches in diameter. The dama (*Caragana pygmæa*) was usually luxuriant, rising to three feet or more. *Clematis graveolens*, *Crepis glauca*, *Tanacetum gracile*, *Artemisia salsoloides*, *A. sacrorum*, *A. Roxburghiana*, and *Christolea crassifolia* were also collected here. On the banks of a stream near Ligchephu *Hippophaë Rhamnoides* occurred full of berry. At Gyanima (Nima Khar), near a small lake at a lower elevation, the soil was covered with green turf, intersected by numerous small streams; and *Ranunculus aquaticus*, *R. Cymbalariæ*, *Hippuris vulgaris*, two species of *Gentiana*, and *Primula tibetica*, not exceeding an inch in height, were found in abundance. In the ravines near the lake of Rakas Tal (15,000 ft. and upwards) a small willow, *Salix sclerophylla*, was not uncommon, and *Rheum Moorcroftianum*, *Gentiana nubigena*, *Lagotis glauca*, *Arenaria Stracheyi*, and *Pleurospermum* were collected or observed. The vegetation along the southern shore of Rakas Tal and between the lakes was excessively meagre, and no novelties were added to the collection. *Caragana pygmæa*, *Potentilla sericea*, *Thylacospermum rupifragum*, *Silene Moorcroftiana*, *Dracocephalum heterophyllum*, *Nepeta tibetica*, *N. supina*, *Oxytropis Stracheyana*, *Aster molliusculus*, *Senecio coronopifolius*, *Artemisia Stracheyi*, *Tanacetum* sp., *Lactuca Lessertiana*, *Androsace villosa*, *Sedum fastigiatum*, *Draba lasiophylla*, *Delphinium cæruleum*, and *Allium Jacquemontii*, together with a few grasses and sedges, would nearly complete the flora of this desert region. In the valley of the Karnali river there was a comparatively luxuriant vegetation. Descending from Gunda Yaukti, *Biebersteinia Emodi*, *Euphorbia tibetica*, *Scirpus Caricis*, and *Agropyron longearistatum* were added to the collection. Between Chirchun and Shelong, *Urtica hyperborea* was found, probably above 17,500 ft.

The foregoing extracts and excerpts embody all the important botanical data, to which we may add a short note by General Strachey on the general character of the vegetation, written in connection with our account of Captain Bower and Dr. Thorold's collection :—

"The time during which we were there was little more than a month, and the area we traversed was comparatively limited; but I think the collections were fairly complete. We were, however, rather late in the year, and we may have lost some of the earlier flowering plants. The total number of flowering-plants collected in Tibet consisted of forty-one natural orders, of which thirty-three were exogenous and eight endogenous; the exogenous genera being ninety-six with 173 species, and the endogenous genera twenty-four with forty-five species, of which thirty were grasses and sedges. A single fern (*Cystopteris fragilis*) was found and three or four mosses. The lichens were obtained exclusively, I think, from rocks. The country in which our collections were made is between the eightieth and eighty-second meridians, extending from Niti to Manasarowar Lake." Niti here should probably be Balch; and the statistics of the flora are probably higher than they would be within our limits; but it is difficult to obtain an exact verification of all the details.

The following characteristic plants not in our Enumeration were found by Strachey and Winterbottom between Milam and Balch Dhura, or at least eastward of the eightieth meridian:—*Arenaria glanduligera*, Edgw., *Geranium pratense*, L., *Viola kunawarensis*, Royle, *Lychnis brachypetala*, Hort. Berol., *Epilobium palustre*, L., *Lonicera glauca*, Hook. f. & Thoms., *Artemisia biennis*, Willd., *Lindelofia Benthami*, Hook. f., *Pedicularis versicolor*, Wahlenb., *Euphorbia Stracheyi*, Boiss., *Carex Lehmani*, Drejer, and *Poa bulbosa*, L. Had we included the foregoing plants in our Tibet list, it would have added two natural orders, namely Violaceæ and Onagraceæ, not otherwise represented; but as they do not occur in any of the other collections, we have, for reasons given elsewhere, left them out.

Dr. THOMAS THOMSON. *Little Tibet* or *Baltistan*. 1847–48.

Although Thomson did not extend his travels into Tibet Proper, he explored the western extension of the same botanical region and the adjacent countries in which there is a transition to the rich flora of the humid Himalayas, and his work, 'Western Himalaya and Tibet,' has neither been superseded nor greatly supplemented from a botanical standpoint. It abounds in geological and botanical information, which is repeated in a more digested form in the Introduction to the 'Flora Indica.'

Starting from Simla on the second of August, 1847, the Mission to which Thomson was attached travelled up the valley of the Sutlej river to its junction with the Piti, across the State of Piti, over the Parang Pass and north-eastward to the Indus, the course of which was followed, with a detour in Zanskar, to Leh. Thence northward to Nubra and down the Shayuk river to its junction with the Indus and onward to Iskardo. On the second of December they left Iskardo in the direction of Kashmir, by way of the Indus and Sind to Dras, where they were stopped by the snow. They returned to Iskardo, where they wintered. In February, 1848, an excursion was made down the Indus to Rondu, the most north-westerly point reached—about 75° and 35° 25′. They again returned to Iskardo, and then went southward to Kashmir and Janu, on a tributary of the Chenab river and again north-eastward, across the Upper Chenab valley and Zanskar, to Kalatze, on the Indus, and then on to Leh. Thence by way of Nubra, to Karakorum Pass, in about 77° 40′ and 35° 35′. The return journey was by way of Leh, Kalatze, Kargil, Zoji Pass, and Kashmir to Lahore. Taking Thomson's map, the country traversed in various directions would be between 75° and 78° and 31° and 35° 35′.

Dr. (Sir Joseph) D. Hooker. 88° 45′; 28°. 1849.

Entered Tibet, in October, 1849, from the northern boundary of Independent Sikkim, in about 88° 45′ and 28°. He twice ascended Mount Bhomtso (18,500 ft.) not far from the frontier, where, however, the climate, and consequently the flora, is that of dry Tibet. The botanical results were poor, the number of species gathered in two days' journey amounting to only fifteen or twenty. They are almost identical with those from equal elevations (16,000 to 18,000 ft.) in West Tibet. "A stunted *Lonicera* and *Urtica* being the prevalent species at 16,000 ft., with creeping *Carices* in the sand, and tufted plants of Alsineæ, *Draba*, *Androsace*, *Oxytropis chiliophylla*, *Sedum*, *Saxifraga*, and grasses and sedges, most of which ascend to 18,000 ft. The curious genus *Thylacospermum* forms hard, hemispherical mounds on the stony soil, and is one of the most conspicuous features of the flora. The ground was everywhere there covered with an efflorescence of carbonate of soda, and the pools of water were full of *Ranunculus aquatilis* and *Zannichellia palustris*, also typical of similar situations in West Tibet."

In the Introduction to Hooker and Thomson's 'Flora Indica,' from which the preceding paragraph was extracted, "Western Tibet," including Little Tibet and Baltistan, is divided into eight Provinces, namely :—

1. Gugé, the Tibetan course of the Sutlej.
2. Piti and Parang, the basins of the rivers of those names, tributaries of the Sutlej.
3. Zanskar, the basin of the Zanskar river.
4. Dras, the basin of the Dras river.
5. Nari, the upper course of the Indus.
6. Ladak, the middle Tibetan course of the Indus.
7. Balti, the lower Tibetan course of the Indus.
8. Nubra, the upper basins of the Nubra and Shayuk rivers, tributaries of the Indus.

These Provinces comprise the country botanized by Thomson, Strachey and Winterbottom, and others; but only Gugé and Nari come within our limits.

Respecting the boundary between India and Tibet, in relation to botanical regions, the authors express the opinion that it should begin where the dry region begins, and this is practically the boundary adopted in this paper.

The Brothers SCHLAGINTWEIT. 80°—81°; 30°—31° 30′. 1854–58.

Having made use of many of their data, it may be worth while to indicate briefly their route in the North-west Himalaya and Tibet. They traversed the country in many directions between 70° and 80° and between 80° and 37°—that is to say, the valleys of the middle Sutlej and Indus and the upper Ravie, Chenab, and Jelam rivers. They crossed into Tibet by the Milam route, and reached as far north as Gartok; and they crossed the Karakorum and Kuen Luen chains in two places. Bushia, in the direction of Khotan, was their furthest to the north-east; but they reached Yarkand and Kashgar in the north-west. From the south they crossed the Pass of Skardo and made the southern ascent of the Karakorum range.

Captain H. BOWER and Surgeon-Captain W. G. THOROLD. 80°—102°; 29° 30′—34° 30′. 1891–92.

Left Leh on June 14th, 1891, and entered Tibet by the Lanak

La (30° 25′), travelling in an easterly direction to the Mangtza Cho at an elevation of 16,540 ft., over a Pass 18,400 ft. high. Descending to 17,930 ft. they came upon a large lake, the Horpa Cho, the highest they encountered throughout their journey and "probably the highest in the world." This is in about 81°. The next lake they struck was Aru Cho, and then taking a south-easterly direction to camp forty-six, on the banks of Lake Chargat Cho in about 88° and 31°. This is a region of lakes, and in spite of opposition the travellers pressed on in the same direction as far as Gaga Linchin beyond Garing Cho, 88° 25′ and 31° 30′, altitude 15,560 ft., and their nearest point to Lhasa. On October 4th they began to retrace their steps by way of Chargat Cho, where they turned northward, and on the 18th they had to climb a Pass 18,768 ft. high. The cold was intense, although the thermometer only went down to 15° below zero Fahr. They continued northward nearly to the thirty-third parallel, and then proceeded in a south-easterly direction. On November the 14th they camped for the first time during five months below 15,000 ft. Their route lay through Chiamdo, about 96° 40′ and 31° 10′; Batang, Litang, to Tachienlu, Szechuen, in China Proper—about 102° and 30°. Thence to Yatu, and by the Min and Yangtze rivers to Shanghai. Thus they traversed Tibet from west to east and finished by crossing China. There is scarcely any reference to the vegetation in Captain Bower's narrative, except the absence of pasture; but the following extract contains some interesting facts:—

"The whole of central and northern Tibet and almost the whole of Western Tibet is known as the Chang. It consists of a high tableland with hills, mostly of a rounded character; but here and there sharply defined snowy ranges are met with. The mountains have a general east and west tendency, but no defined watershed exists; rivers may be met flowing in almost any direction and all terminate in large salt lakes. These lakes appear to have been at one time much bigger than they now are, as unmistakable signs that they are drying up are to be seen. An idea of the physical configuration of the country may be gathered from the fact that for five months we never once camped at a lower altitude than the summit of Mont Blanc; and all the enormous stretch of country we covered in that time contained not a single tree. The greater part of this Chang is, of course, uninhabitable for the greater part of the year, and most of the places that would afford grazing in summer are too far distant from suitable winter quarters to be availed of by the nomads.

"In South-eastern Tibet the country is of quite a different character; deeply-cut valleys, steep, well-wooded hills and rivers that eventually find their way to the sea being the characteristics. The population is a settled one, living in houses and growing crops."

Captain Bower's Official Report, which was of a confidential character and not on sale, contains a preliminary list of the plants with comments, both by Dr. Thorold and W. B. Hemsley, and also a brief account of the Zoology by the former. Through the courtesy of the Secretary of State for India we have been permitted the use of a copy for the purpose of extracting the scientific results. As this report is not a public one it seems desirable to extract in full the paragraphs relating to the collections. In the first place we reproduce Dr. Thorold's note on the botanical collection :—

"I am indebted to Mr. W. Botting Hemsley, F.R.S., of the Royal Botanical Gardens, Kew, for the determination of the species. The collection includes, as far as I am aware, every flowering plant seen by me in Tibet, with the exception of the wild rhubarb and the burtza [*Tanacetum tibeticum*], the roots of which latter plant are used in high altitudes of Eastern Ladak for fuel by shepherds and sportsmen. Both these plants are very bulky, and are found in Ladak, and were therefore not collected. I could get no information as to the use of any of the plants as medicines. The leaf of the wild rhubarb is dried and mixed with tobacco for smoking; the smoke is mild and fragrant, and though not resembling tobacco in taste, is pleasant. Owing to the extremely rigorous climate the season of flowers in the high central plateau of Tibet is short.

"When we crossed the frontier of Tibet on July 3rd, 1891, the flowers were in bud; the eggs of the birds were in their nests on the ground, and summer was commencing. No flowers were seen after September 8th, and by that date the grass was in seed, and the autumn well begun.

"The plants were, therefore, collected within a comparatively short period. South-eastern Tibet, which was traversed between the beginning of December and the beginning of February, is a well-wooded country, rich in flora; but the high central plateau of Tibet has not a plant bigger than the burtza, growing four to six inches above the ground; and in this region the only plants that can be used for fuel are the burtza and the *Myricaria germanica* var. *prostrata*, the roots and stems of which are both woody. For long intervals, however, neither of these plants was found.

"It is interesting to note the frequent comparatively large underground fleshy stems and roots, showing the provision made by nature to store up nutriment for the plant below the surface of the soil, in a climate where the temperature even in midsummer falls at night to a few degrees above or below freezing. The nutritive value of the grass must be very great, from the beginning of July to the end of October, as the herds and flocks of the nomads testify. The plants requiring special names in the catalogue will be named hereafter."

W. B. Hemsley's preliminary summary of the botanical collection is perhaps worth inserting here :—

"The botanical collection submitted by Dr. Thorold to Kew for determination consists entirely of flowering plants, and comprises about 115 species, of which twenty probably are undescribed, or at least unrepresented, in the Kew Herbarium. But until they are critically worked out the number of novelties must remain uncertain, and there was no time to do this previous to Dr. Thorold's return to India. Apart from the number of novelties, however, this is a highly interesting collection, representing as nearly as possible, as Dr. Thorold assures us, the complete Phanerogamic Flora of the region explored, at altitudes of 15,000 to 19,000 ft. and chiefly above 17,000 ft. As may be seen from the accompanying rough list, many of the species are the same as those first discovered some forty years ago by Dr. Thomson in a somewhat higher latitude and ten to fifteen degrees farther west. Most of these are only now collected for the second time.

"The plants are nearly all characteristic of a very dry climate, consisting largely of exceedingly dwarf herbaceous perennials with large root-stocks, evidently often of considerable age. *Ephedra vulgaris* [correctly *E. Gerardiana*], from an elevation of 16,500 ft., is the only truly shrubby plant, and this, judging from the specimens, does not exceed six inches in height, even if it attain so much. Quite a large proportion of the species do not rise more than one to three inches above the surface of the soil, and some of them not more than half an inch. No fewer than twenty-eight Natural Orders are represented in this small collection, yet the great bulk of the species belong to about half-a-dozen Orders. Thus, the Compositæ contribute twenty-two species, the Gramineæ thirteen, the Leguminosæ twelve, the Cruciferæ eleven, and the Ranunculaceæ eight. Among the plants collected at altitudes of 18,000 ft. and upwards are :—*Capsella Thomsoni*, *Thermopsis inflata*, *Saussurea tridactyla*, *Tretocarya pratensis*, *Microula Benthami*, and *Poa alpina*. The *Saussurea* is recorded from 19,000 ft., perhaps the greatest elevation at which any flowering plant was ever collected.

"Many other points of interest suggest themselves, but it would be premature to attempt to indicate them before the collection has been more thoroughly worked out."

It may be added that no important modification of the foregoing summary results from the more critical determination of all the species, except that *Tretocarya pratensis* and *Microula Benthami* are synonymous, and the same as *M. tibetica*. Dr. Thorold's valuable notes accompanying the specimens collected by him are incorporated in the general account of the Vegetation, which follows the Enumeration.

Dr. Thorold, so far as we are aware, was the only one of our travellers who collected specimens and data of the Zoology of Tibet. The following is a list of the Butterflies, collected or observed, extracted from the Official Report, in Bower's 'Diary of a Journey across Tibet' (Calcutta, 1893), p. 115 :—

"*Name.*	*Date.*	*Alt.*	*Lat.*	*Long.*
Oeneis pumilus, Feld.	Aug. 9, 1891.	16,000	33° 25′	84° 25′
Vanessa ladakensis, Moore...	Sept. 10, ,,	15,500	31° 29′	89° 10′
Synchloë Butleri, Moore......	June 28, ,,	17,000	Ladak	
Pieris chloridice, Hübn.......	June 30, ,,	16,500	,,	
Parnassius acco, Gray.........	July 10, ,,	17,600	34° 25′	80° 35′
,, *Jacquemontii*, Boisd.	July 9, ,,	,,	34° 32′	80° 25′
Colias Fieldii, Mén.	Feb. 15, 1892.	8,500		

"The above collection includes every butterfly seen by me in Tibet, as far as I am aware. The originals have been sent to the Curator, Indian Museum, Calcutta.

"All these species are also found at high altitudes on the north-west frontiers of Tibet and China, with the exception of *Pieris chloridice*, which ranges from Europe to the North-west Himalayas, and *Parnassius acco*, which so far has only been met with on the Karakorum range and the frontier of Ladak and Tibet. As, with the exceptions just noted, they are found at both the east and west frontiers of Tibet, it is justifiable to infer that these species inhabit the whole of the Tibetan central plateau."

The following interesting observations on the Fauna of Tibet are from the same source, pp. 115–116:—"The high central plateau of Tibet is densely stocked with animal life. Yak, *Poëphagus grunniens*; Tibetan antelope, *Kemas Hodgsonii*; Tibetan ravine deer, *Procapra picticaudata*; Kiang or the wild horse, *Equus hemionus*; Burhel, *Ovis Nahura*; *Ovis Hodgsonii*; wild dog, *Canis Chanco*; and grey wolf, *Canis laniger*, were the larger well-known animals met with in suitable ground; often in immense numbers. Herds of 40 to 80 yak—bulls, cows, and calves together—were seen grazing in sheltered valleys or on the hill-sides. As many as 300 kiang, 700 or 800 antelope, and 80 or 100 ravine deer were sometimes viewed on the same day.

"The animal food-supply on the high central plateau is practically inexhaustible, considering the few months in the year this plateau is inhabitable. Hares, Tibetan sand-grouse, *Syrrhaptes tibetanus*, and 'ram chickore,' *Tetraogallus himalayensis*, are resident and occur in great numbers.

"Wild goslings of bar-headed geese, *Anser indicus*, were found in pools at altitudes of about 17,000 ft.; but this appears to be the only game-bird that breeds on the high central plateau. In the autumn immense flocks of 'coolen,' duck, geese, and teal were seen winging their flight India-wards from the north. A single full snipe was very rarely flushed from a marsh. The other animals on the high central plateau were foxes of many kinds, marmots, *Arctomys Bolac*, and a large-eared field-mouse. The only fox identified was *Vulpes ferilatus*, Hodgson. The footmarks of bears were seen, but none of other carnivora except those mentioned above. The small running streams on the southern border of the high central plateau, if rising from springs not liable to freezing, were well stocked with fish; small, but excellent eating. Locusts and butterflies were found on the high central plateau. In South-eastern Tibet, immediately before entering the wooded country, we met with an extremely rare bear (undetermined). The Tibetan wapati, *Cervus eustephanus*, the musk-deer, *Moschus moschiferus*, and the napi *Elaphodus cephalophus*, were the animals met with in the forests and identified. Musk-pods and stag-horns for medicine are largely exported to China from districts not in close proximity to monasteries. It is not yet finally decided whether the stag above mentioned is the *Cervus eustephanus* or not, the question being still under the consideration of experts. The game-birds found in the region and identified were *Crossoptilon tibetanum*, *Iphagınıs Geoffroyii*, *Phasianus decollatus*, *Tetraophasis Schzenii*, *Bonasia Sevatzovi*, and *Perdrix sifanica*. *Crossoptilon tibetanum* is 'Hodgson's eared pheasant,' a magnificent white bird, the habitat of which for many years, and until quite recently, was unknown, the only skin in existence until recently having been procured by a Nepalese, who brought it from Pekin with the story that it had been brought thither as part of a tribute. Near the monasteries the killing of animals is forbidden, and the neighbouring country is a magnificent game-preserve stocked with pheasants and deer. In South-east Tibet, in the large rivers, fish were numerous and large. Honey-bees were seen in this district, and honey was procurable."

We have much pleasure in mentioning here that Captain Bower was awarded the Founders' Medal of the Royal Geographical Society in 1894.

The Hon. W. Woodville Rockhill. 90°—102°; 29°—37°. 1892.

Left Peking on the first of December 1891 and travelled westward through Kalgan, Tumed, and Hangkin to Orat (107° 41′), and then southward and westward to Nifoushan (105° 40′. 37° 40′), Yingspanhui, Lanshoufu and Hsining (101° 15′. 36° 45′), arriving there on the tenth of February, 1892. Kumbum and Lusar were visited and a short excursion was made into the Salar country; then a westerly course was taken, south of lake Koko Nor, to Shangchia (97° 40′. 36°), arriving there on the fourth of April. Thence through Tsaidam, as far as Naichi Gol (94° 35′. 36° 25′), continuing southward across the Kokotom Pass, the Kokoshili range, the Ulanula and Dangle mountains, the sources of the Toktomai river, and the valley and basin of the Murus, reaching Namru Tso (90°. 32°) the eighth of July. This was the nearest approach to lake Tengri Nor, about twenty miles to the south, permitted by the local authorities. The rest of the journey in Tibet was eastward and southward to Shamdun (99°. 29°), Sept. 1st; then northward to Batang, and eastward to Litang and Tachienlu and across China to Shanghai.

Mr. Rockhill presented to Kew through Professor C. S. Sargent, Director of the Arnold Arboretum, Harvard University, the botanical collection he made on this journey; and we may repeat here his note on it, which appeared in the Society's Journal

(Bot. xxx. 1894, p. 131), accompanying our detailed enumeration of the species:—

"The object I had in view when making the little collection of plants, which, through Professor C. S. Sargent's kindness, has been examined and classified by Mr. Hemsley, of the Royal Gardens, at Kew, was to give some idea of the flora of the country between the Kuen Luen range to the north and the inhabited regions of Tibet adjacent to the Tengri Nor on the south. This region has an average altitude of 15,000 ft. above sea-level along the route followed by me in 1892, and had not, prior to my visit, been explored.

"The route followed in 1879 by Przewalski when travelling towards Lhasa, which was nearly parallel to the last that I took, differed considerably as regards the configuration of the country from mine; and consequently I anticipated that notable differences in the flora along the two roads would be discovered.

"I traversed this country in the months of May, June, July, and part of August, and heavy snowstorms and nearly daily frosts occurred during this period, though the thermometer rose more than once to 70° F., and even to 83° on one occasion in the shade at 2 P.M. The mean temperature from the 17th of May, when we entered the mountainous region to the south of the Tsaidam, to the 11th of August, when we descended to below the Timber line (13,500 ft. above sea-level) on the Ramachú, where I ceased collecting plants, except such as the natives pointed out to me as being used by them either as food or medicinally, is shown in the following table:—

1892.	7 A.M.	2 P.M.	7 P.M.
May 17 to 31	37°·5 F.	54°·6 F.	37°·3 F.
June	35·7	55·9	38·3
July	43·0	54·6	44·2
Aug. 1 to 11	40·6	61·5	47·3

"Nearly the whole of the region traversed in this interval was of sandstone formation, the predominating colour of which was bright red. The water was invariably brackish, and in many cases undrinkable; the soil everywhere sandy, or covered with a rather fine gravel, and occasionally a little clay. The grasses grew in bunches, nowhere forming a sod, except around the rare pools of pure water fed by the melting snows we occasionally passed.

"I was careful to collect all the flowering plants I saw along my route, and the barrenness of this region may be judged by the very small number I have brought home with me.

"The only edible plant we found in this country was a species of onion (*Allium senescens*) *, which grew in the sand in great quantities at altitudes higher than 15,000 ft. above the sea-level, though we looked for it in vain below this level.

"I may here remark that the rhubarb-plant, which I found growing in enormous quantities on the north and north-eastern slopes of mountains on the Ich'u, Lench'u, and other feeders of the Jyama-nu ch'u, thrived at an altitude above sea-level, ranging from 12,000 to 13,500 ft. I note this fact, as Col. Przewalski (Mongolia, ii. p. 84) says that this plant rarely flourishes at an elevation of more than 10,000 ft. above the level of the sea."

Including the rhubarb and onion referred to in the above note, of which no specimens reached Kew, the flowering plants observed by Mr. Rockhill numbered fifty species. Each specimen was carefully labelled, giving locality, altitude, latitude and longitude, date, relative frequency, and other particulars. Only two species were not recognized as belonging to previously described species, namely *Gentiana Rockhillii*, Hemsl., and *Kobresia Sargentiana*, Hemsl.

The references to vegetation in Mr. Rockhill's narrative are few, yet on that account of great interest, because so much of the country traversed had no vegetation worthy of the name. But a few special allusions to plants are worth extracting. At p. 192 (May 28th, 93° 35'. 35° 30', 13,788 ft.) it runs: "The Sharakingi Gol (*i. e.* river of the yellow thigh-bone) is a clear mountain rivulet tumbling down over granite boulders from the snow-covered pass. The road up the latter looks very easy. The grass around our camp is just beginning to turn green, and the ground is covered with yellow and violet tulips and a little edelweiss."

The "tulips" were *Gagea pauciflora*, which appeared in our original list as *Tulipa* (§ *Orithya*) sp. aff. *T. eduli*, Baker; but it was again examined, and our colleague, Mr. C. H. Wright, succeeded in identifying it. Rockhill mentions the iris and tulip again on June 17, in about 92° and 35°. By June 25th (90°. 33° 40') grass was showing green, and *Lagotis*, *Carex*, *Kobresia*, and *Festuca* were picked in flower. Under date of Aug. 2nd (93° 15'. 31° 50')

* There was no specimen of this plant in Mr. Rockhill's collection.—W. B. H.

we find the note: "The ground on which we have camped is one big bed of fragrant, light blue flowers (*Microula sikkimensis*), and the grass is so long that it makes a soft bed for us." The change in climate and flora is already perceptible in this longitude.

Mr. Rockhill's mean temperatures are reproduced in our chapter on climate. It may be worth while pointing out that in his Table of Latitudes and Altitudes ('Journey through Mongolia and Tibet,' pp. 386–395), he makes some interesting comparisons with the altitudes and geographical names obtained by other travellers.

From August 11th, approximately in 94° and 32°, Rockhill followed Bower and Thorold's eastward route, and the differences in altitudes and geographical names, as given by the former, are considerable.

Mr. and Mrs. St. GEORGE R. LITTLEDALE. 80°—90° 25′; 30°—37°. 1895.

Travelled overland by Constantinople, Tiflis, and Samarkand, across the Tian Shan through the Terek Pass (12,700 ft.) in midwinter, onward to Kashgar. Thence to Yarkand, which they left on Feb. 4th, 1895, for Khotan, Keria, and Cherchen (85° 35′ and 38° 10′), where they arrived on March 19th; and it was not till May 15th that they actually crossed the Arka Tag into Tibet. Their route thence was south-east by east toward Lhasa, which was really the goal of their journey. The pass, though not steep, was high and long and cost them the lives of five or six donkeys and a couple of horses. They were now on the Tibetan Plateau, with lakes and low mountains to the south, as far as could be seen, and to the north the high range of the Arka Tag, with fine glaciers and snowfields. Two peaks, towering above their neighbours, were measured, and estimated to be 25,340 ft. high. Volcanic country was next traversed, where vegetation and fresh water were both scarce. One night all their sheep were killed by wolves; and, owing to the great altitude and scarcity of food, their baggage animals died at an appalling rate and they had to walk. On June 26th (88° 12′ and 33° 12′) they had the first rain since leaving the Black Sea in November, and saw the first men since leaving Cherchen in April. Continued mortality of their animals compelled them to abandon the greater portion of their stores. They passed along the east side of the lake, called by Captain Bower Garing Cho (about 89° 30′ and 31° 40′), into which a river drains which they were unable to ford, and therefore had to construct rafts as best they could. The grazing in this district is described as being of the most luxuriant description; but apparently no botanizing was attempted here. Soon the Tengri Nor or Nam Tso—Great Sky Lake—appeared in view, stretching far away to the east; while the horizon to the south was fringed by the magnificent Ninchen Tangla range, with the towering peak of Charemaru, upwards of 24,000 ft. high. They crossed the Ninchen Tangla over the Goring La at 19,587 ft. and in 30° 12′, and then descended into the Goring Tangu valley, at about 16,600 ft. Here they were less than fifty miles from Lhasa; and it was here that a small botanical collection was made during the delay consequent on their attempts to continue their journey to that city. At length they had to yield, and on August 29th they started on their long march of 1200 miles to Kashmir, passing northward to the Garing Tso or Zilling Tso, and then westward near the thirty-second parallel. Nearly all the lakes of this country have greatly decreased in size, and the process was still going on; a difference in level of as much as 200 ft. being observed in some places. On September 22nd they sighted some volcanic mountains 4000 ft. above their camp at 15,484 ft., and on the eighty-sixth meridian. On October 10th they sighted the Aling Kangri (81°), and on the 27th they entered Ladak by the Kongda La to the village Shushal to the south-east of Leh. Out of 160 or 170 animals that left Cherchen, or were purchased on the way, only two ponies and six mules reached Srinagar.

The collection contains sixty-four species of vascular plants, including one fern, *Polypodium hastatum*, Thunb., previously only known from China Proper, Japan, Formosa, and Corea. Ten of the species were described as new, and a very pretty grass is the type of a new genus, *Littledalea*, Hemsl. A detailed account of this collection is given in the 'Kew Bulletin,' 1896, pp. 207–216; and some of the novelties are figured in Hooker's 'Icones Plantarum,' tt. 2467–2472.

Captain M. S. Wellby and Lieutenant (Captain) Neill Malcolm, D.S.O. 80°—102°; 34° 25′—37° 25′. 1896.

Entered Tibet from Leh, as their basis, a little south of the Lanak La (79° 35′ and 34° 25′); the same route, practically, as Captain Deasy and Mr. Arnold Pike took. The greater part of their track across Tibet to China was between the thirty-fifth and thirty-sixth parallels; whereas Captain Bower and Dr. Thorold's route was mainly south of the thirty-fourth parallel. From the ninety-fifth meridian their general course was north-eastward, skirting the north shore of Koko Nor (100°), and thence to Sining and Lanchau, and down the Hoangho to Peking and Tientsin.

Captain Wellby's opening words of his Narrative of this marvellous journey are appropriately repeated here:—"Throughout the journey across this land we generally followed valleys, nullahs, and dry beds of rivers. After marching some 120 miles from Lanak La, we saw immense snow-ranges, running east and west, both north and south of us. The north range was particularly conspicuous with an abrupt massive peak ..... For four months we saw no vegetation higher than an onion, and for nearly four months we were at an average height of 16,000 ft. For more than fourteen weeks we were without seeing any sign of mankind, and should have been much longer had we not providentially met a Tibetan caravan travelling at right angles to our route on its way from Lhasa to China. The distance we covered from Leh (78°) to the Chinese frontier town of Tankar (101°) was very nearly 2000 miles. It took us nearly five months and a half."

By June 22nd, or little more than three weeks after starting, they had lost from exhaustion twenty-three mules and ponies, leaving only sixteen, and all their sheep were dead; yet since leaving Lanak La they had not travelled 200 miles. Vegetation was exceedingly scarce; grass just beginning to sprout. In other places they found "boortsa" (*Tanacetum*). Previous to this they had found a small white butterfly at a camp over 16,000 ft., and a brown one was seen a month later. At these high altitudes—16,000 ft. and upwards—"it was astonishing to find the thermometer registering 100° Fahr. in the sun, while at night-time there were sometimes 25° of frost." On July 27th, camp 68 (63?), they crossed a river (in about 87° 30′) which took its rise in the hills close by. The bed of it was half a mile across, and it was the largest body of running water they had seen. "Everywhere grew good grass, flowers, wild onions, and other vegetables, and yak and antelope were abundant." A week or so later they again came upon good grass, fresh water, onions, rhubarb, and game. All went well until Aug. 10th, when, in consequence of the exhausted state of their mules, they were forced to camp at the summit of a pass, 16,614 ft. high. There was no grass, but certain hardy plants occurred here and there. On the following morning they were astonished at finding nine of the mules dead. No suggestion is made as to the probable cause. In consequence, everything that could be spared had to be left, and they proceeded a sadly reduced party, living on kiang (wild ass) and wild onions, when they could be found. On Aug. 22nd they arrived at a magnificent fresh-water lake (camp 93, in about 92° 30′ and 35° 30′), where rich green grass was abundant and flowers plentiful; wild yak and kiang, water-fowl and hares, likewise, and the travellers describe it as an artist's and sportsman's paradise. The lake was about twenty-three miles long, and four miles broad in places. At 7 P.M., although nearly 16,000 ft. above the sea-level, the thermometer registered nearly 50° Fahr., and during the night it only just froze. Near here they fell in with a caravan of merchants, after marching fourteen weeks and traversing nearly 1000 miles without seeing a sign of mankind. On September 14th they encountered the first brushwood since leaving Niagzu, near Leh, and camped on the right bank of the river Shugatza or Shuga Gol, where there was good grazing. At Namoran Gol (about 97° and 36° 20′) they found wild currants and other berries. Thence they travelled along the north side of the Koko Nor and onward through Kumbum, Sining, and Lanchau to the Huangho, and through China.

The collection of dried plants comprises between sixty and seventy species, all carefully labelled with date, approximate altitude, longitude and latitude, colour of flowers, etc.

Only two species, *Astragalus Malcolmii*, Hemsl. & Pears., and *Saussurea Wellbyi*, Hemsl. (Hooker's 'Icones Plantarum,' t. 2588), proved different from anything in the Kew Herbarium. One other, it is true, had not been previously described, so far as we have been able to ascertain. This is *Peucedanum Malcolmii*, Hemsl. & Pears., also collected by Hedin.

Fifty species of this small collection were obtained at altitudes of above 16,000 ft., and four of them at 17,000 ft. and upwards. These are *Cochlearia scapiflora*, *Thylacospermum rupifragrum*, *Allium Semenovii*, and a very dwarf species of *Festuca*, probably *F. valesiaca*. The *Allium* is doubtless the onion referred to in the letter published in the 'Geographical Journal,' ix. p. 216, where it is stated that they ate quantities of wild onions, which they found in enormous beds. The greatest elevation given is 17,200 ft. for the *Festuca* in question. With the exception of *Statice aurea*, at 13,350 ft., all the others are from localities above 15,000 ft.

A preliminary list of the plants, furnished from Kew, is given in Wellby's 'Through Unknown Tibet,' p. 423; and this is followed by some meteorological observations, a summary of which will be found in our chapter on climate.

In the autumn of 1898, Captain Wellby started on a journey through Abyssinia to Lakes Rudolf and Stefanie, and on his return in 1899 he was ordered to join his regiment in South Africa. He was in Ladysmith during the siege, and was afterwards attached to General Sir Redvers Buller's force in the Transvaal. On July 30, 1900, he was wounded in an engagement at Mertzicht, and died of his wounds on August 5th. He dried a collection of plants on his Abyssinian expedition and presented it to Kew. An interesting account of this expedition appeared after his death in the 'Geographical Journal,' xvi. (1900), pp. 292–306, with a map.

Captain Neill Malcolm also went on service to South Africa, and was severely wounded at Paardeberg on the 18th of February, 1900, but has happily recovered. Since his return from South Africa he has been to Kew, and given us information on various points connected with the collection of dried plants.

Duffadar Shahzad Mir, of the 11th Bengal Lancers, deserves mention here. He took part in the expedition across Tibet, and afterwards accompanied Captain Wellby on his African travels, and is everywhere spoken of by him in the warmest words of praise and gratitude. He had previously travelled with Captain Younghusband.

Dr. Sven Hedin. 87° 30′—102°; 35° 30′—39°. 1895–7.

Left Kashgar for Khotan on the 14th of December, 1895, whence he continued his travels through the desert to Keria Darja, Schah Jar, Korla, and the Lob Nor country. Then the Takla Makan desert was crossed and various journeys were made in the Kashgar and neighbouring countries; finally, by way of Khotan, Karia, Kopa, Dalai Kurgan, across the Arka Tag, they entered Tibet, crossing Littledale's route of 1893, near the North Karamuran Pass, Aug. 21st, 1896. His first camp (Aug. 1st, 1896) on this section of his travels was in about 85° 25′ and 37°, and the name Bulak Baschi is the nearest on the map, but he mentions that their camping-place had no special name. They proceeded in a south-easterly direction, crossing the thirty-sixth parallel in about 87° 30′, and their route then lay between the thirty-fifth and thirty-sixth parallels to about 93° 30′. From this point they took a northward course, reaching 36° 40′ in the ninety-fourth meridian, and then eastward, skirting the salt desert of Tsaidam, to about 96° 30′. Again northward to Kurlik Nor (37° 15′) and then eastward to Koko Nor (100°) and onward to Sining, Kalgan, and Peking, where they arrived in March 1897. Dr. Hedin suffered the same hardships and disasters as our other travellers in these inhospitable regions. Indeed, in many respects, their several narratives are much alike. In February 1898, Dr. Hedin, who was awarded the Founders' Medal for that year, read an account of his travels before the Royal Geographical Society of London, and it was published in the 'Geographical Journal' (xi. 1898), from which we extract as follows:—

"The landscape is very desolate, and when the average height reaches 16,000 ft. it is clear that vegetation must be scanty. I collected all the plants we found. They had, as a rule, rather fleshy and downy leaves lying close to the ground in order to protect themselves from the wind and frost. The poor pasturage which was now and then found was so scattered and bitter, that the animals would not have eaten it if they had not been driven to it by hunger. The ground is, however, generally perfectly bare, and the weathering products which have washed down into the central parts of the basins without outlet have, in the course of time, been disintegrated into very fine particles, so that sand and gravel are very scarce. Since the ground is damp as a result of dew and rain, it becomes soft, and the animals frequently sank a foot deep. Only the lake shores, along which we frequently travelled, were suitable for our march. The cold was not at all great, and in the daytime one could ride without a cloak, on account of the strong insolation. At night the temperature seldom sank under 14° Fahr. The worst of all was the wind and hail. With the regularity of clockwork the west wind came every day at one o'clock and swooped down on the plateau with intense fury.

"From the Arka Tag pass we saw, far to the south, a great chain of mountains with perpetual snow-fields and shining tops.

This chain is parallel to Arka Tag, and constitutes, as I afterwards found, a continuation of the Koko Shili. Its highest peak was named after King Oscar. Between these two gigantic chains, which run from east to west, stretches a rolling plateau which is divided into a whole series of basins without outlet . . . . In the middle of each basin is a lake of clear but bitter water from the streams of the surrounding mountains. In travelling east we discovered twenty-three such lakes, of whose existence not even the Chinese had any idea. The largest was three days long. These lakes were dead and desolate as well as the surrounding country. Birds were very scarce, except one species of gull.

"The only animals that were capable of putting any life into these regions were the yaks and khulans, which were there in incredible numbers. Yak-dung afforded us the very best of fuel, and every evening we could warm ourselves by fine, large fires.

"Thus we wandered day after day across the plateaux of Tibet for two months without seeing a single living being. We found trace of man only twice during this time: at the last halting-place north of Arka Tag, where a charred pile of coals after a camp fire showed that we were crossing Littledale's route; and between our seventeenth and eighteenth halting-places, where, in the soft sand, we still found traces of Bonvalot and the Prince of Orleans's camels, these tracks having remained undisturbed for eight years. Meanwhile our caravan dwindled down in an alarming manner; at last the men had to go afoot, and we thought it was time to try to find inhabited country."

Dr. Sven Hedin presented his Tibetan botanical collection to Kew on the condition that we furnished a list of the plants to be embodied in his account of the scientific results of his travels in Petermann's 'Geographische Mittheilungen.' This has already appeared, but we shall be excused for including it in the following enumeration in order to make it accessible to a wider circle of botanists. It should be explained that this collection, consisting of less than sixty species, was made on his journey, in 1896, across the Arka Tag mountains into Tibet and through the Tsaidam country, mainly between the meridians of eighty-five and ninety-four and the thirty-fifth and thirty-seventh parallels. Some of the plants were collected on the north side of the Kuen Luen range, in Chinese Turkestan. But we have not been able to localize all the plants with exactitude, because some of them are merely dated, whilst others only bear the number of the camp. The party left Dalai Kurgan on the sixth of August, and marched through the pass of Sarik Kol, and it seems that about a third of the plants were collected between these two places; so that a number of them were not actually found in Tibet Proper. Among those sent to Kew there is absolutely nothing new; but Dr. Hedin had previously given two species of *Gentiana* from Sarik Kol to Dr. S. Murbeck, which he described as new, and indeed they seem to be very distinct. *Gentiana Hedini* is remarkable in having fringed scales, similar to those on the corolla, on the inside of some of the sepals; and the other, *G. cordisepala*, is distinguished by the shape of the sepals. But these and several others are excluded from our final enumeration.

Dr. Hedin was the only one of our travellers who collected Algæ, and my colleague Mr. C. H. Wright furnishes the following particulars of the collection, which was determined by Dr. N. Wille:—

"The algæ collected in Northern Tibet by Dr. S. Hedin number twenty-four species, belonging to sixteen genera. Eight species were collected in salt water, viz.:—*Spirogyra* sp., *Enteromorpha percursa*, *Rhizoclonium riparium*, *R. Kerneri*, *R. macromeres*, *Cladophora vaga*, *Vaucheria dichotoma* and *V. littorea* (?).

"One species proved to be new and has been described as *Harpochytrium Hedinii*, Wille. It was found epiphytic on a species of *Zygnema*, growing in fresh water at Sorgotsu Namaga. All the other species occur in Europe, those extending outside that area being:—

"*Cosmarium subspeciosum*. Greenland, Brazil; a variety in New Zealand.

Closterium acerosum. Nova Zembla, Siberia, Japan, Burma, N. America and the Argentine.

Ulothrix tenerrima. New Zealand.

Rhizoclonium riparium. Montevideo.

Cladophora crispata. N. America, Chiloë, Peru, New Zealand.

Vaucheria dichotoma. N. America (*fide* Kuetzing).

Binuclearia tatrana has been found in Lake Csober in the Carpathians at an altitude of about 4500 ft."

Captain H. H. P. Deasy and Mr. Arnold Pike. 80°—84°; 32° 30′—37°. 1896.

Entered Tibet by Lanak La (79° 35′ and 34° 25′), where they arrived on the 18th of June, 1896, when it was quite free of snow, though 18,000 ft. high. The intention was to cross Tibet from west to east with the special object of determining the identity of the rivers; but various misfortunes befel the party, and they returned, after making a circuit, from Chorul Cho, the most south-easterly point attained, without accomplishing their main object.

The minimum thermometer fell to +8° Fahr., or 24° of frost, during the night of June 16th at an altitude of 17,500 ft. They travelled in a north-easterly direction by Mangtza Cho and Lake Yeshil Kul (81° 45′ and 34° 50′), thence eastward to about 82° 25′, where the country was simply alive with antelope* females and their young. Here was plenty of grass and a moderate amount of fresh water. From this point they went southward to Chorul, about 82° 45′ and 32° 30′, and in several places there was a profusion of grass, but fresh water was often scarce. The return journey began here, and terminated, so far as Tibet was concerned, at the Kone La in November. During this journey twenty-four thousand square miles of territory were surveyed and the heights of seventy-nine peaks were determined. Great altitudes were reached in many parts, and Napo La, next to the last pass crossed, is 18,800 ft. high. Captain Deasy makes few allusions in his Narrative to the vegetation, except in relation to pasturage; but Mr. Pike made a botanical collection, and the specimens were carefully labelled with localities and approximate altitudes, some of which were higher than any on record. This collection, combined with two or three others, formed the subject of an exhibition and preliminary paper at a meeting of the Linnean Society on April 19th, 1900, and the approximate altitudes were referred to as absolute altitudes. Since then Captain Deasy has furnished corrected altitudes, and we shall return to this point when discussing the altitudinal limits of the flowering plants constituting the flora of Tibet.

* Captain Deasy estimated that there were at least 15,000 of these animals in view at one time. Przewalski, it may be added (Peterm. Geogr. Mitth. xx. p. 43) states that enormous herds of animals existed in the Koko Nor region, including yaks, antelopes, gazelles, and sheep. Tchihatchef, referring to Przewalski's account (La Végétation du Globe, i. p. 612, in a footnote), credits the latter with saying that yaks roved there by millions! "En parlant des derniers [yaks] il dit qu'ils y errent par *millions*." Such a statement, however, does not occur in the place cited; but we are not prepared to assert that it occurs nowhere in Przewalski's writings.

In 1897–8 Captain Deasy made another journey, or journeys, in Turkestan and Tibet. The plants collected on these expeditions were presented to the British Museum; but two or three new Tibetan species published in the 'Journal of Botany' have been added to our list.

In his Narrative he says very little about the vegetation, or absence of vegetation, generally; but the following extract relating to the country near his most north-easterly point in Tibet, Kara Sai, is interesting as a sample of the local conditions:—

"In the lower part of the Tolan Khoja valley there is plenty of excellent grass and water, but in the upper part, known as Sarok Tuz (Yellow Salt), there is no grass, but only a limited supply of burtza and not much water. At the head of this valley lies a pass of about 16,500 ft., a very easy and comparatively low one, which may be considered the natural boundary between Turkestan and the great Tibetan plateau. Looking forward from a hill near this pass, not a trace of vegetation is to be seen; and it was not till the western side of the small and irregularly shaped lake, called Shor Kul, was reached that any grass was obtained......Between the lake and the Kuen Luen range the country is absolutely barren. At the first camp beyond Shor Kul there was little or no vegetation, so the remaining sacks of chopped straw were issued. Here it was again necessary to dig for water, which was by no means sufficient for all the animals. However they quenched their thirst the next day, when the most easterly tributary of the Kiria river was reached. This tributary and the next are undoubtedly the smallest of the principal affluents of the Kiria river, and flow through a country devoid of all vegetation."

The botanical collection of the first expedition was almost entirely made by Mr. Arnold Pike. Indeed Captain Deasy gives him credit for the whole. It was presented to Kew in February, 1897; and a list of the determinations was sent to Captain Deasy in April of the same year, but various circumstances have hitherto prevented the publication of a full account of the plants, though, as already mentioned, they were included in an exhibition and a preliminary paper on the Tibetan Flora read before the Linnean Society on April 19th, 1900. The collection comprises nearly a hundred species, but contains very little that was previously unknown. *Senecio* (§ *Cremanthodium*) *Deasyi*, Hemsl.

(Hooker's 'Icones Plantarum,' t. 2587) is apparently new, and *Astragalus Arnoldii*, Hemsl. & Pears., we also believe to be new.

Summary.

Names.	Longitude.	Latitude.	Date.
Strachey & Winterbottom ..	80°—81° 40′	30° 30′—31° 5′	1848
Hooker	88° 45′	28°	1849
Bower & Thorold....	80°—102°	29° 30′—34° 30′	1891-2
Rockhill	90°—102°	29°—37°	1892
Littledales	80°—90° 25′	30°—37°	1895
Wellby & Malcolm	80°—102°	34° 25′—37° 25′	1896
Hedin	87° 30′—102°	35° 30′—39°	1895-7
Deasy & Pike	80°—84°	32° 30′—37°	1896

The Map.

The accompanying sketch-map, prepared by Miss M. Smith, was compiled from various sources, but mainly from the maps illustrating the narratives of the various travellers whose botanical collections are dealt with in this paper. It must not be regarded as a critical compilation, for some of the names and altitudes may be contradictory, but it should be of some assistance to persons interested in the subject.

ENUMERATION OF THE JOINT COLLECTIONS.

Ranunculaceæ.

Clematis alpina, *Mill. Gard. Dict.* ed. 8, n. 9; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 107; *Peterm. Mitteil.* Erg.-Heft 131, p. 373.

Atragene alpina, *Linn. Sp. Pl.* p. 542.

Sheltered nooks on hills, 16,200 ft., *Thorold.* Harato, 11,000 ft., *Hedin.* Flowers yellow or blue.

Clematis orientalis, *Linn. Sp. Pl.* p. 543, var. **tangutica**, *Maxim. Fl. Tangut.* p. 3.

C. graveolens, *Lindl. in Journ. Hort. Soc.* i. (1846) p. 307; *Hook. f. Fl. Brit. Ind.* i. p. 4; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 133; *Bot. Mag.* t. 4495.

Sutlej river in Gugé, 14,000 ft., *Strachey & Winterbottom.* Pochu valley, 94° 45′, 31° 45′, very abundant at 14,000 ft., *Rockhill.* 82° 41′, 32° 36′, 14,400 ft., September 4, *Deasy & Pike*, 889. Flowers yellow.

Anemone imbricata, *Maxim. Fl. Tangut.* p. 8, t. 22; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 133; *Kew Bull.* 1896, p. 208.

Foot-hills of Dangla mountains, north-western extremity of range, 90° 35′, 33° 40′, 16,500 ft., June 27, *Rockhill.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers changing from a red-brown to violet or white.

Thalictrum alpinum, *Linn. Sp. Pl.* p. 545; *Hook. f. Fl. Brit. Ind.* i. p. 12.

T. acaule, *Cambess. in Jacquem. Voy. Bot.* p. 3.

Gugé, 15,000 ft., *Strachey & Winterbottom.* Flowers yellow.

Callianthemum cachemirianum, *Cambess. in Jacquem. Voy. Bot.* p. 5, t. 3; *Hook. f. Fl. Brit. Ind.* i. p. 14.

Ranunculus pimpinelloides, *D. Don, in Royle, Ill. Bot. Himal.* p. 53.

In 88° 30′, 35° 20′, 16,294 ft., July 28, *Wellby & Malcolm.* Flowers yellow.

Adonis cærulea, *Maxim. in Bull. Acad. Pétersb.* xxiii. (1877) p. 306; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 107.

Wide valleys, 17,200 ft., *Thorold.* Flowers blue.

Ranunculus aquatilis, *Linn. Sp. Pl.* p. 556, partim.

Gyanima, 15,500 ft., *Strachey & Winterbottom.* Bhomtso, *Hooker.* Flowers white.

Ranunculus Cymbalariæ, *Pursh, Fl. Amer. Sept.* ii. p. 392; *Fl. Dan.* xiii. t. 2293; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 107; *Hook. f. Fl. Brit. Ind.* i. p. 17.

Gugé valleys, 14,000–15,000 ft., *Strachey & Winterbottom.* Edge of streams, 17,800 ft., *Thorold.* Near the Horpa Tso, 16,400 ft., June 28, *Deasy & Pike.* Flowers yellow.

Ranunculus hyperboreus, *Rottb. in Skrift. Kjoeb. Selsk.* x. (1770) p. 458, *var.* **natans**, *Regel*; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 108; *Hook. f. Fl. Brit. Ind.* i. p. 18.

Streams, 16,200 ft., *Thorold.* Flowers yellow.

Ranunculus involucratus, *Maxim. Fl. Tangut.* p. 15, t. 22. ff. 7–13; *Hook. Ic. Pl.* t. 2586 A.

Near the Horpa Tso, 16,400 ft., June 28, *Deasy & Pike*, 817. Flowers yellow.

Ranunculus lobatus, *Jacquem. Voy. Bot.* p. 4; *Hook. f. Fl. Brit. Ind.* i. p. 17.

Gugé, 15,000 ft., *Strachey & Winterbottom.* 82° 40′, 33° 30′, 16,800 ft., August 18, *Deasy & Pike.* Flowers yellow.

Ranunculus pulchellus, *C. A. Mey. in Ledeb. Fl. Alt.* ii. p. 333; *Ledeb. Ic. Fl. Ross.* t. 111; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 108; *Hook. f. Fl. Brit. Ind.* i. p. 17.

Niti pass, 17,000 ft., *Strachey & Winterbottom.* Near water, 17,300 ft., *Thorold.* Damp soil on the shore of Aru Tso, 16,200 ft., August 4, *Deasy & Pike*, 865. Flowers yellow.

Ranunculus similis, *Hemsl. in Hook. Ic. Pl.* t. 2586 B.

R. involucratus, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 107, *non Maxim.*

Sandy earth and gravel in valleys, 17,500 ft., *Thorold.* 82° 30′, 35°, 16,649 ft., June 19, *Wellby & Malcolm.* 81° 40′, 34° 50′, 16,600 ft., July 6, *Deasy & Pike*, 844. Flowers yellow.

Ranunculus tricuspis, *Maxim. Fl. Tangut.* p. 12, *et Enum. Pl. Mong.* p. 16, t. 4. ff. 17–27; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 133.

Valley of Murus, 91° 18′, 33° 44′, 15,640 ft., June 23, *Rockhill.* In moist soil near stream, 82° 8′, 34° 38′, 17,000 ft., July 27, *Deasy & Pike*, 850. Flowers yellow.

Delphinium Brunonianum, *Royle, Illustr. Bot. Himal.* p. 56; *Kew Bull.* 1896, p. 208; *Hook. f. Fl. Brit. Ind.* i. p. 27; *Bot. Mag.* t. 5461.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers blue.

Delphinium cæruleum, *Jacquem. Voy. Bot.* p. 7, t. 6; *Huth, in Engl. Bot. Jahrb.* xx. p. 463; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 108; *Peterm. Mitteil.* Erg.-Heft 131, p. 373; *Hook. f. Fl. Brit. Ind.* i. p. 25.

Near Rakas Tal, 15,000–17,000 ft., *Strachey & Winterbottom.* Top of pass, 17,800 ft., *Thorold.* September 18, *Hedin.* 90° 10′, 35° 17′, 15,970 ft., August 4, *Wellby & Malcolm.* Flowers blue.

Delphinium grandiflorum, *Linn. Sp. Pl.* p. 531; *Journ. Linn. Soc., Bot.* xxx. (1894) pp. 108 et 133.

Side of slope, 14,800 ft., *Thorold.* Kechu valley, 96° 28′, 31° 25′, 12,700 ft., *Rockhill.* Flowers blue.

Delphinium Pylzowii, *Maxim. in Bull. Acad. Pétersb.* xxiii. (1877) p. 307, *et Fl. Tangut.* i. p. 21, t. 3; *Regel's Gartenfl.* 1876, p. 289, t. 879; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 134; *Kew Bull.* 1896, p. 208.

Dangchu valley, 92° 12′, 32° 12′, 14,500 ft., *Rockhill.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers violet-blue and black.

Delphinium sp. aff. *D. Brunoniano.*

91° 39′, 35° 21′, 16,386 ft., August 11, *Wellby & Malcolm.*

Aconitum dissectum, *D. Don, Prodr. Fl. Nep.* p. 197, fide *O. Stapf.*

A. Napellus, *Linn.* var., *Hemsl. in Kew Bull.* 1896, p. 208.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers blue.

Papaveraceæ.

Meconopsis horridula, *Hook. f. et Thoms. Fl. Ind.* p. 252; *Journ. Linn. Soc., Bot.* xxx. (1894) pp. 108 et 134; *Kew Bull.* 1896, p. 208; *Peterm. Mitteil.* Erg.-Heft 131, p. 373; *Hook. f. Fl. Brit. Ind.* i. p. 118.

Water-logged soil in valley close to marsh, 15,500 ft., *Thorold.* Plateau west of Dangla mountains, 89° 44′, 32° 51′, 16,350 ft., July 3, *Rockhill.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* 85°, 35° 37′, *Hedin.* 92°, 35° 20′, 16,000 ft., August 17, *Wellby & Malcolm.* Flowers blue.

Meconopsis integrifolia, *Franch. in Bull. Soc. Bot. France,* xxxviii. (1886) p. 389; *Kew Bull.* 1896, p. 208.

Cathcartia integrifolia, *Maxim. in Bull. Acad. Pétersb.* xxiii. (1877) p. 310.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers blue.

Hypecoum leptocarpum, *Hook. f. et Thoms. Fl. Ind.* i. p. 276; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 108; *Hook. f. Fl. Brit. Ind.* i. p. 120.

Sheltered nullahs, 15,500 ft., *Thorold.* Flowers pale violet.

Fumariaceæ.

Corydalis Boweri, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 108; *Kew Bull.* 1896, p. 208.

Water-logged soil in valley, 15,500 ft., *Thorold.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers yellow.

Corydalis Hendersoni, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) pp. 109 et 134; *Peterm. Mitteil.* Erg.-Heft 131, p. 373.

Sandy, gravelly soil in valleys, 17,600 ft., *Thorold.* Extreme head of valley on foot-hills of Dangla mountains, 90° 50′, 33° 43′, 16,340 ft., *Rockhill.* Camp 32, September 22, *Hedin.* 90° 10′, 35° 17′, 15,970 ft., August 4, *Wellby & Malcolm.* 25 miles east of the Lanak-la, 17,100 ft., June 20, *Deasy & Pike.* Flowers yellow.

Corydalis Moorcroftiana, *Wall. Cat.* n. 1432; *Kew Bull.* 1896, p. 209; *Hook. f. Fl. Brit. Ind.* i. p. 125.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers yellow with purple tips.

Corydalis tibetica, *Hook. f. et Thoms. Fl. Ind.* i. p. 265; *Hook. f. Fl. Brit. Ind.* i. p. 124.

Lanjar, 17,000 ft., *Strachey & Winterbottom.* Flowers pale yellow with brown or green tips.

CRUCIFERÆ.

Parrya exscapa, *C. A. Mey. in Ledeb. Fl. Alt.* iii. p. 28; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 134; *Hook. f. Fl. Brit. Ind.* i. p. 131.

Basin of Murus, extreme head of valley, on foot-hills of Dangla mountains, 90° 50′, 33° 43′, 16,340 ft., *Rockhill.* Flowers purple.

Parrya lanuginosa, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* v. (1861) p. 136, et xxx. (1894) p. 110; *Hook. f. Fl. Brit. Ind.* i. p. 132.

Lanjar, 17,500 ft., *Strachey & Winterbottom.* In water-logged, stony soil, 17,600 ft., *Thorold.* East of Horpa Tso, 17,000 ft., July 5, *Deasy & Pike*, 832. Flowers purple.

Parrya macrocarpa, *R. Br. in Parry Voy. App.* p. 270; *Hook. f. Fl. Brit. Ind.* i. p. 131; *Hook. Fl. Bor.-Am.* i. t. 15.

Gugé, 14,000–15,000 ft., *Strachey & Winterbottom.* Flowers rose-purple.

Parrya prolifera, *Maxim. Fl. Tangut.* p. 56, t. 15.

In 83° 20′, 35° 8′. 16,480 ft., June 27, *Wellby & Malcolm.* North Tibet, *Przewalski.* Flowers violet.

Cheiranthus himalayensis, *Cambess. in Jacquem. Voy. Bot.* p. 14, t. 13; *Hook. f. Fl. Brit. Ind.* i. p. 132.

C. himalaicus, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* v. (1861) p. 137.

In 82° 24′, 4° 55′, 17,300 ft., July 23, *Deasy & Pike*, 842. Flowers violet or purple.

Alyssum canescens, *DC. Syst. Veg.* ii. p. 322; *Hook. f. Fl. Brit. Ind.* i. p. 141.

Tisum, 15,000 ft., *Strachey & Winterbottom*. 87° 10′, 35° 18′, 16,159 ft., July 21, *Wellby & Malcolm*. 82° 12′, 34° 20′, 16,100 ft., July 31, *Deasy & Pike*, 857, 859. Flowers white.

Draba alpina, *Linn. Sp. Pl.* p. 642; *Journ. Linn. Soc., Bot.* v. (1861) p. 150, et xxx. (1894) p. 110; *Hook. f. Fl. Brit. Ind.* i. p. 142.

Valley, 17,600 ft., *Thorold*. Without locality, *Wellby & Malcolm*; *Deasy & Pike*. Flowers yellow.

Draba alpina, *Linn.*, var. γ. **algida**, *Regel*, *in Radde, Reisen im Süden von Ost-Sibirien*, i. p. 189.

D. algida, *Adams, ex Fisch. in DC. Syst. Veg.* ii. p. 337; *Hook. Fl. Bor.-Am.* i. p. 50.

Without locality, *Deasy & Pike*, 833. Flowers yellow.

Draba fladnitzensis, *Wulf. in Jacq. Misc.* i. p. 147, t. 17. f. 1; *Kew Bull.* 1896, p. 209; *Hook. f. Fl. Brit. Ind.* i. p. 143.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. Flowers white.

Draba incompta, *Stev. in Mém. Soc. Nat. Mosc.* iii. (1812) p. 268; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 110; *Hook. f. Fl. Brit. Ind.* i. p. 142.

Gravelly soil in valleys, 16,500 ft., *Thorold*. Flowers white (Thorold); yellow (Flora British India).

Draba lasiophylla, *Royle, Illustr. Bot. Himal.* p. 71; *Hook. f. Fl. Brit. Ind.* i. p. 143.

Gugé, 15,000–16,500 ft., *Strachey & Winterbottom*. Flowers white.

Cochlearia scapiflora, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* v. (1861) p. 154, et xxx. (1894) p. 110; *Hook. f. Fl. Brit. Ind.* i. p. 145.

Gugé, 15,500 ft., *Strachey & Winterbottom*. 17,800 ft., *Thorold*. 82° 45′, 35°, 17,108 ft., June 22, *Wellby & Malcolm*. Flowers pale lilac.

Sisymbrium humile, *C. A. Mey. ex Ledeb. Fl. Alt.* iii. p. 137; *Ledeb. Ic. Fl. Ross.* t. 147; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 110; *Hook. f. Fl. Brit. Ind.* i. p. 148.

Sandy, gravelly soil near water, 17,500 ft., *Thorold*. 82° 8′, 34° 20′, 16,100 ft., July 29, *Deasy & Pike*, 855. Flowers white.

Eutrema Przewalskii, *Maxim. Fl. Tangut.* p. 68, t. 28. ff. 11–23; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 134.

Basin of Murus, in lateral valley, 91° 05′, 33° 45′, 15,700 ft., June 24, *Rockhill.* Near the Horpa Tso, 16,400 ft., June 28, *Deasy & Pike*, 821. Flowers white.

Erysimum Chamæphyton, *Maxim. Fl. Tangut.* i. p. 63, t. 28. ff. 1–10; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 134.

Hill-slope two miles north of Murus river (head-waters of Yangtsekiang), 91° 31′, 33° 53′, 14,750 ft.; and the basin of Murus, in lateral valley, 91° 05′, 33° 45′, 15,700 ft., *Rockhill.* Flowers pink and white.

Erysimum funiculosum, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* v. (1861) p. 165, et xxx. (1894) p. 110; *Hook. f. Fl. Brit. Ind.* i. p. 153.

Near water in valley, 17,600 ft., *Thorold.* 87°, 35° 18′, 16,401 ft., July 20, *Wellby & Malcolm.* Flowers yellow.

Erysimum ——?

90° 10′, 35° 17′, 15,970 ft., August 4, *Wellby & Malcolm.*

A dwarf perennial with woody rootstock, fleshy, pubescent leaves, and white flowers.

Christolea crassifolia, *Cambess. in Jacquem. Voy. Bot.* p. 17, t. 17; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 110; *Hook. f. Fl. Brit. Ind.* i. p. 154.

Sutlej river in Gugé, 13,500 ft., *Strachey & Winterbottom.* Sandy, gravelly soil in valleys, 16,800 ft., *Thorold.* 15,200 ft., August 28, *Deasy & Pike*, 880. Flowers white.

Seen to-day (Aug. 28) in great quantities. Soil, decomposed granite (?) and gravel.—*Deasy & Pike.*

Braya rosea, *Bunge, Del. Sem. Hort. Dorp.* (1841) p. 8; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 110; *Hook. f. Fl. Brit. Ind.* i. p. 155.

Sagta Deo and Gugé, 10,000–16,500 ft., *Strachey & Winterbottom.* Muddy, stony soil close to streams, 17,800 ft., *Thorold.* Flowers purplish white.

Braya sinensis, *Hemsl. in Journ. Linn. Soc., Bot.* xxix. (1894) p. 303, t. 29.

Near the Horpa Tso, 16,400 ft., June 28, *Deasy & Pike*, 819. Flowers white.

Braya uniflora, *Hook. f. et Thoms. Journ. Linn. Soc., Bot.* v. (1861) p. 168, et xxx. (1894) p. 110; *Hook. f. Fl. Brit. Ind.* i. p. 155; *Hook. Ic. Pl.* t. 2251.

Sandy, gravelly soil, 17,600 ft., *Thorold.* 83° 45′, 35° 15′, 16,528 ft., July 1, *Wellby & Malcolm.* Near the Mangtsa Tso, 17,000 ft., June 24, *Deasy & Pike*, 809. Flowers changing white to pink.

Root when split smells something like horse-radish.—*Deasy & Pike.*

Capsella Thomsoni, *Hook. f. in Journ. Linn. Soc., Bot.* v. (1861) p. 172, *et Fl. Brit. Ind.* i. p. 159; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 110; *Kew Bull.* 1896, p. 209; *Peterm. Mitteil.* Erg.-Heft 131, p. 373.

Hutchinsia tibetica, *Thoms. in Hook. Ic. Pl.* t. 900.

Sandy, gravelly soil near water, 17,500 ft., *Thorold.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Camp 17, September 2, *Hedin.* 86° 10′, 35° 19′, 16,214 ft., July 16, *Wellby & Malcolm.* 82° 8′, 34° 38′, 17,000 ft., July 27, *Deasy & Pike.* Flowers white.

Lepidium capitatum, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* v. (1861) p. 175, et xxx. (1894) p. 110; *Hook. f. Fl. Brit. Ind.* i. p. 160.

Stony ground close to water, 16,200 ft., *Thorold.* Flowers purple with yellow centre.

Lepidium cordatum, *Willd. ex DC. Syst. Veg.* ii. p. 554; *Peterm. Mitteil.* Erg.-Heft 131, p. 373.

Harato, 11,000 ft., October 5, *Hedin.* Flowers white.

Lepidium latifolium, *Linn. Sp. Pl.* p. 644; *Hook. f. in Journ. Linn. Soc., Bot.* v. (1861) p. 173, *et Fl. Brit. Ind.* i. p. 160; *Peterm. Mitteil.* Erg.-Heft 131, p. 373.

Harato, 11,000 ft., October 5, *Hedin.* Flowers white.

Dilophia salsa, *Thoms. in Hook. Kew Journ. Bot.* v. (1853) p. 20, et iv. (1852) t. 12; *Kew Bull.* 1896, p. 209; *Peterm. Mitteil.* Erg.-Heft 131, p. 373; *Hook. f. Fl. Brit. Ind.* i. p. 161.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Camp 10, *Hedin.* 87° 50′, 35° 12′, 16,000 ft., July 24, *Wellby & Malcolm.* 82° 40′, 33° 30′, 16,800 ft., August 18, *Deasy & Pike*, 877. Flowers white or rose.

Iberidella Andersoni, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* v. (1861) p. 177; *Hook. f. Fl. Brit. Ind.* i. p. 163.

Sagta Deo and Gugé, 10,000–16,500 ft., *Strachey & Winterbottom.* Flowers white or pale rose.

Crambe cordifolia, *Stev. in Mém. Soc. Nat. Mosc.* iii. (1812) p. 267; *Hook. f. Fl. Brit. Ind.* i. p. 165.

Without special locality, *Strachey & Winterbottom*. Flowers white.

CARYOPHYLLACEÆ.

Lychnis apetala, *Linn. Sp. Pl.* p. 437; *Fl. Lapp.* t. 12. f. 1; *Wahlenb. Fl. Lapp.* t. 7; *Hook. Fl. Bor.-Am.* i. p. 91; *Kew Bull.* 1896, p. 209; *Hook. f. Fl. Brit. Ind.* i. p. 222.

Gugé, 15,000 ft., *Strachey & Winterbottom*. Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. Without locality, *Deasy & Pike*, 894. Flowers purple-brown.

Lychnis macrorhiza, *Royle, Illustr. Bot. Himal.* p. 80; *Hook. f. Fl. Brit. Ind.* i. p. 223.

Lanjar, 17,000 ft., *Strachey & Winterbottom*. Flowers purple.

Silene Moorcroftiana, *Wall. Cat.* n. 626; *Hook. f. Fl. Brit. Ind.* i. p. 219.

Near Rakas Tal, 15,000–17,000 ft., *Strachey & Winterbottom*. Flowers dull red or white.

Stellaria decumbens, *Edgew. in Trans. Linn. Soc.* xx. (1846) p. 35; *Kew Bull.* 1896, p. 209; *Hook. f. Fl. Brit. Ind.* i. p. 234.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. Flowers white.

Stellaria decumbens, *Edgew.*, var. **pulvinata**, *Edgew. et Hook. f. in Fl. Brit. Ind.* i. p. 235; *Kew Bull.* 1896, p. 209; *Peterm. Mitteil.* Erg.-Heft 131, p. 373.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. Between camps 26 and 27, September 14, *Hedin*. Flowers white.

Stellaria graminea, *Linn. Sp. Pl.* p. 422; *Hook. f. Fl. Brit. Ind.* i. p. 233.

Lungyung and Tisum, 15,000 ft., *Strachey & Winterbottom*. Flowers white.

Stellaria subumbellata, *Edgew. in Hook. f. Fl. Brit. Ind.* i. p. 233; *Kew Bull.* 1896, p. 209.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. Flowers white.

Arenaria festucoides, *Benth. in Royle, Illustr. Bot. Himal.* p. 81, t. 21. f. 3; *Hook. f. Fl. Brit. Ind.* i. p. 236.

Karnali river, 15,500 ft., *Strachey & Winterbottom.* Flowers white.

Arenaria Littledalei, *Hemsl. in Kew Bull.* 1896, p. 209.

Gooringia Littledalei, *Williams, in Bull. Herb. Boiss.* v. (1897) p. 530.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers white.

Arenaria musciformis, *Wall. Cat.* n. 641; *Kew Bull.* 1896, p. 209; *Peterm. Mitteil.* Erg.-Heft 131, p. 373; *Hook. f. Fl. Brit. Ind.* i. p. 237.

Balch pass, 15,000–16,500 ft., *Strachey & Winterbottom.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Highlands of North Tibet, *Hedin.* 86°, 35° 19′, 15,296 ft., July 15, *Wellby & Malcolm.* South shore of Mangtsa Tso, 17,000 ft., June 24, *Deasy & Pike,* 813. Flowers white.

Arenaria Stracheyi, *Edgew. in Hook f. Fl. Brit. Ind.* i. p. 240.

Rakas Tal, 15,500 ft., *Strachey & Winterbottom.* Dampish soil on broken granite, 16,800 ft., August 12, *Deasy & Pike,* 876. Flowers white.

Thylacospermum rupifragum, *Schrenk, Enum. Pl. Nov.* ii. p. 53; *Hook. f. Fl. Brit. Ind.* i. p. 243.

Arenaria (Dicranilla) rupifraga, *Fenzl, in Ledeb. Fl. Ross.* i. p. 780.

Bryomorpha rupifraga, *Kar. et Kir. in Bull. Soc. Imp. Nat. Mosc.* xv. (1842) p. 172.

Gugé, 15,000–16,500 ft., *Strachey & Winterbottom.* 82° 45′, 35°, 17,108 ft., June 27, *Wellby & Malcolm.* Without locality, *Deasy & Pike.* Flowers very minute, white.

TAMARISCACEÆ.

Myricaria elegans, *Royle, Illustr. Bot. Himal.* p. 214; *Hook. f. Fl. Brit. Ind.* i. p. 250.

Sutlej river in Gugé, 13,500 ft., *Strachey & Winterbottom.* Flowers pink.

Myricaria prostrata, *Hook. f. et Thoms. in Benth. et Hook. f. Gen. Pl.* i. p. 161; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 134.

M. germanica, *Desv.*, var. prostrata, *Thiselton-Dyer in Hook. f. Fl. Brit. Ind.* i. p. 250; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 111.

17,300 ft., *Thorold.* Upper Naichi Gol valley near river, 93° 49′, 35° 52′, 12,130 ft., May 21, *Rockhill.* 83°, 35° 8′, 16,487 ft., June 25, *Wellby & Malcolm.* Aru Tso, 16,500 ft., August 5, 871; 15 miles south-west of the Mangtsa Tso, 16,000 ft., June 22, *Deasy & Pike*, 805. Flowers pink.

Petals pale pink, stamens white, pistil green. Many very small insects and red spiders in these flowers.—*Deasy & Pike.*

Zygophyllaceæ.

Nitraria Schoberi, *Linn. Syst.* ed. 10, p. 1044; *Gmel. Fl. Sibir.* ii. t. 98; *Maxim. Fl. Tangut.* p. 102; *Peterm. Mitteil.* Erg.-Heft 131, p. 373.

Harmut Vogana, October 17, *Hedin.* Flowers white. Fruit red or black.

Geraniaceæ.

Geranium collinum, *Steph., Willd. Sp. Pl.* iii. p. 705; *Kew Bull.* 1896, p. 209; *Hook. f. Fl. Brit. Ind.* i. p. 429.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers blue.

Biebersteinia Emodi, *Jaub. et Spach, Illustr.* ii. p. 109; *Hook. f. Fl. Brit. Ind.* i. p. 427.

Chirchun and other localities, 16,500 ft., *Strachey & Winterbottom.* Flowers yellow.

Leguminosæ.

Thermopsis inflata, *Cambess. in Jacquem. Voy. Bot.* p. 34, t. 39; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 111; *Hook. f. Fl. Brit. Ind.* ii. p. 63.

Top of pass in sand, 18,500 ft., *Thorold.* 81° 41′, 34° 53′, 16,200 ft., July 8, *Deasy & Pike,* 843. Flowers bright yellow.

Thermopsis lanceolata, *R. Br. in Ait. Hort. Kew.* ed. 2, iii. p. 3; *Ledeb. Fl. Ross.* i. p. 510; *Journ. Linn. Soc., Bot.* xxiii. (1886) p. 150; *Kew Bull.* 1896, p. 210; *Peterm. Mitteil.* Erg.-Heft 131, p. 373.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Camp 31, September 21, *Hedin.* Flowers yellow.

Caragana pygmæa, *DC. Prodr.* ii. p. 268; *Hook. f. Fl. Brit. Ind.* ii. p. 116.

Gugé plains, 14,000–17,000 ft., *Strachey & Winterbottom.* Flowers bright yellow.

Astragalus (**§ Cercidothrix**) **Arnoldi**, *Hemsl. & H. H. W. Pearson*, sp. nov.

Suffrutex nanus, cæspitoso-multiceps, sericeo-canescens pilis peltatim affixis. *Radix* alta, crassa, lignosa, fibrosa. *Rami* breves, patentes, lignosi, petiolis foliorum persistentibus instructi. *Folia* conferta, 3–7-foliolata, 2–4 lin. longa; foliola opposita, breviter elliptica, strigoso-villosa, $\frac{3}{4}$–1$\frac{1}{2}$ lin. longa, $\frac{1}{2}$ lin. lata; stipulæ membranaceæ, extus pubescentes, petiolis breviter adnatæ, breviter connato-vaginantes, circiter 1$\frac{1}{2}$ lin. longæ. *Racemi* umbelliformes, pedunculati, axillares, circiter 6-flori, pilis atris albidisque adpressis vestiti. *Flores* purpurei, bracteati, breviter pedicellati. *Calyx* obliquus, dentibus 5 subæqualibus brevibus erectis mox declinatis, pilis atris albidisque adpressis hirsutus, circiter 1$\frac{1}{2}$ lin. longus. *Vexillum* glabrum, apice late rotundatum, emarginatum, calycem duplo superans; alæ spathulatæ. *Ovarium* antice hirsutum, breviter stipitatum, 4-ovulatum; stylus glaber. *Legumen* non visum.

Without locality: 17,500 ft., *Deasy & Pike*, 808, 810; 17,500 ft., *Thorold*, 12 & 37. Flowers purple.

This species resembles *A. brahuicus*, Bunge, in habit.

Astragalus confertus, *Benth.*; *Hook. f. Fl. Brit. Ind.* ii. p. 123.

Top of pass, 18,000 ft., and sandy, gravelly soil in valleys, 17,500 ft., *Thorold*, 8 & 58. Without locality, *Deasy & Pike*, 893. Flowers blue or purple-blue.

Astragalus Heydei, *Baker*, *in Hook. f. Fl. Brit. Ind.* ii. p. 118; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 111.

A. Hendersoni, *Baker*, *loc. cit.* ii. p. 120.

Sandy, gravelly soil in valleys, *Thorold*, 50. 87°, 35° 18′, 16,400 ft., July, *Wellby & Malcolm.* 25 miles east of Lanak La, 17,100 ft., *Deasy & Pike*, 802. Flowers purple.

With very complete material before us, we have no hesitation in uniting Mr. Baker's *A. Hendersonii* with his *A. Heydei.*

Astragalus (**Phaca**) **Malcolmii**, *Hemsl. & H. H. W. Pearson*, sp. nov.

Herba pumila, acaulis, perennis, pubescens pilis basi affixis. *Rhizoma* ascendens, tenuis, internodiis 2–3 lin. longis. *Folia* imparipinnata, 9–13-foliolata, $\frac{1}{2}$–$\frac{3}{4}$ poll. longa: foliola opposita, brevissime petiolulata, oblonga vel elliptica, obtusa, subcarnosa, dense pubescentia, 1$\frac{1}{4}$–2 lin. longa, circiter $\frac{3}{4}$ lin. lata;

stipulæ herbaceæ, petiolis brevissime adnatæ, basi inter se connatæ, ellipticæ, minute apiculatæ, circiter 1½ lin. longæ. *Racemi* scapiformes, densi, capituliformes, multiflori, pilis atris pubescentes. *Flores* bracteati, purpurei, brevissime pedicellati. *Calyx* subcampanulatus, alte 5-lobatus, pilis atris pubescens, circiter 2 lin. longus ; lobi angusti, erecti, mox declinati, circiter ¾ lin. longi. *Vexillum* glabrum, apice late rotundatum, circiter 3 lin. longum. *Stamina* a petalis libera. *Ovarium* stipitatum, glabrum, 2-ovulatum. *Stylus* glaber. *Legumen* non visum.

In 87° and 35° 18′, 16,401 ft., July, *Wellby & Malcolm*. Flowers purple.

Allied to *A. tibetanus*, which, however, is distinctly caulescent.

Astragalus melanostachys, *Benth.* ; *Hook. f. Fl. Brit. Ind.* ii. p. 125.

A. bracteosus, *Klotzsch, Reise Pr. Wald., Bot.* p. 160, t. 5, *non Boiss.*
A. strictus, *Hemsl. in Kew Bull.* 1896, p. 210, *non R. Grah.*

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. Flowers purple.

Astragalus nivalis, *Kar. et Kir.* ; *Hook. f. Fl. Brit. Ind.* ii. p. 136.

In 89°–95°, 35°–37°, August 7, *Hedin*. 88° 30′, 35° 20′, 16,294 ft., July, *Wellby & Malcolm*. Flowers purple.

Astragalus tribulifolius, *Benth.* ; *Hook. f. Fl. Brit. Ind.* ii. p. 120 ; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 111 ; *Peterm. Mitteil.* Erg.-Heft 131, p. 373.

Sandy valley, 15,800 ft., *Thorold*. September 1 & 21, *Hedin*. Flowers purple.

Astragalus Webbianus, *Grah.* ; *Hook. f. Fl. Brit. Ind.* ii. p. 132.

Gugé plains, 15,000 ft., *Strachey & Winterbottom*. Flowers purple.

Oxytropis cachemirica, *Cambess. in Jacquem. Voy. Bot.* p. 38' t. 44 ; *Kew Bull.* 1896, p. 210 ; *Hook. f. Fl. Brit. Ind.* ii. p. 139.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., July and August, *Littledale*. Flowers violet or yellow.

Oxytropis densa, *Benth.* ; *Hook. f. Fl. Brit. Ind.* ii. p. 138.

Sandy, gravelly soil in valleys, 17,500 ft., *Thorold*, 11. Flowers purple-red.

Oxytropis lapponica, *Gaud.*; *Hook. f. Fl. Brit. Ind.* ii. p. 137.

O. glacialis, *Benth. loc. cit.*

Niti pass, *Strachey & Winterbottom.* Muddy, stony soil in valleys, 17,600–17,800 ft., *Thorold*, 40 & 59. Flowers purple and white.

Oxytropis microphylla, *DC.*; *Hook. f. Fl. Brit. Ind.* ii. p. 139.

O. chiliophylla, *Royle, Illustr. Bot. Himal.* p. 198; *Jacquem. Voy. Bot.* p. 38, t. 45.

Oxytropis physocarpa, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 111, *vix Ledeb.*

Sandy, gravelly soil in valleys, 17,500 ft., *Thorold.* 91° 20′, 36° 46′, June 22, *Rockhill.* August 7, *Hedin.* 87°, 35° 18′, 16,400 ft., July 21, *Wellby & Malcolm.* Near the Mangtsa Tso, 17,500 ft., June 24, and 82° 42′, 32° 34′, 15,000 ft., September 4, *Deasy & Pike*, 808 & 887. Flowers purple or violet.

Thorold's specimens were originally referred to *O. physocarpa*, Ledeb., which is hardly distinguishable in the flowering state.

Oxytropis Stracheyana, *Benth.*; *Hook. f. Fl. Brit. Ind.* ii. p. 138.

Side of slope, 16,200 ft., *Thorold*, 96. 88° 20′, 35° 20′, 16,600 ft., July 27, *Wellby & Malcolm.* Flowers purple-blue.

Oxytropis tatarica, *Cambess. ex Bunge, in Mém. Acad. Pétersb.* sér. 7, xxii. (1874) i. p. 16; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 112; *Hook. f. Fl. Brit. Ind.* ii. p. 138.

Various localities, 17,500–17,800 ft., *Thorold*, 13, 39 & 73. Toktomai Muren, 14,000–15,000 ft., *Rockhill.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* 88° 20′, 35° 14′, 16,140 ft., July 26, *Wellby & Malcolm.* 25 miles east of the Lanak La, 17,100 ft., *Deasy & Pike*, 804. Flowers purple.

Stracheya tibetica, *Benth. in Hook. Kew Journ. Bot.* v. (1853) p. 307; *Hook. f. Fl. Brit. Ind.* ii. p. 147.

Tisum, 15,000 ft., *Strachey & Winterbottom.* Flowers purple.

ROSACEÆ.

Potentilla Anserina, *Linn. Sp. Pl.* p. 495; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 135; *Hook. f. Fl. Brit. Ind.* ii. p. 350.

Tisum, 15,000 ft., *Strachey & Winterbottom.* Plateau west of Dangla mountains, 89° 38′, 33° 09′, 16,220 ft., *Rockhill.* Flowers yellow.

Potentilla bifurca, *Linn. Sp. Pl.* ed. 2, p. 711; *Gmelin, Reise Beschreib.* i. t. 27. f. 1; *Falk, Beyträge z. topogr. Kennt. Russ. Reichs*, ii. t. 10; *Kew Bull.* 1896, p. 210; *Hook. f. Fl. Brit. Ind.* ii. p. 353.

Gugé, 16,000 ft., *Strachey & Winterbottom.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* 16,300 ft., *Wellby & Malcolm.* Flowers yellow.

Potentilla fruticosa, *Linn. Sp. Pl.* p. 495; *Kew Bull.* 1896, p. 210; *Peterm. Mitteil.* Erg.-Heft 131, p. 373; *Fl. Brit. Ind.* ii. p. 347.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Camp 31, September 21, *Hedin.* Without locality, *Deasy & Pike*, 891. Flowers yellow.

Potentilla fruticosa, *Linn.*, var. **Inglisii**, *Hook. f. Fl. Brit. Ind.* ii. p. 348.

P. Inglisii, *Royle, Illustr. Bot. Himal.* p. 207, t. 41.

Tazang, 16,500 ft., *Strachey & Winterbottom.* Flowers yellow.

Potentilla fruticosa, *Linn.*, var. **pumila**, *Hook. f. Fl. Brit. Ind.* ii. p. 348.

Without locality, *Thorold.* Plateau west of Dangla mountains, 89° 44′, 32° 51′, 16,350 ft., *Rockhill.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers yellow.

Potentilla multifida, *Linn. Sp. Pl.* p. 496; *Hook. f. Fl. Brit. Ind.* ii. p. 353.

Niti pass, etc., 15,000–17,000 ft., *Strachey & Winterbottom.* Flowers yellow.

Potentilla nivea, *Linn. Sp. Pl.* p. 499; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 135; *Hook. f. Fl. Brit. Ind.* ii. p. 358.

Kechu valley, 96° 28′, 31° 25′, 12,700 ft., *Rockhill.* Flowers yellow.

Potentilla sericea, *Linn. Sp. Pl.* p. 495, var. **polyschista**, *Lehm. Rev. Gen. Pot.* p. 34; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 112; *Hook. f. Fl. Brit. Ind.* ii. p. 354.

P. polyschista, *Boiss. Fl. Orient.* ii. p. 710.

Near Rakas Tal, 15,000–17,000 ft., *Strachey & Winterbottom.* Sandy earth and gravel in valleys, 17,500 ft., *Thorold.* Near the Mangtsa Tso, 17,000 ft., June 24, *Deasy & Pike*, 811, 890. Flowers yellow.

Chamærhodos sabulosa, *Bunge, in Ledeb. Fl. Alt.* i. p. 431; *Ledeb. Ic. Fl. Ross.* iii. t. 257; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 112; *Hook. f. Fl. Brit. Ind.* ii. p. 360.

Gugé, 15,000 ft., *Strachey & Winterbottom.* Sandy soil in valleys, 17,000 ft., *Thorold.* 82° 6′, 34° 20′, 16,700 ft., July 29, *Deasy & Pike*, 856. Flowers yellow.

SAXIFRAGACEÆ.

Saxifraga flagellaris, *Willd. ex Sternb. Rev. Saxifr.* p. 25, t. 6; *Hook. f. Fl. Brit. Ind.* ii. p. 397.

Lanjar, 17,000 ft., *Strachey & Winterbottom.* Flowers yellow, often with red lines.

Saxifraga Hirculus, *Linn. Sp. Pl.* p. 402, var. **hirculoides,** *C. B. Clarke, in Hook. f. Fl. Brit. Ind.* ii. p. 392.

S. hirculoides, *Decne. in Jacquem. Voy. Bot.* p. 67, t. 78. f. 1.

Balch pass, 17,000 ft., *Strachey & Winterbottom.* Lanak pass, *Thomson.* Flowers yellow.

Saxifraga Jacquemontiana, *Decne. in Jacquem. Voy. Bot.* p. 68, t. 78. f. 2, var. **stella-aurea,** *C. B. Clarke, in Hook. f. Fl. Brit. Ind.* ii. p. 395.

S. stella-aurea, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* ii. (1857) p. 72.

91° 40′, 35° 21′, August 12, *Wellby & Malcolm.* Flowers yellow. A very imperfect specimen, doubtfully placed in this species.

Saxifraga parva, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 112.

Sides of rivulets, 17,000 ft., *Thorold.* Growing near a stream on a patch of grass in broken granite, 16,800 ft., August 12, *Deasy & Pike*, 875. Flowers yellow.

Saxifraga saginoides, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* ii. (1857) p. 68; *Peterm. Mitteil.* Erg.-Heft 131, p. 374; *Hook. f. Fl. Brit. Ind.* ii. p. 392.

Without locality, September 1, *Hedin.* Flowers yellow.

Saxifraga tangutica, *Engl. in Bull. Acad. Pétersb.* xxix. (1883) p. 114; *Kew Bull.* 1896, p. 210.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers yellow.

Parnassia ovata, *Ledeb. in Mém. Acad. Pétersb.* v. (1815) p. 528; *Hook. f. Fl. Brit. Ind.* ii. p. 403.

P. trinervis, *Drude, in Linnæa*, xxxix. (1875) p. 322; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 112.

Tisum, 15,000 ft., *Strachey & Winterbottom*. Marsh, 15,000 ft., *Thorold*. Flowers white.

CRASSULACEÆ.

Sedum algidum, *Ledeb. Fl. Alt.* ii. p. 194, var. **tanguticum**, *Maxim. in Bull. Acad. Pétersb.* xxix. (1884), col. 126; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 135.

Camp north of Tsacha-tsang-bo-chu, 90° 03′, 32° 28′, 15,650 ft., July 5, *Rockhill*. Flowers yellow.

Sedum crenulatum, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* ii. (1858) p. 96; *Hook. f. Fl. Brit. Ind.* ii. p. 417.

Niti pass, etc., 14,000–17,000 ft., *Strachey & Winterbottom*. Flowers rose-pink.

Sedum Ewersii, *Ledeb. Fl. Alt.* ii. p. 191; *Hook. f. Fl. Brit. Ind.* ii. p. 421.

Gugé, 15,500 ft., *Strachey & Winterbottom*. Flowers purple-red.

Sedum fastigiatum, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* ii. (1858) p. 98; *Hook. f. Fl. Brit. Ind.* ii. p. 419.

Valleys in Gugé, and near Rakas Tal, 15,000–17,000 ft., *Strachey & Winterbottom*. Flowers red.

Sedum Przewalskii, *Maxim. in Bull. Acad. Pétersb.* xxix. (1884) col. 156; *Kew Bull.* 1896, p. 211.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. Flowers yellow.

Sedum quadrifidum, *Pall. Reise*, iii. p. 730; *Ledeb. Fl. Ross.* ii. p. 177; *Journ. Linn. Soc., Bot.* ii. (1858) p. 97, et xxx. (1894) p. 112; *Kew Bull.* 1896, p. 211; *Peterm. Mitteil.* Erg.-Heft 131, p. 374; *Hook. f. Fl. Brit. Ind.* ii. p. 418.

S. coccineum, *Royle, Illustr. Bot. Himal.* p. 222, t. 48. f. 3.

Close to streams in valleys, 17,000 ft., *Thorold*. Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. 89° 35′, 35° 18′, 15,990 ft., August 1, *Wellby & Malcolm*. September 2, *Hedin*. Flowers yellow.

The identification of the Tibet specimens is not quite satisfactory.

Sedum Rhodiola, *DC. Fl. Fr.* ed. 3, iv. p. 386; *Ledeb. Fl. Ross.* ii. p. 179; *Hook. f. Fl. Brit. Ind.* ii. p. 417.

In 82° 8′, 34° 38′, 17,000 ft., July 27, *Deasy & Pike*, 852. Flowers yellow. Leaves often red-tipped.

The specimens are much below the average of the species in size.

Sedum rotundatum, *Hemsl. in Kew Bull.* 1896, p. 210; *Hook. Ic. Pl.* t. 2469.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. Flowers red.

Sedum tibeticum, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* ii. (1858) p. 96; *Kew Bull.* 1896, p. 210; *Hook. f. Fl. Brit. Ind.* ii. p. 418.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. Flowers red.

Sedum tibeticum, *Hook. f. et Thoms.*, var. **Stracheyi**, *C. B. Clarke, in Hook. f. Fl. Brit. Ind.* ii. p. 418; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 112.

S. Stracheyi, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* ii. (1858) p. 96.

Close to water, 17,500 ft., *Thorold*. Twenty-five miles east of the Lanak La, 17,100 ft., June 20, *Deasy & Pike*, 803.

Sempervivum acuminatum, *Jacquem. Voy. Bot.* p. 63, t. 74. f. 1; *Hook. f. Fl. Brit. Ind.* ii. p. 422.

Gugé plains, 15,500 ft., *Strachey & Winterbottom*. Flowers purple-red.

HALORRHAGIDACEÆ.

Myriophyllum verticillatum, *Linn. Sp. Pl.* p. 992; *Kew Bull.* 1896, p. 211; *Hook. f. Fl. Brit. Ind.* ii. p. 433.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. Flowers very small; anthers yellow.

Hippuris vulgaris, *Linn. Sp. Pl.* p. 4; *Hook. f. Fl. Brit. Ind.* ii. p. 432.

Gyanima, 15,000 ft., *Strachey & Winterbottom*. Flowers very small; anthers yellow.

UMBELLIFERÆ.

Selinum striatum, *Benth. et Hook. f. Gen. Pl.* i. p. 914; *Hook. f. Fl. Brit. Ind.* ii. p. 699.

Around Aru Tso, 16,200 ft., August 4, *Deasy & Pike*, 868. Flowers white.

Smells like meadow-sweet. Common, but not plentiful, in dampish places.—*Deasy & Pike.*

Pleurospermum Hookeri, *C. B. Clarke, in Hook. f. Fl. Brit. Ind.* ii. p. 705.

Shelshel and Rakas Tal, 15,500 ft., *Strachey & Winterbottom.* Bracts and flowers white.

Pleurospermum Hookeri, *C. B. Clarke*, var. **Thomsoni**, *C. B. Clarke, loc. cit.*; *Kew Bull.* 1896, p. 211.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.*

Pleurospermum stellatum, *Benth. ex C. B. Clarke, in Hook. f. Fl. Brit. Ind.* ii. p. 704, var. **Lindleyanum**, *C. B. Clarke, loc. cit.* p. 705; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 113.

Sandy soil in broad valley, 16,400 ft., *Thorold.* Bracts and flowers white.

Very young specimens of another species of *Pleurospermum* were gathered by the Littledales.

Peucedanum (§ **Cervaria**) **Malcolmii**, *Hemsl. et H. H. W. Pearson.*

Species habitu *P. Hystrici*, Bunge, altaicæ simillima, a quâ fructus forma, vittarum numero, foliorum basibus petiolisque persistentibus tenuioribus præcipue differt.

Herba pumila, perennis, pubescens, foliorum basibus petiolisque persistentibus, circiter 6 poll. alta. *Folia* petiolata, bipinnatisecta, glanduloso-pubescentia, circiter 3 poll. longa, jugis primariis distantibus, pinnulis trifidis vel nonnunquam pinnatifidis; segmenta ultima lineari-ovata, acuta, crassiuscula, puberula, $\frac{3}{4}$ lin. longa, $\frac{1}{4}$ lin. lata; vaginæ valde nervatæ, intus glabræ, extus minute pubescentes vel glabrescentes, $\frac{3}{4}$–1 poll. longæ. *Umbellæ* compositæ radiis primariis 6–12; involucri involucellique bracteæ paucæ, lineari-lanceolatæ, integræ vel basi rarissime irregulariter lobatæ, 3- vel 1-nervatæ, pubescentes, $1\frac{1}{2}$–$3\frac{1}{2}$ lin. longæ. *Flores* pedicellis brevibus pilosis suffulti. *Calycis* dentes dense pubescentes, deltoidei, $\frac{1}{8}$–$\frac{1}{4}$ lin. longi. *Petala* pallide lutea, glabra; anterius obreniforme, 2 lin. latum; lateralia posterioraque subrotunda, $\frac{3}{4}$ lin. diametro. *Fructus* ellipticus vel fere obovatus, apice leviter emarginatus, complanatus, puberulus, jugis dorsalibus vix elevatis, lateralibus contiguis dilatatis marginem alatem formantibus, $2\frac{1}{2}$ lin. longus, $1\frac{1}{2}$–2 lin. latus; vittæ ad valleculas solitariæ vel rarissime irregulariter 2-næ, fructus basin attingentes vel rarius abbreviatæ, dorsales obscuræ, commissurales claræ. Semen complanatum, facie planum, dorso convexum.

In 85° and 35° 37′, September 7, *Hedin.* 88° 20°, 35° 14′, 16,142 ft., July 26, *Wellby & Malcolm.* Flowers yellow.

Ladaki name "Kumbak"; found everywhere near fresh water; eaten as a vegetable.—*Wellby & Malcolm.*

Caprifoliaceæ.

Lonicera hispida, *Pall. ex Roem. et Schult. Syst.* v. p. 258; *Kew Bull.* 1896, p. 211; *Hook. f. Fl. Brit. Ind.* iii. p. 11.

L. bracteata, *Royle, Illustr. Bot. Himal.* pp. 236 & 237, t. 53.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers pale yellow.

Dipsaceæ.

Morina Coulteriana, *Royle, Illustr. Bot. Himal.* p. 245; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 113; *Hook. f. Fl. Brit. Ind.* iii. p. 216.

Valleys, 15,500 ft., *Thorold.* Flowers yellow.

Compositæ.

Aster altaicus, *Willd. Enum. Hort. Berol.* p. 881; *Hook. f. Fl. Brit. Ind.* iii. p. 251.

Without locality, *Wellby & Malcolm*; *Deasy & Pike.* Flowers blue.

Aster Bowerii, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 113; *Kew Bull.* 1896, p. 211; *Hook. Ic. Pl.* t. 2495; *Peterm. Mitteil.* Erg.-Heft 131, p. 374.

Sandy, gravelly soil on hill-sides, 18,000 ft., *Thorold.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Camp 10, *Hedin.* 88° 20′, 35° 14′, 16,142 ft., July 26, *Wellby & Malcolm.* Horpa Tso, 17,000 ft., July 3, *Deasy & Pike.* Flowers described as lavender, lilac, and light purplish mauve.

Growing in old gravel; very scarce.—*Deasy & Pike.*

Aster Heterochæta, *C. B. Clarke, Comp. Ind.* p. 44; *Hook. f. Fl. Brit. Ind.* iii. p. 250.

Heterochæta asteroides, *DC. Prod.* v. p. 282.

In 86° 48′, 35° 18′, 16,300 ft., July 19, *Wellby & Malcolm.* Without locality, *Deasy & Pike.* Flowers blue with a yellow centre.

Aster molliusculus, *Wall. Cat.* n. 2972; *Clarke, Comp. Ind.* p. 45; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 114; *Hook. f. Fl. Brit. Ind.* iii. p. 251.

Gugé, 15,000 ft., *Strachey & Winterbottom.* Sandy soil in sheltered nooks, 16,000 ft., *Thorold.* Flowers purple.

Aster tibeticus, *Hook. f. Fl. Brit. Ind.* iii. p. 251; *Journ. Linn. Soc., Bot.* xxx. (1894) pp. 113 et 135; *Kew Bull.* 1896, p. 211.

Calcareous soil, 17,800 ft., *Thorold.* Valley of Murus, 91° 18', 33° 44', 15,640 ft., June 23, *Rockhill.* Goring valley, 90° 25', 30° 12', about 16,500 ft., *Littledale.* Flowers purple with yellow centre.

Aster tricephalus, *C. B. Clarke, Comp. Ind.* p. 43; *Kew Bull.* 1896, p. 211; *Hook. f. Fl. Brit. Ind.* iii. p. 250.

Goring valley, 90° 25', 30° 12', about 16,500 ft., *Littledale.* Flowers blue.

Leontopodium alpinum, *Cass. in Dict. Sc. Nat.* xxv. p. 474; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 136; *Kew Bull.* 1896, p. 211; *Peterm. Mitteil.* Erg.-Heft 131, p. 374; *Hook. f. Fl. Brit. Ind.* iii. p. 279.

Valleys in Gugé, 15,000 ft., *Strachey & Winterbottom.* Bank Chilchang Tso (Lake Glenelg), 90° 10', 33° 27', 16,000 ft., June 30, *Rockhill.* Goring valley, 90° 25', 30° 12', about 16,500 ft., *Littledale.* September 1, *Hedin.* 88° 30', 35° 14', 16,616 ft., July 27, *Wellby & Malcolm.* Near the Aru Tso, 17,000 ft., July 4, *Deasy & Pike*, 867. Flowers white, tipped with purple.

Leontopodium Stracheyi, *C. B. Clarke, in Herb. Kew.*; *Journ. Linn. Soc.* xxx. p. 136.

L. alpinum, *Cass.*, var. Stracheyi, *Hook. f. Fl. Brit. Ind.* iii. p. 279.

Ruchu valley, in river bottom, 95° 12', 31° 10', 12,100 ft., August 16, *Rockkill.* Flowers white.

Anaphalis mucronata, *C. B. Clarke, in Herb. Kew.*; *Journ. Linn. Soc.* xxx. p. 136.

Basin of Dangchu, right bank affluent, 92° 08', 32° 20', 15,180 ft., July 21, *Rockhill.* Flowers white.

Anaphalis xylorhiza, *Sch.-Bip. ex Hook. f. Fl. Brit. Ind.* iii. p. 281; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 114; *Kew Bull.* 1896, p. 212.

Rocky outcrops, 15,500 ft., *Thorold.* Goring valley, 90° 25', 30° 12', about 16,500 ft., *Littledale.* Flowers white.

Antennaria nana, *Hook. f. et Thoms. ex C. B. Clarke, Comp. Ind.* p. 100; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 136; *Hook. f. Fl. Brit. Ind.* iii. p. 278.

Valley of Murus, head-waters of Yangtsekiang, 91° 20′, 33° 45′, 14,900 ft., June 22, *Rockhill.* Flowers white.

Allardia tomentosa, *Decne. in Jacquem. Voy. Bot.* p. 87, t. 95; *Hook. f. Fl. Brit. Ind.* iii. p. 313.

Balch pass, 16,000–17,000 ft., *Strachey & Winterbottom.* Flowers yellow.

Tanacetum fruticulosum, *Ledeb. Fl. Alt.* iv. p. 58, *et Ic. Fl. Ross.* i. t. 38; *Hook. f. Fl. Brit. Ind.* iii. p. 318.

15,000 ft., August 30, *Deasy & Pike*, 885. Flowers yellow.

Known to the Ladaks as "Tchŭktchŭk," *Deasy & Pike.*

Tanacetum gracile, *Hook. f. et Thoms. ex Hook. f. in Fl. Brit. Ind.* iii. p. 318.

Sutlej river in Gugé, 13,350 ft., *Strachey & Winterbottom.* Flowers yellow.

Tanacetum tibeticum, *Hook. f. et Thoms. ex C. B. Clarke, Comp. Ind.* p. 154; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 114; *Kew Bull.* 1896, p. 212; *Peterm. Mitteil.* Erg.-Heft 131, p. 374; *Hook. f. Fl. Brit. Ind.* iii. p. 319.

Close to water among stones, 17,000 ft., *Thorold.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Camp 10, *Hedin.* Without locality, *Wellby & Malcolm.* 81° 41′, 34° 52′, 16,200 ft., July 12, *Deasy & Pike*, 836. Flowers yellow.

Ladaki name "Boortzse." The only vegetable fuel of this country.—*Deasy & Pike.*

Artemisia Campbellii, *Hook. f. et Thoms. ex C. B. Clarke, Comp. Ind.* p. 164; *Hook. f. Fl. Brit. Ind.* iii. p. 327.

Bhomtso, 16,000–18,000 ft., *Hooker.* Flowers brown.

Artemisia desertorum, *Spreng. Syst.* iii. p. 490; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 114; *Hook. f. Fl. Brit. Ind.* iii. p. 322.

Broad valleys, 16,000 ft., *Thorold.* Flowers yellow.

Artemisia macrocephala, *Jacquem. ex Besser in Bull. Soc. Nat. Mosc.* ix. (1836) p. 28; *Hook. f. Fl. Brit. Ind.* iii. p. 329.

A. Griffithiana, *Boiss. Fl. Orient.* iii. p. 376.

Without locality at 15,000 ft., August 30, *Deasy & Pike*, 884. Flowers yellow.

Known to the Ladaks as "Cumtchen," *Deasy & Pike.*

Artemisia minor, *Jacquem. ex Besser, in Bull. Soc. Nat. Mosc.* ix. (1836) p. 22; *DC. Prod.* vi. p. 124; *Hook. f. Fl. Brit. Ind.* iii. p. 329.

A. tibetica, *Hook. f. loc. cit.*

A. Sieversiana, *Willd.*, var. tibetica, *C. B. Clarke, Comp. Ind.* p. 165.

88° 30′, 35° 20′, 16,294 ft., July 28, *Wellby & Malcolm.* Flowers mauve.

Artemisia Roxburghiana, *Besser, in Bull. Soc. Nat. Mosc.* ix. (1836) p. 57; *Hook. f. Fl. Brit. Ind.* iii. p. 326.

Sutlej river, 11,500 ft., *Strachey & Winterbottom.* Flowers purple.

Artemisia sacrorum, *Ledeb. in Mém. Acad. Pétersb.* v. (1805) p. 571; *Hook. f. Fl. Brit. Ind.* iii. p. 326.

Sutlej river in Gugé, 12,000–13,500 ft., *Strachey & Winterbottom.* Flowers yellow or yellow-green.

Artemisia salsoloides, *Willd. Sp. Pl.* iii. p. 1832; *Besser, Monogr. Artem.* t. 2; *Kew Bull.* 1896, p. 212; *Hook. f. Fl. Brit. Ind.* iii. p. 321.

Sutlej river in Gugé, 12,000–13,500 ft., *Strachey & Winterbottom.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Without locality, *Deasy & Pike*, 897. Flowers yellow-green.

Artemisia Stracheyi, *Hook. f. et Thoms. ex C. B. Clarke, Comp. Ind.* p. 164; *Kew Bull.* 1896, p. 211; *Hook. f. Fl. Brit. Ind.* iii. p. 328.

Manasarowar, 14,000–15,500 ft., *Strachey & Winterbottom.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers yellow-green.

Artemisia (§ **Dracunculus**) **Wellbyi**, *Hemsl. et H. H. W. Pearson* sp. nov.; ab *A. salsoloide*, Willd., habitu pumiliore, racemis brevioribus laxioribusque, involucri phyllis marginibus membranaceis atro-fuscis, foliis integris trifidis vel raro pinnatisectis diversa.

Suffrutex circiter ½ ped. altus. *Radix* elongata, lignosa, ramosa. *Caules* numerosi, ramosi, infra lignosi, supra herbacei, repentes vel ascendentes, subangulati, sericeo-pubescentes vel glabrescentes. *Folia* alterna, sessilia, carnosa, dense appresso-pubescentia, demum glabra, integra, lineari-oblonga vel ambitu cuneatim spatulata, apice alte trifida vel raro pinnatisecta, basibus persistentibus, 4–7 lin. longa; lobi lineares, lineari-oblongi vel -ovati, acuti, marginibus revolutis, 1–4 lin. longi. *Capitula* globosa, pauciflora, 2–3 lin. diametro, pedunculis brevibus bracteolatis suffulta, axillaria, solitaria, plus minus nutantia, in racemos simplices foliatos $\frac{3}{4}$–2 in. longos laxe disposita; phylla circiter 12, oblonga, obtusa, concava, herbacea, crassiuscula, glabra, marginibus membranaceis atro-fuscis, costis prominentibus, 1–1$\frac{1}{4}$ lin. longa, $\frac{1}{2}$–$\frac{3}{4}$ lin. lata. *Receptaculum* nudum. *Flores marginales* feminei, 1–1$\frac{1}{2}$ lin. longi, lobis stigmaticis circiter $\frac{1}{2}$ lin. longis. *Flores disci* omnes masculi ovariis abortivis, tubulosi, 1$\frac{1}{8}$–1$\frac{1}{4}$ lin. longi. *Antheræ* $\frac{1}{2}$–$\frac{3}{4}$ lin. longæ, connectivis in aristas tenues breviores productis.

Artemisia sp., *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 114.

17,100 ft., *Thorold.* 86° 10′, 35° 19′, 16,214 ft., July 16, *Wellby & Malcolm.* 82° 8′, 34° 48′, 17,000 ft., July 27, *Deasy & Pike.* Flowers yellow-green.

Plant strongly scented, something like crushed nettle-leaves.—*Deasy & Pike.*

Cremanthodium Deasyi, *Hemsl.*

Senecio (§ Cremanthodium) Deasyi, *Hemsl. in Hook. Ic. Pl.* t. 2587.

Werneria nana, [*Benth. in*] *Benth. & Hook. f. Gen. Pl.* ii. p. 451.

Ligularia nana, *Decne. in Jacquem. Voy. Bot.* p. 91, t. 99.

In water-logged, stony soil, 17,600 ft., *Thorold*, 33. Growing in gravel east of Horpa Tso, 17,000 ft., very scarce and very little vegetation of any kind, *Deasy & Pike*, 827, 841. Flowers yellow.

It was only after the publication of this plant under the name of *Senecio* (§ *Cremanthodium*) *Deasyi* that we found out that it had been collected before in Kashmir and described under the names cited above. *Werneria* is a large Andine genus with which four or five Abyssinian and Himalayan allied plants have been associated. So far as *Werneria nana*, Benth., is concerned we have no hesitation about placing it in *Cremanthodium*; and it is very closely allied to *C. humile*, Maxim. We will not presume to settle here the limits of the genus *Senecio*; but taking such other genera, numerous in species, as *Erica*, *Solanum*, and *Carex*, in relation to range of variation, it might well include *Cacalia*, *Cremanthodium* and several other proposed genera, perhaps *Werneria* itself. Jacquemont's figure was from a better specimen than ours.

Cremanthodium Fletcheri, *Hemsl.*

Senecio (§ Cremanthodium) Fletcheri, *Hemsl. in Kew Bull.* 1896, p 212.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers yellow.

Cremanthodium goringensis, *Hemsl.*

Senecio (§ Cremanthodium) goringensis, *Hemsl. in Kew Bull.* 1896, p. 212; *Peterm. Mitteil.* Erg.-Heft 131, p. 374.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Near lake 18, September 12, *Hedin.* 91° 20′, 35° 23′, 16,404 ft., August 10, *Wellby & Malcolm.* Aru Tso, 16,200 ft., August 4, *Deasy & Pike*, 864. Flowers yellow.

Senecio arnicoides, *Wall. Cat.* n. 8138, var. **frigidus**, *Hook. f. Fl. Brit. Ind.* iii. p. 351; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 114.

Niti pass, 16,700 ft., *Strachey & Winterbottom.* Water-logged soil in wide valleys, 17,000 ft., *Thorold.* Flowers yellow.

Senecio coronopifolius, *Desf. Fl. Atlant.* ii. p. 273; *Hook. f. Fl. Brit. Ind.* iii. p. 341.

Rakas Tal and Shelshel, 14,000–16,000 ft., *Strachey & Winterbottom.* Flowers yellow.

Saussurea alpina, *DC. in Ann. Mus. Par.* xvi. (1810) p. 198; *Peterm. Mitteil.* Erg.-Heft 131, p. 374.

August 7, *Hedin.* Flowers purple-blue.

Saussurea Aster, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 115, t. 5.

Sandy, gravelly soil, 17,500 ft., *Thorold.* 86° 48′, 35° 18′, 16,300 ft., July 19, *Wellby & Malcolm.* Near Horpa Tso, 16,400 ft., June 28, *Deasy & Pike*, 818. Flowers purple (Thorold); blue (Wellby & Malcolm).

Saussurea bracteata, *Decne. in Jacquem. Voy. Bot.* p. 94, t. 102; *Peterm. Mitteil.* Erg.-Heft 131, p. 374; *Hook. f. Fl. Brit. Ind.* iii. p. 366.

S. Koslowi, *C. Winkl. in Act. Horti Petrop.* xiii. p. 241.

Balch pass and Lanjar, 16,000–17,000 ft., *Strachey & Winterbottom.* Camp 31, *Hedin.* 82° 40′, 33° 30′, 16,800 ft., August 12, *Deasy & Pike*, 873. Flowers red.

Saussurea glanduligera, *Sch.-Bip. ex Hook. f. Fl. Brit. Ind.* iii. p. 371; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 114.

Tisum, 15,000 ft., *Strachey & Winterbottom.* Sandy, stony soil in valley at 17,800 ft., *Thorold.* On gravel near an ice-covered lake, 82° 24′, 34° 41′, 16,600 ft., July 6, *Deasy & Pike*, 834, 899. Flowers purple.

Saussurea Hookeri, *C. B. Clarke, Comp. Ind.* p. 230; *Hook. f. Fl. Brit. Ind.* iii. p. 371.

Balch pass, 16,000 ft., *Strachey & Winterbottom.* Flowers purple.

Saussurea Kunthiana, *C. B. Clarke, Comp. Ind.* p. 225; *Hook. f. Fl. Brit. Ind.* iii. p. 369.

Leontodon ? Kunthiana, *Wall. Cat.* n. 3292.

Aplotaxis leontodontoides, *DC. Prodr.* vi. p. 539.

In 88° 20′, 35° 20′, 16,526 ft., July 29, *Wellby & Malcolm.* Without locality, *Deasy & Pike*, 900. Flowers purple.

Saussurea pumila, *C. Winkl. in Act. Horti Petrop.* xiii. p. 244. September 21, *Hedin.* Flowers rose-lilac.

Saussurea pygmæa, *Spreng. Syst.* iii. p. 381; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 114.

Top of pass, 17,800 ft., *Thorold.* Flowers purple.

Saussurea sorocephala, *Hook. f. et Thoms. in C. B. Clarke, Comp. Ind.* p. 226; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 115; *Peterm. Mitteil.* Erg.-Heft 131, p. 374; *Hook. f. Fl. Brit. Ind.* iii. p. 377.

Aplotaxis gnaphalodes, *Royle, Illustr. Bot. Himal.* p. 251, t. 59. f. 1.

Stony soil close to water, 17,000 ft., *Thorold.* Camp 10, *Hedin.* 86° 48′, 35° 18′, 16,301 ft., July 19, *Wellby & Malcolm.* Horpa Tso, 17,000 ft., July 5, *Deasy & Pike*, 828, 829. Flowers purple.

Saussurea subulata, *C. B. Clarke, Comp. Ind.* p. 226 partim; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 114; *Kew Bull.* 1896, p. 212; *Peterm. Mitteil.* Erg.-Heft 131, p. 374; *Hook. f. Fl. Brit. Ind.* iii. p. 367.

S. setifolia, *Klatt in Sitz. Akad. Muench.* (1878) p. 95.

Close to water, 17,000 ft., *Thorold.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* August 6, *Hedin.* 88° 20′, 35° 20′, 16,526 ft., July 29, *Wellby & Malcolm.* Near the Mangtsa Tso, 16,900 ft., June 25, *Deasy & Pike*, 815, 849. Flowers purple or mauve.

Saussurea tangutica, *Maxim. in Bull. Acad. Pétersb.* xxvii. (1881) p. 489; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 136.

Near the summit of Gam (or Angti) La, 98° 13′, 30° 40′, 15,600 ft., *Rockhill.* Tsaidam, *Przewalski.* Floral leaves large, rose or purple.

Saussurea Thomsoni, *C. B. Clarke, Comp. Ind.* p. 227; *Hook. f. Fl. Brit. Ind.* iii. p. 366.

S. acaulis, *Klatt, in Sitz. Akad. Muench.* (1878) p. 91.

S. amblyophylla, *C. Winkl. in Act. Horti Petrop.* xiii. p. 245.

In 86°, 35° 19′, 16,528 ft., July 15, *Wellby & Malcolm.* Tsaidam, *Przewalski.* Flowers purple.

Saussurea Thoroldi, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 115, t. 4. ff. 5–9; *Kew Bull.* 1896, p. 212.

Sandy soil close to water, 16,400 ft., *Thorold.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* 88° 20′, 35° 14′, 16,142 ft., July 16, *Wellby & Malcolm.* Without locality, *Deasy & Pike*, 898. Flowers purple.

Eaten as a vegetable; found in damp places; flowers purple.—*Wellby & Malcolm.*

Saussurea tridactyla, *Sch.-Bip. ex Hook. f. Fl. Brit. Ind.* iii. p. 377; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 115.

Hill-side, 19,000 ft., *Thorold.* Flowers white.

Saussurea Wellbyi, *Hemsl. in Hook. Ic. Pl.* t. 2588.

Widely distributed: 90°–96°, 35° 15′–36°, 14,600–16,800 ft., *Wellby & Malcolm.*

In flower during August and September. Flowers purple.

Crepis flexuosa, *C. B. Clarke, Comp. Ind.* p. 254.

Crepis glauca, *Benth. et Hook. f. Gen. Pl.* ii. p. 515; *Hook. f. Fl. Brit. Ind.* iii. p. 394.

Youngia flexuosa, *Ledeb. Fl. Ross.* ii. p. 838.

Prenanthes polymorpha et P. flexuosa, *Ledeb. Fl. Alt.* iv. p. 145, *et Ic. Pl. Ross.* t. 498.

Sutlej river in Gugé, 13,350 ft., *Strachey & Winterbottom.* 17,200 ft., *Thorold*, 70. 88° 20′, 35° 20′ 16,526 ft., July 29, *Wellby & Malcolm.* 82° 6′, 32° 32′–34° 21′, 14,400 and 16,100 ft., September 4, *Deasy & Pike*, 857, 862, 878, 888. Flowers yellow.

Grows in rather damp places; scarce.—*Deasy & Pike.*

Crepis glomerata, *Benth. et Hook. f. Gen. Pl.* ii. p. 515; *Hook. f. Fl. Brit. Ind.* iii. p. 398.

Tisum, 15,000 ft., *Strachey & Winterbottom.* Flowers yellow.

Crepis sorocephala, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 116, t. 4. ff. 1–4.

Sandy, gravelly soil, 17,500 ft., *Thorold.* 83° 15′, 35° 11′, 16,316 ft., June 29, *Wellby & Malcolm.* Without locality, *Deasy & Pike*, 825.

Flowers white with blue tints; centre black and yellow.—*Wellby & Malcolm.*

Crepis, sp. aff. *C. sorocephalæ*, Hemsl., et *C. glomeratæ*, Decne.

Near the Mangtsa Tso, 17,000 ft., June 24, *Deasy & Pike*, 814 (only specimen seen).

This meagre specimen consists of a deep, stout, woody taproot, and a rosette of heads at ground-level. The bracts of the involucre are glabrous, and the dried flowers are pink.

Taraxacum bicolor, *DC. Prod.* vii. p. 148.

T. officinale, *Wigg.*, var., *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 116.

Leontodon leucanthus, *Ledeb. Fl. Alt.* iv. p. 154, *et Ic. Pl. Ross.* t. 132.

Stony, wide valleys, 17,200 ft., *Thorold*, 55 & 71. 82° 12′, 34° 20′, 16,100 ft., in damp ground and swamps, July 31, *Deasy & Pike*, 860, 895, 896. Flowers white tinged with yellow.

Taraxacum lanceolatum, *Poir. in Lam. Encyc.* v. p. 349.

T. officinale, *Wigg.*, var.?, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 116.

Hill-sides, 16,000 ft., *Thorold*, 135. Near Aru Tso, 16,900 ft., August 5, *Deasy & Pike*, 840, 869. Flowers yellow.

Taraxacum officinale, [*Weber in*] *Wigg. Prim. Fl. Holsat.* p. 56, var. **parvula**, *Hook. f. Fl. Brit. Ind.* iii. p. 401; *Kew Bull.* 1896, p. 213.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers yellow.

Taraxacum palustre, *DC. Fl. Fr.* iv. p. 45; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 137; *Kew Bull.* 1896, p. 212.

Valley of the Murus, 91° 18′, 33° 44′, 15,640 ft., June 23, *Rockhill.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers yellow.

Lactuca Deasyi, *S. Moore, in Journ. Bot.* xxxviii. (1900) p. 428.

Aksu, 81° 7′, 35° 5′, 16,500? ft., *Deasy.* Flowers yellow.

Lactuca Lessertiana, *C. B. Clarke, Comp. Ind.* p. 270; *Hook. f. Fl. Brit. Ind.* iii. p. 408.

Valleys of Gugé, 16,000 ft., *Strachey & Winterbottom.* Flowers blue.

CAMPANULACEÆ.

Cyananthus incanus, *Hook. f. et Thoms. in Journ. Linn. Soc., Bot.* ii. (1858) p. 20; *Hook. f. Fl. Brit. Ind.* iii. p. 434, var. **leiocalyx**, *Franch. in Morot's Journ. de Bot.* i. (1887) p. 279; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 137.

Kechu valley, 96° 28′, 31° 25′, 12,700 ft., August 22, *Rockhill.* Flowers blue.

PLUMBAGINACEÆ.

Statice aurea, *Linn. Sp. Pl.* p. 276; *Amman. Stirp. Rar. Ruth. Ic.* p. 132, t. 18. f. 2.

In 97°, 35° 42′, 13,363 ft., September 15, *Wellby & Malcolm.* Flowers yellow.

PRIMULACEÆ.

Androsace Chamæjasme, *Host, Syn. Pl. Austr.* p. 95; *Willd. Sp. Pl.* i. p. 799; *Reichb. Ic. Fl. Germ.* xvii. t. 1112. f. 6; *Hook. f. Fl. Brit. Ind.* iii. p. 499, var. **coronata**, *Watt in Journ. Linn. Soc., Bot.* xx. (1882) p. 17, t. 17 A, et xxx. (1894) p. 117; *Peterm. Mitteil.* Erg.-Heft 131, p. 374.

Sandy, gravelly soil in sheltered spots near water, 17,500 ft., *Thorold*, 20. September 1, *Hedin.* 81° 41′, 34° 51′, 16,200 ft., July 9, *Deasy & Pike*, 812, 845. Flowers purple, or white with purple centre, or white with yellow centre.

Sweet smell like English May.—*Deasy & Pike.*

Androsace Tapete, *Maxim. in Bull. Acad. Pétersb.* xxxii. (1888) p. 505; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 137.

Valley of Murus, head-waters of Yangtsekiang, 91° 20′, 33° 45′, 14,900 ft., June 22, *Rockhill.* 83°, 35° 8′, 16,487 ft., June 25, *Wellby & Malcolm.* Profuse in valleys west of Horpa Tso, 17,500 ft., June 28, *Deasy & Pike*, 816. Flowers white.

Androsace villosa, *Linn. Sp. Pl.* p. 142; *Hook. f. Fl. Brit. Ind.* iii. p. 499, var. **latifolia**, *Ledeb.*; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 137.

Near Rakas Tal, 15,000–17,000 ft., *Strachey & Winterbottom.* Valley of the Murus, 91° 18′, 33° 44′, 15,640 ft., June 23, *Rockhill.* Flowers white.

Primula purpurea, *Royle, Illustr. Bot. Himal.* p. 311, t. 77. f. 2; *Kew Bull.* 1896, p. 213; *Hook. f. Fl. Brit. Ind.* iii. p. 490, *sub* P. Stuartii.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers pale or deep purple.

Primula rotundifolia, *Wall. ex Roxb. Fl. Ind. ed. Carey*, ii. p. 18; *Kew Bull.* 1896, p. 213; *Hook. f. Fl. Brit. Ind.* iii. p. 483.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers purple.

Primula tibetica, *Watt, in Journ. Linn. Soc., Bot.* xx. (1882) p. 6; xxx. (1894) p. 117; *Hook. f. Fl. Brit. Ind.* iii. p. 488.

Gugé valleys, 14,000–15,000 ft., *Strachey & Winterbottom.* Close to water, 16,200 ft., *Thorold.* Flowers purple.

Glaux maritima, *Linn. Sp. Pl.* p. 207; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 117; *Hook. f. Fl. Brit. Ind.* iii. p. 505.

At 16,200 ft., *Thorold.* Flowers pink.

Gentianaceæ.

Gentiana aquatica, *Linn. Sp. Pl.* p. 229; *Pallas, Fl. Ross.* i. pt. 2, p. 109, t. 98; *Hook. f. Fl. Brit. Ind.* iv. p. 110.

Gyanima, 15,000 ft., *Strachey & Winterbottom.* 16,800 ft., *Deasy & Pike*, 874, partim. Flowers blue.

Gentiana falcata, *Turcz. ex Kar. et Kir. in Bull. Soc. Nat. Mosc.* xv. (1842) p. 404; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 117.

Marsh, 15,000 ft., *Thorold.* Flowers blue.

Gentiana humilis, *Steven, in Mém. Soc. Nat. Mosc.* iii. (1812) p. 258; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 117; *Hook. f. Fl. Brit. Ind.* iv. p. 111.

At 16,200 ft., *Thorold.* 15,000 ft., August 30, *Deasy & Pike*, 883.

Flowers pale blue or lavender; growing in a marsh; very scarce.—*Deasy & Pike.*

Gentiana nubigena, *Edgew. in Trans. Linn. Soc.* xx. (1846) p. 85; *Hook. f. Fl. Brit. Ind.* iv. p. 116.

Balch pass and Rakas Tal, 15,000–17,000 ft., *Strachey & Winterbottom.* Flowers blue.

Gentiana Rockhillii, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 137.

Kechu valley, 96° 28′, 31° 25′, 12,700 ft., August 22, *Rockhill.* Flowers blue.

Gentiana squarrosa, *Ledeb. in Mém. Acad. Pétersb.* v. (1812) p. 527; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 117; *Hook. f. Fl. Brit. Ind.* iv. p. 111.

Banks of dry rivulet on hill-side, 17,200 ft., *Thorold.* Flowers blue.

Gentiana tenella, *Rottb. in Kiob. Skr. Selsk.* x. (1770) p. 436, t. 2. f. 6; *Hook. f. Fl. Brit. Ind.* iv. p. 109.

In 91° 40′, 35° 21′, 16,812 ft., August 12, *Wellby & Malcolm.* 82° 40′, 33° 30′, 16,800 ft., August 12, *Deasy & Pike,* 874, partim.

Flowers gentian-blue. Growing near stream in a patch of grass on broken granite. Only one or two specimens seen, although I looked closely.—*Pike.*

Gentiana thianschanica, *Rupr. Sert. Thianschan. in Mém. Acad. Sc. Pétersb.* xix. (1869) p. 61.

G. decumbens, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 117, *non Linn.*

Sandy soil near water, 15,400 ft., *Thorold.* Flowers greenish-white.

Gentiana Thomsoni, *C. B. Clarke, in Hook. f. Fl. Brit. Ind.* iv. p. 109.

G. arenaria, *Maxim. in herb. Kew., ined.?*

Without locality, *Deasy & Pike.* North Tibet, *Przewalski.* Flowers very small, blue.

Pleurogyne brachyanthera, *C. B. Clarke, in Hook. f. Fl. Brit. Ind.* iv. p. 120.

P. diffusa, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 117, *non Maxim.*

Hill-side close to water, 16,800 ft., *Thorold.* On the south-east shore of Aru Tso, growing with *Taraxacum lanceolatum,* Poir., 16,900 ft., August 5, *Deasy & Pike.* Flowers blue.

Boraginaceæ.

Microula sikkimensis, *Hemsl. in Hook. Ic. Pl.* sub t. 2562.

Tretocarya sikkimensis, *Oliver, loc. cit.* t. 2255; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 138.

Basin of Suchu valley, north side, Drayalamo pass, 93° 17′, 31° 52′, August 2, *Rockhill.* Flowers red and blue.

Microula tibetica, *Benth. in Benth. et Hook. f. Gen. Pl.* ii. p. 853; *Hemsl. in Hook. Ic. Pl.* t. 2562; *Maxim. in Bull. Acad. Pétersb.* xxvi. (1880) p. 501.

M. Benthami, *C. B. Clarke, in Hook. f. Fl. Brit. Ind.* iv. p. 167; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 118; *Hook. Ic. Pl.* t. 2257.

Tretocarya pratensis, *Maxim. in Bull. Acad. Pétersb.* xxvii. (1881) p. 505; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 117.

Close to streams, 18,000 ft., *Thorold.* 88° 20′, 35° 20′, 16,616 ft., July 27, *Wellby & Malcolm.* 82° 8′, 34° 38′, 17,000 ft., *Deasy & Pike,* 848. Flowers white or blue.

Solanaceæ.

Physochlaina præalta, *Hook. Bot. Mag.* t. 4600, in nota; *Hook. f. Fl. Brit. Ind.* iv. p. 244.

Physochlaina grandiflora, *Hook. Bot. Mag.* t. 4600.

Scopolia præalta, *Dun. in DC. Prod.* xiii. p. 554.

Tisum, 15,000 ft., *Strachey & Winterbottom.* Flowers yellow.

Scopolia sp.

Camps 29 and 30, *Hedin.*

This specimen is leafless and bears only a few old fruits.

Scrophulariaceæ.

Scrophularia dentata, *Royle, ex Benth. Scroph. Ind.* p. 19; *Hook. f. Fl. Brit. Ind.* iv. p. 256.

Without locality, *Deasy & Pike.* Flowers purple-brown.

Pedicularis alaschanica, *Maxim. in Bull. Acad. Pétersb.* xxiv. (1878) p. 59, var. **tibetica**, *Maxim.*; *Prain, in Ann. Bot. Gard. Calc.* iii. p. 164, t. 25. ff. *a–b*; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 118.

Broad valley, 16,000 ft., *Thorold.* Flowers yellow.

Pedicularis cheilanthifolia, *Schrenk*; *Fisch. et Mey. Enum. Pl. Nov.* ii. p. 19; *Prain, in Ann. Bot. Gard. Calc.* iii. p. 171, t. 32. ff. *a–c*; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 118; *Hook. f. Fl. Brit. Ind.* iv. p. 308.

Balch pass, about 17,000 ft., *Strachey & Winterbottom.* In wide valleys, 17,000 ft., *Thorold.* Near Aru Tso, 16,200 ft., August 4, *Deasy & Pike*, 866. Flowers white veined with purple.

Pedicularis longiflora, *Rudolph, in Mém. Acad. Pétersb.* iv. p. 345, t. 3; *Prain, in Ann. Bot. Gard. Calc.* iii. p. 112, t. 1. ff. *e–f.*

P. tubiflora, *Fisch. in Mém. Soc. Mosc.* iii. (1812) p. 58.

Valley of Gugé, 15,000 ft., *Strachey & Winterbottom.* Without locality, 15,000 ft., August 30, 1896, *Deasy & Pike*, 881.

Growing profusely in a swamp; flowers yellow streaked with purple-red; faint smell like cowslips.—*Deasy & Pike.*

Pedicularis Oederi, *Vahl, in Hornem. Dansk. Oek. Plantel.* ed. 2, p. 580; *Prain, in Ann. Bot. Gard. Calc.* iii. p. 181, t. 34. ff. *a–c*; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 138.

P. versicolor, *Wahlenb. Veg. Helvet.* p. 118.

Balch pass, 16,500 ft., *Strachey & Winterbottom.* Valley of the Murus, 91° 18′, 33° 44′, 15,640 ft., June 23, *Rockhill.* Flowers yellow.

Pedicularis Przewalskii, *Maxim. in Bull. Acad. Pétersb.* xxiv. (1878) p. 55; *Prain, in Ann. Bot. Gard. Calc.* iii. p. 120, t. 5; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 138; *Kew Bull.* 1896, p. 213.

Basin of Suchu, valley north side, Drayalamo pass, 93° 17′, 31° 52′, 14,000 ft., August 2, *Rockhill.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers purple.

Pedicularis rhinanthoides, *Schrenk, Enum. Pl. Nov.* i. p. 22; *Prain, in Ann. Bot. Gard. Calc.* iii. p. 109, t. 1; *Kew Bull.* 1896, p. 213; *Hook. f. Fl. Brit. Ind.* iv. p. 314.

Balch pass, 13,000–16,500 ft., *Strachey & Winterbottom.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers purple.

Oreosolen unguiculatus, *Hemsl. in Kew Bull.* 1896, p. 213.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers yellow.

SELAGINACEÆ.

Lagotis brachystachya, *Maxim. in Bull. Acad. Pétersb.* xxvii. (1881) p. 525; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 138; *Peterm. Mitteil.* Erg.-Heft 131, p. 374.

Hill-slope 2 miles north of Murus river, 91° 31′, 33° 53′, 14,750 ft., June 21, *Rockhill*. In a stream, September 1, *Hedin*. 90° 20′, 35° 15′, 15,781 ft., August 5, *Wellby & Malcolm*. Flowers white.

Lagotis decumbens, *Rupr. Sert. Tiansch.* p. 64; *Hook. f. Fl. Brit. Ind.* iv. p. 559.

Gymnandra Thomsoni, *C. B. Clarke, in Herb. Kew.*

East of Horpa Tso, 17,000 ft., July 5, *Deasy & Pike*, 831. Flowers purple.

Lagotis glauca, *J. Gaertn. in Nov. Comm. Petrop.* xiv. (1770) p. 533, t. 18. f. 2, var. **kunawurensis**, *Hook. f. Fl. Brit. Ind.* iv. p. 560.

Gymnandra kunawurensis, *Royle, ex Benth. Scroph. Ind.* p. 47.

Rakas Tal, 15,000–16,000 ft., *Strachey & Winterbottom*. Flowers purple.

LABIATÆ.

Nepeta decolorans, *Hemsl. in Hook. Ic. Pl.* t. 2470, *et in Kew Bull.* 1896, p. 213.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale*. Flowers blue.

Nepeta discolor, *Royle, ex Benth. in Hook. Bot. Misc.* iii. (1833) p. 378; *Hook. f. Fl. Brit. Ind.* iv. p. 659.

Niti pass, 15,000 ft., *Strachey & Winterbottom*. Flowers white or pale blue.

Nepeta longibracteata, *Benth. Lab.* p. 737; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 118; *Hook. f. Fl. Brit. Ind.* iv. p. 660.

Balch pass, 17,000 ft., *Strachey & Winterbottom*. Stony soil in old watercourse, 17,400 ft., *Thorold*. South end of Aru Tso, 16,200 ft., August 4, *Deasy & Pike*, 870.

Plant smells like "pear drops." Rare.—*Deasy & Pike*. Flowers blue.

Nepeta supina, *Steven, in Mém. Soc. Nat. Mosc.* iii. (1812) p. 265; *Hook. f. Fl. Brit. Ind.* iv. p. 658.

Near Rakas Tal, 15,000–17,000 ft., *Strachey & Winterbottom*. Flowers blue.

Nepeta thibetica, *Benth. Lab.* p. 737; *Hook. f. Fl. Brit. Ind.* iv. p. 664.

Near Rakas Tal, 15,000–17,000 ft., *Strachey & Winterbottom*. Flowers white.

Nepeta Thomsoni, *Benth. ex Hook. f. Fl. Brit. Ind.* iv. p. 658.

Lanjar, 16,400 ft., *Strachey & Winterbottom.* Flowers blue.

Dracocephalum heterophyllum, *Benth. Lab.* p. 738; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 118; *Peterm. Mitteil.* Erg.-Heft 131, p. 375; *Hook. f. Fl. Brit. Ind.* iv. p. 665.

Near Rakas Tal, 15,000–17,000 ft., *Strachey & Winterbottom.* Hill-sides at 17,700 ft., *Thorold*, 54. Camps 14 and 21, *Hedin.* 87° 35′, 35° 18′, 16,237 ft., July 23, *Wellby & Malcolm.* 81° 51′, 31° 41′, 16,200 ft., July 10, *Deasy & Pike*, 838, 847. Flowers white.

Dracocephalum Hookeri, *C. B. Clarke, in Hook. f. Fl. Brit. Ind.* iv. p. 666.

North of Sikkim, 15,000 ft., *Hooker.* Flowers blue.

Phlomis rotata, *Benth., ex Hook. f. Fl. Brit. Ind.* iv. p. 694; *Kew Bull.* 1896, p. 214.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers white.

Lamium rhomboideum, *Benth. Lab.* p. 509; *Hook. f. Fl. Brit. Ind.* iv. p. 678.

Kyungar, at 15,000 ft., *Strachey & Winterbottom.* Flowers purple.

The locality cited is a little south of Balch Dhura, but this species was inadvertently left in the revised table, and has been included in all the comparisons and calculations, so we retain it here, especially as its general distribution justifies the inference that it occurs in Tibet Proper.

CHENOPODIACEÆ.

Eurotia ceratoides, *C. A. Mey. in Ledeb. Fl. Alt.* iv. p. 239; *Peterm. Mitteil.* Erg.-Heft 131, p. 375; *Hook. f. Fl. Brit. Ind.* v. p. 8.

Plains of Gugé, 15,000–16,000 ft., *Strachey & Winterbottom.* August 7, *Hedin.* Flowers green.

Kalidium gracile, *Fenzl, in Ledeb. Fl. Ross.* iii. p. 769; *Peterm. Mitteil.* Erg.-Heft 131, p. 375.

Harato, 11,000 ft., *Hedin.* Flowers green.

Salsola collina, *Pallas, Ill. Pl.* p. 34, t. 26; *Hook. f. Fl. Brit. Ind.* v. p. 17.

Without locality, *Deasy & Pike*, 886. Fruit pink.

Salsola Kali, *Linn. Sp. Pl.* p. 222; *Hook. f. Fl. Brit. Ind.* v. p. 17.

Tisum, 15,000 ft., *Strachey & Winterbottom*. Fruit pink.

Halogeton glomeratus, *C. A. Mey. in Ledeb. Fl. Alt.* i. p. 378, *Ic. Pl. Ross.* i. t. 40; *Hook. f. Fl. Brit. Ind.* v. p. 20.

88° 30′, 35° 20′, 16,294 ft., July 28, *Wellby & Malcolm*. Flowers white or pink.

Some doubt exists as to the correctness of the identification of Wellby & Malcolm's specimen, the material being in a very young condition.

POLYGONACEÆ.

Polygonum Bistorta, *Linn. Sp. Pl.* p. 360; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 138.

Pochu valley, 94° 45′, 31° 45′, 14,000 ft., August 14, *Rockhill*. Flowers red.

Polygonum bistortoides, *Boiss. Diagn.* ser. 1, v. p. 46; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 138.

Ramachu valley, hill-side, 94° 28′, 31° 48, 12,800 ft, August 12, *Rockhill*. Flowers red.

Polygonum Deasyi, *Rendle, in Journ. Bot.* xxxviii. (1900) p. 428 (*errore* tibeticum).

North Tibet, *Deasy*. Flowers crimson.

Polygonum sibiricum, *Laxm. in Nov. Act. Petrop.* xviii. (1773) p. 531, t. 7. f. 2; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 118; *Peterm. Mitteil.* Erg.-Heft 131, p. 375; *Hook. f. Fl. Brit. Ind.* v. p. 52.

P. hastatum, *Murray, in Nov. Comm. Gott.* v. (1774) p. 37, t. 6; *Ledeb. Ic. Pl. Ross.* iv. t. 361.

Near salt lake, 16,300 ft., *Thorold*. Between camps 12 and 13, 16,160 ft., August 27, *Hedin*. 83°, 35° 10′, 16,481 ft., June 27, *Wellby & Malcolm*. Flowers pink; green (Thorold).

The Tibetan specimens are small—in many cases minute; while those from Siberia are much taller. Used as a vegetable in Tibet.

Polygonum sphærostachyum, *Meissn. Monogr.* p. 53; *Kew Bull.* 1896, p. 214; *Hook. f. Fl. Brit. Ind.* v. p. 32; *Bot. Mag.* t. 6847.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers crimson.

Polygonum tibeticum, *Hemsl. in Kew Bull.* 1896, p. 214, *et in Hook. Ic. Pl.* t. 2471.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers pink.

Polygonum tortuosum, *D. Don, Prod. Fl. Nep.* p. 71; *Hook. f. Fl. Brit. Ind.* v. p. 52.

Plains of Gugé, 15,500 ft., *Strachey & Winterbottom.* Flowers red.

Polygonum viviparum, *Linn. Sp. Pl.* p. 360; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 138; *Kew Bull.* 1896, p. 214; *Hook. f. Fl. Brit. Ind.* v. p. 31.

Valleys in Gugé, 14,000–16,000 ft., *Strachey & Winterbottom.* Pochu valley, 94° 45′, 31° 45′, 14,000 ft., August 14, *Rockhill.* Goring valley, 90° 25′, 30° 12°, about 16,500 ft., *Littledale.* Flowers pink.

Rheum spiciforme, *Royle, Illustr. Bot. Himal.* p. 318, t. 78; *Kew Bull.* 1896, p. 214; *Peterm. Mitteil.* Erg.-Heft 131, p. 375; *Hook. f. Fl. Brit. Ind.* v. p. 55.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Camp 21, *Hedin.* 81° 41′, 34° 52′, 16,200 ft., July 9, plentiful over an area of about two square miles at the foot of limestone cliffs, *Deasy & Pike*, 846. North Tibet, *Przewalski.* Flowers white or pink. Fruit crimson.

Ladaki name "Latchu."—*Deasy & Pike.*

Rheum Moorcroftianum, referred to by Strachey (Geogr. Journ. 1900, xv. pp. 258–259) as "a species of Rhubarb very common in Tibet," is probably *R. spiciforme*, Royle.

THYMELÆACEÆ.

Stellera Chamæjasme, *Linn. Sp. Pl.* p. 559; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 118; *Hook. f. Fl. Brit. Ind.* v. p. 196.

Sandy valleys, 15,000 ft., *Thorold.* Flowers green or yellow.

ELÆAGNACEÆ.

Hippophaë Rhamnoides, *Linn. Sp. Pl.* p. 1023; *Hook. f. Fl. Brit. Ind.* v. p. 203.

Plains of Gugé, 12,000–15,000 ft., *Strachey & Winterbottom.* Flowers green. Fruit orange or scarlet.

EUPHORBIACEÆ.

Euphorbia tibetica, *Boiss. in DC. Prodr.* xv. 2, p. 114: *Hook. f. Fl. Brit. Ind.* v. p. 260.

Between Gunda-yaukti and Tazang, 15,400–16,100 ft., *Strachey & Winterbottom.* Without locality, *Deasy & Pike.* Flowers green.

URTICACEÆ.

Urtica hyperborea, *Jacquem. ex Wedd. Monogr. Urt.* p. 68; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 118; *Kew Bull.* 1896, p. 214; *Peterm. Mitteil.* Erg.-Heft 131, p. 375; *Hook. f. Fl. Brit. Ind.* v. p. 548.

Amongst stones, 16,200 ft., *Thorold.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Between camps 29 and 30, September 20, *Hedin.* 17,000 ft., *Deasy & Pike*, 863. Flowers green.

SALICACEÆ.

Salix Lapponum, *Linn. Sp. Pl.* p. 1019; *Ledeb. Fl. Ross.* iii. p. 617; *Kew Bull.* 1896, p. 214 (?).

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Flowers green.

Salix sclerophylla, *Anderss. in Journ. Linn. Soc., Bot.* iv. (1860) p. 52; *Hook. f. Fl. Brit. Ind.* v. p. 630.

Between Jungbwa Tol and Rakas Tal, 15,000 ft., *Strachey & Winterbottom.* Flowers green.

GNETACEÆ.

Ephedra Gerardiana, *Wall. Cat.* n. 6048; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 118; *Stapf, Gatt. Ephedra*, p. 75.

E. vulgaris, *Brandis, For. Fl.* p. 501, *partim, non Rich.*; *Hook. f. Fl. Brit. Ind.* v. p. 640.

Salt-impregnated soil close to salt-lake, 16,500 ft., *Thorold*, 67. Near the Aru Tso, 16,700 ft., *Deasy & Pike*, 861. Flowers yellow. Fruit red.

Common on west side of Lanak La. It has a slightly resinous smell and taste, and is called "tseput" by the Ladakis, who mix it, when dried and powdered, with tobacco to make "tso tuck," a pinch of which they place under the tongue.—*Deasy & Pike.*

IRIDACEÆ.

Iris Thoroldii, *Baker, in Journ. Linn. Soc., Bot.* xxx. (1894) p. 118 et p. 139; *Hook. Ic. Pl.* t. 2302.

Top of pass, 17,800 ft., *Thorold,* 116 bis. Sharakuyi Gol, 93° 27′, 35° 50′, 13,800 ft., May 29, *Rockhill*; 91°, 35° 16′, 16,301 ft., August 8, *Wellby & Malcolm.* Flowers yellow.

LILIACEÆ.

Allium Jacquemontii, *Regel, in Act. Horti Petrop.* iii. 2 (1875) p. 162; *Hook. f. Fl. Brit. Ind.* vi. p. 342.

Near Rakas Tal, 15,000–17,000 ft., *Strachey & Winterbottom.* Flowers lilac.

Allium Semenovi, *Regel, in Bull. Soc. Nat. Mosc.* xli. (1868) 1, p. 449, *Fl. Turk.* i. p. 49, t. 8. ff. 4 et 5; *Peterm. Mitteil.* Erg.-Heft 131, p. 375; *Hook. f. Fl. Brit. Ind.* vi. p. 338.

Camp 31, September 7, *Hedin.* Widely distributed: 88°–96°, 35° 10′–35° 20′, 14,600–17,000 ft., *Wellby & Malcolm.*

Flowers dull white or pale yellow.

Allium senescens, *Linn. Sp. Pl.* p. 299, var.; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 119.

Rocky hill among stones, 16,200 ft., *Thorold.* Without locality, *Deasy & Pike.* Flowers pink.

The same variety was collected by Conway in the Karakorum.

Gagea pauciflora, *Turcz. in Bull. Soc. Nat. Mosc.* 1838, p. 102 (name only), et xxvii. (1854) pars II. p. 113; *Ledeb. Fl. Ross.* iv. p. 143.

Plecostigma pauciflorum, *Turcz. in Bull. Soc. Nat. Mosc.* xxvii. (1854) pars II. p. 113; *Trautv. Imag.* t. 2; *Maxim. Ind. Fl. Mongol. in Prim. Fl. Amur.* p. 485.

Ornithogalum pauciflorum, *Turcz. in Bull. Soc. Nat. Mosc.* xxvii. (1854) pars ii. p. 113.

Tulipa ornithogaloides, *Fisch. ex Ledeb. Fl. Ross.* iv. p. 143.

Szechenyia lloydioides, *Kanitz, Pl. Exped. Széchenyi Asia Centr.* p. 60, t. 7. ff. 1–3.

Tulipa (§ Orithya) sp.aff. T. eduli, *Baker*; *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 139.

Sharakuyi Gol, hill-slope, 93° 27′, 35° 50′, 13,800 ft., May 29, *Rockhill.* Flowers yellow.

JUNCACEÆ.

Juncus Thomsoni, *Buchenau, in Bot. Zeitung,* xxv. (1867) p. 148.

J. leucomelas, *Royle, in Hook. f. Fl. Brit. Ind.* vi. p. 397, partim.

J. membranaceus, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 119, *non Royle.*

Close to water, 16,200 ft., *Thorold*, 102. 82° 12′, 34° 19′, 16,100 ft., July 31, *Deasy & Pike*, 858. Flowers white and yellow.

NAIADACEÆ.

Potamogeton pectinatus, *Linn. Sp. Pl.* p. 127; *Hook. f. Fl. Brit. Ind.* vi. p. 567.

Without locality, 17,000 ft., *Hooker.*

This was taken for *Zannichellia palustris* when it was collected, which accounts for the latter name appearing in the list of Tibet plants in Hooker & Thomson's 'Flora Indica,' Introduction, p. 227.

Flowers small, green, with yellow anthers.

Triglochin palustre, *Linn. Sp. Pl.* p. 338; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 119; *Hook. f. Fl. Brit. Ind.* vi. p. 563.

Between Tisum and the Sutlej river, 15,000 ft., *Strachey & Winterbottom.* Close to water, 16,200 ft., *Thorold.* Flowers small, green, tinged with red.

CYPERACEÆ *.

Kobresia Sargentiana, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 139.

Hill-slope two miles north of Murus river, 91° 31′, 33° 53′, 14,750 ft., June 21, *Rockhill.* Without locality, *Deasy & Pike*, 839 A.

Kobresia schœnoides, *Boeck. in Linnæa,* xxxix. (1875) p. 7; *Hook. f. Fl. Brit. Ind.* vi. p. 697.

82° 16′, 34° 51′, a small patch only, on the bare hill-side: on

* As the flowers of the Cyperaceæ and Gramineæ are almost invariably green, with yellow, or occasionally red, anthers, it has not been considered worth while repeating this under each species.

dry gravel near the bed of a dry mountain stream, 16,300 ft., July 19, *Deasy & Pike*, 839.

Scirpus Caricis, *Retz. Pl. Scand. Prod.* p. 11; *Kew Bull.* 1896, p. 215; *Hook. f. Fl. Brit. Ind.* vi. p. 660.

Between Gunda-yaukti and Tazang, 15,400–16,000 ft., *Strachey & Winterbottom.* Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.*

Carex incurva, *Lightf. Fl. Scot.* ii. p. 544, t. 24. f. 1; *Hook. f. Fl. Brit. Ind.* vi. p. 711.

Without locality, *Deasy & Pike.*

Carex Moorcroftii, *Falconer, ex Boott, in Trans. Linn. Soc.* xx. (1851) p. 140; *Boott, Ill. Gen. Carex*, i. p. 9, t. 27; *Journ. Linn. Soc., Bot.* xxx. (1894) pp. 119 et 139; *Hook. f. Fl. Brit. Ind.* vi. p. 733, with synonymy.

Sandy, gravelly soil, 17,600 ft., *Thorold.* Hill-slope two miles north of Murus river, 91° 31′, 35° 53′, June 21, *Rockhill.* Without locality, *Wellby & Malcolm, Deasy & Pike*, 812.

Moorcroft ('Travels,' i. p. 293) says of this species:—"A very valuable herbage occurs in the 'Long-ma' or 'Sand-grass' of Ladak, which growing on the loose sandy soil and forming an intricate network both on the surface and beneath it, protects the slender covering of the primitive substratum from being blown away by the strong winds that sweep the valleys, and the whole country from being converted into a succession of bare rocks and mounds of sand. The 'Long-ma' rarely reaches more than a height of ten or twelve inches, and frequently not more than five or six, a considerable portion of the blade being always buried in the sand. The length of the root is much more considerable, and strikes so deep that it cannot be extracted entire. At a depth of five feet it was found little diminished in circumference, throwing off numerous lateral fibres through its whole course . . . . . It is sufficiently hardy to outlive other herbage, and in November, when there is nothing else on the ground, it is eaten by horses and yaks. The plant emits a pleasant smell, and has a sweet and agreeable taste, but the leaf is stiff and harsh with sharp edges." (Boott, 'Carex,' *loc. cit.*) Flowers June and July.

Carex rigida, *Gooden. in Trans. Linn. Soc.* (1794) ii. p. 193, t. 22; *Hook. f. Fl. Brit. Ind.* vi. p. 711.

Without locality, *Deasy & Pike.*

Carex sabulosa, *Turcz. ex Kunth, Enum. Pl.* ii. p. 432; *Peterm. Mitteil.* Erg.-Heft 131, p. 375.

Between camps 12 and 13, 16,160 ft., August 27, *Hedin.*

Closely related to *C. melanantha*, Mey., which is common on the Himalaya, and of which it may be merely a long-beaked orm.—*C. B. Clarke.*

Carex stenophylla, *Wahlenb. in Vet.-Akad. Nya Handl. Stockh.* (1803) p. 142; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 119; *Hook. f. Fl. Brit. Ind.* vi. p. 700.

Close to water, 16,200 ft., *Thorold.*

Carex ustulata, *Wahlenb. in Vet.-Akad. Nya Handl. Stockh.* (1803) p. 156; *Kew Bull.* 1896, p. 215; *Hook. f. Fl. Brit. Ind.* vi. p. 734.

Balch pass, about 17,000 ft., *Strachey & Winterbottom.* Goring valley, 90° 25′, 30° 12′, about 16,000 ft., *Littledale.*

GRAMINEÆ.

Pennisetum flaccidum, *Griseb. Gesamm. Abhandl., Gram. Hochasiens*, p. 302; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 120; *Hook. f. Fl. Brit. Ind.* vii. p. 84.

Without locality, *Thorold, Deasy & Pike.*

Stipa Hookeri, *Stapf, in Journ. Linn. Soc., Bot.* xxx. (1894) p. 120; *Hook. f. Fl. Brit. Ind.* vii. p. 232.

Sheltered nullahs near water, 14,800 ft., *Thorold.*

Stipa mongolica, *Turcz. ex Trin. in Bull. Acad. Pétersb.* i. (1836) p. 67; *Hook. f. Fl. Brit. Ind.* vii. p. 229.

Lasiagrostis mongholica, *Trin. et Rupr. in Mém. Acad. Pétersb.* sér. 6, *Sc. Nat.* v. (1842) p. 87.

Gugé, 15,000 ft., *Strachey & Winterbottom.*

Stipa orientalis, *Trin. ex Ledeb. Fl. Alt.* i. p. 83; *Ledeb. Ic. Pl. Ross.* iii. t. 223; *Hook. f. Fl. Brit. Ind.* vii. p. 229.

Tisum, 15,000 ft., *Strachey & Winterbottom.* Without locality, *Wellby & Malcolm, Deasy & Pike.*

This is the common grass of the Pamir, the whole area being practically covered with it.—*Giles*, in Kew Herbarium.

Stipa purpurea, *Griseb. Gesamm. Abhandl., Gram. Hochasiens.*

p. 300; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 120; *Hook. f. Fl. Brit. Ind.* vii. p. 229.

Lasiagrostris tremula, *Rupr. Sert. Thianschan.* p. 35.

Tisum, 15,000 ft., *Strachey & Winterbottom*; 16,500 ft., *Thorold*, 107. Without locality, *Deasy & Pike.*

Stipa sibirica, *Lam. Illustr.* i. p. 158, var. **pallida**, *Hook. f. Fl. Brit. Ind.* vii. p. 231.

S. pallida, *Munro, ex Duthie, Grass. N.W. Ind.* p. 27.

Tisum, 15,000 ft., *Strachey & Winterbottom.*

Oryzopsis lateralis, *Stapf, in Hook. f. Fl. Brit. Ind.* vii. p. 234.

Shelshel river, 14,000 ft., *Strachey & Winterbottom.*

Sir R. Strachey (Geogr. Journ. xv. p. 247) cites this under the name of *O. æquiglumis.*

Deyeuxia compacta, *Munro, ex Duthie, Grass. N.W. Ind.* p. 30; *Hook. f. Fl. Brit. Ind.* vii. p. 267.

Calamagrostis holciformis, *Jaub. et Spach, Ill. Pl. Or.* iv. p. 61, t. 340; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 121.

Gugé, 15,000 ft., *Strachey & Winterbottom.* At great elevations, *Thorold.* Without locality, *Deasy & Pike.*

Deschampsia cæspitosa, *Beauv. Agrost.* p. 91, t. 18. f. 3; *Hook. f. Fl. Brit. Ind.* vii. p. 273.

Balch pass, 16,500 ft., *Strachey & Winterbottom.*

Avena subspicata, *Clairv. Man. Herb.* p. 17; *Hook. f. Fl. Brit. Ind.* vii. p. 278.

Trisetum subspicatum, *Beauv. Agrost.* p. 88; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 119.

Balch pass, about 17,000 ft., *Strachey & Winterbottom.* Without locality, 16,000 ft., *Thorold.*

Phragmites communis, *Trin. Fund. Agrost.* p. 134; *Peterm. Mitteil.* Erg.-Heft 131, p. 375; *Hook. f. Fl. Brit. Ind.* vii. p. 303.

Jugdi, October 17, *Hedin.*

Diplachne Thoroldi, *Stapf, in Journ. Linn. Soc., Bot.* xxx. (1894) p. 121.

Sandy soil in valleys, 15,800 ft., *Thorold*, 120. Without locality, *Deasy & Pike.*

Poa alpina, *Linn. Sp. Pl.* p. 67; *Hook. f. Fl. Brit. Ind.* vii. p. 338, var., *Peterm. Mitteil.* Erg.-Heft 131, p. 375.

September 1, *Hedin.*

This specimen is too poor for certain identification.

Poa attenuata, *Trin. ex Bunge, Verz. Suppl. Fl. Alt.* p. 9; *Hook. f. Fl. Brit. Ind.* vii. p. 340.

P. alpina, *Linn. forma* nana, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 120.

Sheltered valley, 17,000 ft., and sandy gravelly soil on hill-sides, 16,400 ft., and 18,000 ft., *Thorold*, 26, 80, 103. Without locality, *Deasy & Pike.*

Very common on the Great and Little Pamir, growing in thick tussocks both on the open Pamir and on the slopes up to the limit of vegetation.—*Alcock*, in Kew Herbarium.

Poa nemoralis, *Linn. Sp. Pl.* p. 69; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 119; *Hook. f. Fl. Brit. Ind.* vii. p. 341.

Sheltered valley, 17,000 ft., *Thorold.*

Poa pratensis, *Linn. Sp. Pl.* p. 67; *Hook. f. Fl. Brit. Ind.* vii. p. 339.

Plains of Tibet, 15,000 ft., *Strachey & Winterbottom.*

Poa tibetica, *Munro, ex Duthie, Grasses N.W. Ind.* p. 41; *Hook. f. Fl. Brit. Ind.* vii. p. 339.

Plains of Tibet, 15,000 ft., *Strachey & Winterbottom.*

Littledalea tibetica, *Hemsl. in Kew Bull.* 1896, p. 215.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.*

Glyceria distans, *Wahlenb. Fl. Upsal.* p. 36; *Hook. f. Fl. Brit. Ind.* vii. p. 347, *forma* nana.

Atropis distans, *Griseb. in Ledeb. Fl. Ross.* iv. p. 388, *forma* nana, *Hemsl. in Journ. Linn. Soc., Bot.* xxx. (1894) p. 122.

At 16,200–17,000 ft., *Thorold*, 78, 88, 111. 86° 48′, 35° 18′, 16,300 ft., *Wellby & Malcolm.* Without locality, *Deasy & Pike.*

Glyceria distans, *Wahlenb.*, var. **convoluta**.

Atropis distans, *Griseb., var.* convoluta, *Trautv. in Act. Horti Petrop.* i. p. 282; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 122.

A. convoluta, *Griseb. in Ledeb. Fl. Ross.* iv. p. 389, *forma* nana.

Close to water, 16,200 ft., *Thorold*, 89 & 91. 87° 35′, 35° 18′, 16,237 ft., July 23, *Wellby & Malcolm.*

Festuca Deasyi, *Rendle, in Journ. Bot.* xxxviii. (1900) p. 429.

Plateau near Polu, 10,000 ft., *Deasy.*

Festuca nitidula, *Stapf, in Hook. f. Fl. Brit. Ind.* vii. p. 350.
Tisum, 15,000 ft., *Strachey & Winterbottom.*

Festuca sibirica, *Hackel, ex Boiss. Fl. Orient.* v. p. 626: *Hook. f. Fl. Brit. Ind.* vii. p. 355.
Tisum, 15,000 ft., *Strachey & Winterbottom.*

Festuca valesiaca, *Schleich. ex Gaud. Agrost. Helvet.* i. p. 242; *Hook. f. Fl. Brit. Ind.* vii. p. 348.
Festuca ovina, *Linn.*, var. valesiaca, *Koch*; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 122; *Peterm. Mitteil.* Erg.-Heft 131, p. 375.
Festuca ovina, *Linn.?, Journ. Linn. Soc., Bot.* xxx. (1894) p. 140.
Tisum, 15,000 ft., *Strachey & Winterbottom*; 16,500 ft., *Thorold*, 110. Hill-slope two miles north of Murus river, head-waters of Yangtsekiang, 91° 31′, 33° 53′, 14,750 ft., *Rockhill.* September 1, *Hedin.* Near the Horpa Tso, 16,400 ft., June 28. *Deasy & Pike*, 823.

Festuca sp.
In 82° 45′, 35°, 17,108 ft., *Wellby & Malcolm.*
Specimen too poor for identification.

Agropyron longearistatum, *Boiss. Fl. Orient.* i. p. 660; *Peterm. Mitteil.* Erg.-Heft 131, p. 375; *Hook. f. Fl. Brit. Ind.* vii. p. 368.
Between Gunda-yaukti and Tazang, 15,400–16,100 ft., *Strachey & Winterbottom.* Without locality, *Hedin.*

Agropyron striatum, *Nees, ex Steud. Syn. Pl. Gram.* p. 346: *Kew Bull.* 1896, p. 215; *Hook. f. Fl. Brit. Ind.* vii. p. 369.
Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.* Without locality, *Deasy & Pike.*

Agropyron Thoroldianum, *Oliver, in Hook. Ic. Pl.* t. 2262: *Journ. Linn. Soc., Bot.* xxx. (1894) p. 123; *Peterm. Mitteil.* Erg.-Heft 131, p. 375.
At 16,500 ft., *Thorold*, 108. Camp 21, September 7, *Hedin.*
This strongly resembles *Elymus lanuginosus*, Trin., and may prove to be a state of that plant.

Elymus dasystachys, *Trin. in Ledeb. Fl. Alt.* i. p. 120; *Ledeb. Ic. Pl. Ross.* iii. t. 249; *Journ. Linn. Soc., Bot.* xxx. (1894) p. 120; *Peterm. Mitteil.* Erg.-Heft 131, p. 375; *Hook. f. Fl. Brit. Ind.* vii. p. 374.

Sandy plain, 16,000 ft., and valleys, 17,000 ft., *Thorold.* Jugdi, October 17, *Hedin.*

Elymus junceus, *Fisch. in Mém. Soc. Nat. Mosc.* i. (1811) p. 25, t. 4.

In 90° 45′ and 35° 16′, 15,909 ft., August 6, *Wellby & Malcolm.* Without locality, *Deasy & Pike.*

Elymus lanuginosus, *Trin. ex Ledeb. Fl. Alt.* i. p. 121; *Ledeb. Ic. Pl. Ross.* iii. t. 250.

In 88° 20′ and 35° 20′, 16,526 ft., July 29, *Wellby & Malcolm.*

Elymus sibiricus, *Linn. Sp. Pl.* p. 3; *Journ. Linn. Soc. Bot.* xxx. (1894) p. 120; *Hook. f. Fl. Brit. Ind.* vii. p. 373.

Tisum 15,000 ft., *Strachey & Winterbottom.* Close to water, 16,200 ft., *Thorold.* Without locality, *Deasy & Pike.*

Filices.

Polypodium hastatum, *Thunb. Fl. Jap.* iii. p. 335, et *Ic. Fl. Jap.* p. 10; *Hook. Sp. Fil.* v. p. 74; *Kew Bull.* 1896, p. 215.

Goring valley, 90° 25′, 30° 12′, about 16,500 ft., *Littledale.*

VEGETATION

As illustrated by various Collections from the Countries immediately bordering Tibet.

The general character of the vegetation of Tibet is more or less fully described in the extracts we have made from the narratives of the various travellers whose collections are dealt with in this paper. We propose giving here a more connected account, based on data collected from all these sources, from the notes accompanying the dried plants, and from the plants themselves. This will involve some repetitions, which, however, are unavoidable. But before proceeding to an examination and discussion of the data afforded by these collections, it may be useful to give some particulars of the vegetation of the immediately adjoining countries.

To Maximowicz we are indebted for the following observations on the vegetation of the countries immediately to the north and east of Tibet:—

"On the ridges of the Nan Shan and Altyn Tag, and beyond.

towards the Keria mountains, on the mud-beds (commonly called loess) along the Hoangho, and the river-valleys of the Amdo and in Tsaidam, the flora calls to mind that of the adjoining regions of Mongolia; but in the alpine zone the flora is more like that of the mountains of North Central Asia, and the resemblance becomes greater in the drier areas.

"Forests are altogether absent from the mountain-ridges of Chinese Turkestan and the confines of Mongolia—one or two small areas on the eastern Nan Shan mountains excepted.

"In the Keria mountains also the few shrubs which occur, namely, *Tamarix Pallasii*, *Myricaria germanica*, *Caragana pygmæa*, *Hedysarum*, *Nitraria*, and *Lycium turcomanicum*, are met with only in the deepest ravines.

"Descending the northern slopes of Altyn Tag, between 9000 and 7000 feet above the sea, we find *Tamarix laxa*, *Populus diversifolia*, *Ephedra*, *Halostachys orgyalis*, *Zygophyllum*, *Reaumuria*, *Kalidium*, *Karelinia*, *Phragmites*, *Lasiagrostis*, as well as some of those mentioned above; and at the foot of the mountains *Alhagi camelorum* appears.

"In the desert-valleys between the Nan Shan ridges, the flora, sparse and grey of aspect, is composed of *Salsola abrotanoides*, *Sympegma Regeli*, *Astragalus monophyllus*, *Stellera Chamæjasme*, *Potentilla fruticosa*, *Festuca*, and, in the wetter places, *Hedysarum multijugum*, *Tamarix elongata*, *Comarum Salessowii*, *Caryopteris mongolica*, *Hippophaë*, *Calimeris alyssoides*, *Salix*, *Mulgedium tataricum*, *Rheum spiciforme*, *Gentiana barbata*, *Adenophora*, and other species of *Potentilla*.

"The alpine meadows on the Keria mountains are small and are inhabited by few species, among them dwarf grasses, *Artemisia parvula*, species of *Astragalus*, *Allium*, *Iris*, *Statice*, *Saxifraga*, *Androsace*, and others, which are more common in Northern Tibet. The appearance of the alpine meadows of Nan Shan, situated in a belt between 11,000 and 13,000 ft., is a little better, but even here they are by no means extensive, and are frequently interrupted by broken rocks and stony declivities. Here grow about a dozen species of *Oxytropis* and *Astragalus*, among them *O. tragacanthoides*, *Sterigma sulfureum*, *Crepis Pallasii*, *Allium Szovitsianum*, *Potentilla multifida*. And at a higher elevation, on the northern side up to 13,700 ft., on the southern up to 15,000 ft., are found scattered specimens of *Saussurea sorocephala*, *Leontopodium alpinum*, *Thylacospermum*, *Sedum quadrifidum*, *Draba alpina*, *D. himalaica*, and *Werneria nana*.

"Some parts of Tsaidam, which is protected on all sides by high mountains, supports a more vigorous vegetation, although the species represented are not numerous. In the swamps at the foot of the mountains there are *Scirpus maritimus*, *Typha stenophylla*, *Hippuris vulgaris*, and *Utricularia*, with *Elymus sibiricus* on their margins. In the salt plain, among the pools and marshes, many large areas are covered with *Arundo Phragmites* (*Phragmites communis*); the streams are fringed with shrubs of *Myricaria germanica*, *Nitraria*, *Lycium turcomanicum*. In the salt-marshes occur *Kalidium gracile*, *Salsola Kali*, *Halogeton*, and *Kochia mollis*; in the drier areas grow *Nitraria Schoberi* var. *orgyalis*, *Eurotia ceratoides*, *Atraphaxis lanceolata*, *Reaumuria soongorica* and *R. trigyna*; and on the dunes of shifting sand, *Haloxylon Ammodendron*, *Hedysarum Arbuscula*, *Psamma villosa*, *Apocynum venetum*, *Tamarix Pallasii*, *T. laxa*, and *Artemisia campestris* are the predominating plants. On the slopes of the Koko Nor mountains extending into Tsaidam is a forest of *Juniperus Pseudo-Sabina*; along the rivers Bais and Nomochu, towards the Tibetan frontier, *Tamarix Pallasii* attains a height of nearly twenty feet, and *Sphærophysa salsula*, *Calligonum mongolicum*, and *Cynomorium coccineum* occur.

"The elevated plateaux around the Koko Nor and upper Hoangho are either salt-marshes and very sparsely covered with such herbs as *Nitraria*, *Kalidium*, *Polygonum Laxmanni*, *Orchis salina*, *Iris ensata*, *Pedicularis cheilanthifolia*, *Primula sibirica*, or expanses covered with *Lasiagrostis splendens*, *Stipa orientalis*, and other grasses, or meadows in which grow *Calimeris altaica*, *Thalictrum petaloideum*, *Oxytropis aciphylla*, and a few Tibetan species, such as *Hypecoum leptocarpum* and *Hymenolæna* sp., for example. Trees and the taller shrubs have withdrawn from the fierce winds either into the mountain-passes or to the deep precipices and ravines of the loess, where open woods exist composed of *Populus Przewalskii*, with a trunk sometimes 70 ft. high and two feet thick; *Hippophaë*, 40 ft. high and one foot thick; *Abies*, 100 ft. high and three to four feet thick; trees of *Juniperus Pseudo-Sabina*, and very frequently shrubs belonging to the genera *Berberis*, *Sorbus*, *Cotoneaster*, *Lonicera*, *Rosa*, *Ribes*, etc.

"On the high plateau of Tibet there occur not a few Mongolian or Siberian species, especially in the saline areas.

"Certain Tangut species are found in N.E. Tibet and in some river-valleys where loess is absent, in the Amdo province, and here indeed they grow more vigorously than any other species. Forests at 8000 ft. and upwards on the Tetung mountains, and from 11,500 feet on the southern Koko Nor chain, as well as the thickets of the alpine region, contain upwards of 60 species; *e. g.* in the forests: *Betula Bhojpattra*, *B. alba*, *Pinus leucosperma*, *Abies Schrenkiana*, *Sorbus Aucuparia*, *S. microphylla*, *Prunus stipulacea*, seven species of *Lonicera*, *Ribes stenocarpum*, *R. nigrum*, two new species of *Berberis* 12 ft. high, and of the same height *Philadelphus coronarius*, *Hydrangea pubescens*, *Spiræa longigemmis*, *Eleutherococcus senticosus*, *Daphne tangutica*. In the alpine thickets are four new species of *Rhododendron*, *Caragana jubata*, *Sibiræa lævigata*, *Potentilla fruticosa*, *P. glabra*, etc.

"In the shade of the woods and thickets numerous herbs are congregated, often luxuriant and tall, among which are several new species of *Senecio*, *Saussurea*, and *Salvia*, *Podophyllum Emodi*, etc.

"The alpine meadows along the river Tetung, between 13,000 and 15,000 ft., also abound with peculiar species belonging to the genera *Corydalis*, *Gentiana*, *Pedicularis*, *Primula*, *Lagotis*, etc., intermingled with which are Himalayan species, such as *Trollius pumilus*, *Crepis glomerata*, *Saussurea hieracifolia*, *Lancea tibetica*, *Halenia elliptica*, *Dracocephalum heterophyllum*, etc.

"On the most elevated plateau of Tibet trees and the larger shrubs are entirely wanting. Undershrubs, a few inches high, occur on the banks of the river Yangtze (Mur-assu), *Lonicera hispida*, *L. rupicola*, *L. parvifolia*, *Spiræa*, *Hippophaë*, *Caragana*, *Berberis cratægina*, *Ribes* sp., *Salix* sp., as outliers of Siberian and Himalayan species. At first sight the mud or gravel flats seem to be quite destitute of life; nevertheless they support low herbs one to three inches high, growing in widely scattered masses, tufted, erect, or in low cushions with bare intervening spaces, many of which are found also in Amdo, but here they are excessively dwarfed—*Incarvillea compacta*, *Meconopsis integrifolia*, *M. punicea*, *Przewalskia*, *Anaphalis*, *Werneria*, *Cremanthodium*, *Arenaria*, *Ranunculus tricuspis*, *R. pulchellus*, etc. But there is also a considerable proportion of new species—*Nasturtium tibeticum*, *Parrya villosa*, *Androsace Tapete*, *Astragalus* spp., *Oxytropis* spp., and numerous very dwarf species of *Saussurea*, some of which are very handsome.

"Alongside the rivers, yet rarely, are meadows gay with *Stipa pedalis*, *Elymus*, *Comarum*, *Nitraria*, *Clematis orientalis*, *Allium*, *Iris*, *Astragalus*, *Statice*, *Rheum spiciforme*, etc.

"At the base of the mountains to the north, as well as in the Tang-la Range towards the south, are swamps filled with very dense tufts of *Kobresia tibetica*.

"All this peculiar Tibetan flora—as it were a 'very cold' repetition of the Alpine flora of Amdo—does not seem to cross a diagonal line drawn between Tengri lake and Odontala (96° 30′ and 35°), for no mention is made, at least by our travellers, of any species common to this flora and to that of Amdo, to the west of that line, where the region is drier and more sterile, and a large area seems to be uninhabited. Other species, endemic in Tibet, in part at least, do cross that line. Hence it seems proved that Northern Tibet may be divided into two natural provinces according to the distribution of the plants. The western part is poor in species, and in every respect reminds one of the highest regions of the Himalaya and Tibet Minor. The eastern part, Tangut properly so-called, relatively abounds in species which flourish in the deep valleys of the eastern frontier bordering Amdo, and not a few cross beyond Amdo, entering Eastern Khansu, Northern Szechuen, or even the Alps of the Shansi and Chihli Provinces, for example, *Ajuga lupulina*, *Anaphalis Hancockii*, and *Stellaria infracta*."

Plants of the Gilghit-Chitral Expedition, 1885–1886.

The collection of dried plants, made on this expedition by Dr. G. M. Giles, was presented to Kew, and a rough list of them was published in Col. Sir W. S. A. Lockhart's Confidential Report, together with some interesting notes by Dr. Giles. Much care had been devoted to the collecting and labelling of the 500 species, or thereabouts, and it was a pity, as Dr. Giles remarks, that the geographical and biological questions were not worked out; but pressure of work at Kew prevented anything beyond approximate determinations of the species being made. Reference is made here to the collection more with the intention of making known its existence and partial publication in an almost inaccessible report, than for purposes of comparison. But some of Dr. Giles's observations deserve reproduction:—

"As I have already remarked in my other reports, the district over which the Mission worked is an extremely barren one.

Lying well beyond the abundant rainfall of the outer ranges, the ground in general gets, as a rule, but one thorough wetting in the year, viz., at the time of the melting of the snows. From this it follows that outside the limits of the irrigated cultivation, where the hand of man has made oases, the flora is but a scanty one, and is restricted to hardy drought-resisting plants, such as *Artemisia Absinthium*, etc.

"The irrigated ground yields a flora entirely distinct from this, which can hardly be said to be truly indigenous, as nearly all its members have been introduced by the agency of man, either directly or indirectly. A further exception exists in the narrow belt of hillside which lies just below the summer snow-lines. Here continuous melting of the snows above produces a land of ever-moistened soil, which has a flora peculiarly its own, consisting mainly of northern European forms, and which is quite distinct, alike from that of the dry and from the irrigated areas. Its bathymetric limits are from about 13,000 to 15,000 feet, and its character appears pretty uniform alike in the rainy regions of Kashmir and in the dry inner ranges.

"From a natural history point of view it is an unfortunate circumstance that our visit to the Pamir took place at the period of the year that it did. Coming, as we did, just after the snow had melted, but before the revival of vegetation, the collection was disappointingly small from the most interesting region of all we visited.

"In May but few plants had even sprouted, and had it not been for a peculiar circumstance, my Pamir collection might have been numbered on the fingers. This was that a very large number of the plants are provided with inflorescences of a peculiarly permanent character. This character, which no doubt serves the object of preserving the seed during the long period for which the plants are buried under the snow, is especially marked on the higher parts of the Pamir at about 14,000 feet, and is the common characteristic of a large number of the plants of the region of widely different natural orders. In one or two instances the preservation extended to the whole of the floral whorls, the andrœcium excepted, but in the majority of cases it extended to the calyx and gynæceum alone. Many of the plants were thus in a fairly recognizable condition, and collecting these naturally-preserved herbarium specimens I was able to avoid the annoyance of coming away quite empty-handed.

Judging from experience of other parts of the range at the same level I should say that August would be the best time of the year for a naturalist to visit the steppe."

Dr. Giles's observations on the provisions for protecting and preserving the seeds of the plants of this country are valuable, because they throw some light on the permanency of vegetation, even in the most arid regions.

Flora of the Kuen Luen Plains.

In 1892 Captain H. P. Picot, of the Indian Staff Corps, visited the Kuen Luen Plains, in the extreme north-east of Kashmir, and brought home a few fragments of plants screwed up in a newspaper. They are enumerated in a previous volume of this *Journal*, xxx. (1894) pp. 107, 123–124. There are twenty-five species, collected at altitudes between 11,500 and 17,000 ft., chiefly at the greater altitude. Among them were three or four which had only previously been collected by Dr. T. Thomson, about fifty years previously. The following are not in our enumeration:—*Berberis salicina*, Hook. f. & Thoms., *Chrysanthemum Richteria*, Benth., *Lindelofia Benthami*, Hook. f., *Pedicularis dolichorrhiza*, Schrenk, *Allium blandum*, Wall., and *Kobresia Royleana*, Boeck.

The Plants of Mr. Bonvalot and Prince Henry of Orleans's Journey across Tibet.

It was intended in the first instance to include this collection in our Enumeration, but we soon discovered that it was almost entirely made in China Proper. The new plants were described by Prof. Ed. Bureau and Mr. A. Franchet. Freely translated, their note on the collection runs:—It was made almost wholly along a narrow strip of country beginning at Lhassa, and, without deviating much from the thirtieth parallel of latitude, continuing through Batang and Litang as far as Tatsienlou. The plants may be classed as the smallest of the genera to which they belong, and are remarkable for the almost total absence of stem, associated with a great development of corolla. In the direction of Tatsienlou the character of the Flora gradually changes; the plants are larger with broader foliage and more numerous flowers. The majority of the new plants described were collected between Batang and Litang. They are:—*Parrya ciliaris*, *Viola florida*, *Silene platypetala*, *S. cæspitosa*, *Astragalus litangensis*, *Spiræa* *thibetica*, *Abelia angustifolia*, *Lonicera thibetica*, *L. trichosantha*, *Aster batangensis*, *Gnaphalium thibeticum*, *Rhododendron Principis*, *R. primulæflorum*, *R. nigro-punctatum*, *Primula vittata*, *P. leptopoda*, *P. diantha*, *P. Henrici*, *Androsace bisulca*, *Schistocaryum ciliare*, *Pedicularis batangensis*, *P. microphyton*, *Incarvillea Principis*, *I. Bonvaloti*, *Fritillaria lophophora*, and *Aletris lanuginosa*. This wealth of new species is sufficient to prove that we are outside of the Tibetan region, and on the borders of the rich flora of Western China.

VEGETATION

As illustrated by the various Tibetan Collections.

The combined collections comprise 283 species, belonging to 119 genera and forty-one natural orders. A very large proportion of the species are perennial herbaceous plants having long, often very long, thick tap-roots; almost no stem, which may be either unbranched, bearing a single or compound inflorescence, or very shortly-branched, bearing several inflorescences; a rosette of leaves, when unbranched, commonly lying flat on the ground; and an almost sessile inflorescence nestling in the centre of the rosette of leaves. When the stems are branched the leaves are usually very small and numerous. Plants of this description are usually very thinly scattered, and some indeed are so rare that they were only observed in a single locality, or collected by only one of our travellers.

SAUSSUREA.

The genus *Saussurea* * (Compositæ) will serve well to illustrate this type of plant. This genus has been selected because it is highly characteristic and more numerously represented in species than any other genus within our area. Including the very numerous recent discoveries in Western China and Central Asia, *Saussurea* now contains upwards of one hundred described species, exhibiting a very great variety in habit, foliage, and inflorescence. They are by far the most numerous in Central and Northern Asia, but they extend all round the northern hemisphere, chiefly inhabiting mountain regions. One species, *S. alpina*, inhabits Great Britain, and it has nearly the same

* A selection of Tibetan species of *Saussurea* was exhibited at the Society's rooms when this paper was read.

range as the whole genus, including Tibet, Arctic Europe, and North America. Altogether fifteen species have been found in Tibet, being a third more than any other genus is represented by. They are all herbaceous perennials, ranging from an inch to six or eight inches in height. Six of them are of the rosette type, of which *S. Thoroldi*, Hemsl., and *S. Aster*, Hemsl. (Journ. Linn. Soc., Bot. xxx. p. 115, tt. 4 and 5) are characteristic examples. *S. subulata*, C. B. Clarke, is a densely-tufted species, having crowded acerose leaves; *S. tangutica*, Maxim., is of erect habit, having solitary stems, relatively broad distant leaves, those immediately beneath the flower-heads being highly coloured; and *S. tridactyla*, Schulz-Bip., is of a similar habit, but the leaves are deeply divided, and densely clothed with a white woolly tomentum. The last-named species was collected by Dr. Thorold at an elevation of 19,000 ft., and its altitudinal range in the Himalayas is given as 16,000 to 18,000 ft. Indeed the genus *Saussurea* apparently reaches the uppermost limit of flowering plants in Tibet, and twenty-one species have been collected at 15,000 ft. and upwards in the Himalayas. Seven of the Tibetan species were collected at altitudes of 17,000 ft. and upwards; six at altitudes of 16,000 ft. and upwards; whilst of the remaining two the altitudes are not given by the collectors. Further particulars on this point will be found under the heading of "Altitudes."

Saussurea may also be cited as an illustration of the general dispersion of characteristic species within our area. *S. Thoroldi*, for instance, is represented in all the recent collections, though it was previously unknown; and Kew also possesses specimens of it from the mountains of Western China. But further information on this point will be found in our "Enumeration" and "Tabular View of the Distribution of the Plants of Tibet."

ARTEMISIA *and* TANACETUM.

These two genera of the Compositæ are so closely allied that they may be considered as one in our endeavours to picture the vegetation of Tibet. Both genera are widely spread in the northern hemisphere, including North America; and *Artemisia* reappears in the Sandwich Islands and in extratropical South America. Both find their greatest concentration of species in Central Asia and are especially abundant in the drier regions. *Artemisia* numbers upwards of 150 species, and is perhaps nearly as fully developed in North America, where, in the dry regions of the interior and south-west, various species cover vast areas and are commonly called "sage bushes." *Artemisia* and the much smaller genus *Tanacetum* combined are represented in Tibet by about a dozen species; possibly more, because they are so similar that only a trained eye would detect the differences. In appearance they do not differ greatly from the British species, except in a more stunted habit and less development of leaf. Some of them are woody, but the wood is mostly produced underground, or under stones, or in densely matted ramifications close to the surface of the ground. In the drier parts they constitute one of the predominating elements in the vegetation of Tibet. *Tanacetum tibeticum* furnishes, according to Mr. Arnold Pike, the only vegetable* fuel in some parts of the country. The Ladak name of this plant is "boortze," which is mentioned, though variously spelt, by nearly all travellers; yet Pike and Hedin are the only ones who collected specimens. Pike collected it in flower at an elevation of 16,200 ft. in North-west, and Hedin in North Central Tibet. *Tanacetum fruticulosum* is another woody species, and is known to the Ladakis as "tchŭktchŭk"; and *Artemisia macrocephala* as "cumtchen." Therefore it is evident that they distinguish some of the species. At the same time it seems probable that the name "boortze" is applied to more than one species of these strongly scented plants.

Taraxacum *and* Crepis.

There are three or four species of each of these genera, some of which must be rather common in widely separated damp situations and will be alluded to again under "Useful Plants." Pike collected specimens of *Taraxacum bicolor*, DC., at an elevation of 16,100 ft., having roots at least a foot long, whilst the portion above ground was less than two inches.

Several other genera of Compositæ are probably more conspicuous from their colour, but they will be dealt with under that head.

Astragalus *and* Oxytropis.

As components of the vegetation these two genera of the Leguminosæ, like *Artemisia* and *Tanacetum* of the Compositæ, may be treated as one, because they are indistinguishable, except

* In explanation of this it may be mentioned that the only fuel to be had in many parts of Tibet is yak dung, of which the travellers usually found abundance.

by close examination. Nearly a thousand species of *Astragalus* are described from the Old World, chiefly from Central Asia, and there are perhaps two hundred in America, extending from the Arctic regions southward through the Andes. About two hundred species of *Oxytropis* have been described, and they are confined to the northern hemisphere. Thus we have here another parallel to *Artemisia* and *Tanacetum*, and a third may be found in the prominence of the two groups in the vegetation of Tibet; but the *Astragali* generally have much more conspicuous flowers than their counterparts in the Compositæ. Notwithstanding the fact that the *Astragali* are exceedingly numerous in species in Central Asia, we have only fourteen from Tibet. This may be due to the fact that similar species were passed by as the same as others already collected. On the other hand, the fact that some of the species are represented in every collection, or nearly so, stands against there being much confusion in this direction. To give an example: *Oxytropis microphylla*, DC., is in every collection save Littledale's, and from the most distant localities. The specimens vary in having leaves and peduncles from one to six inches in length; and a specimen collected by Pike must have had a thick, woody root that penetrated the ground to the depth of at least two feet. The majority of these *Astragali* may be described as exceedingly diminutive dense shrubs, having relatively thick branches due to the persistent bases of the greatly crowded leaves. There are others, such as *A. tribulifolius*, which have slender, trailing branches, apparently of only one season's duration. Another type of growth is furnished by *A. Heydei*, Baker, which has also deep, permanent root-stocks, from which annual branches are produced some distance down among the stones, which bear a few leaves and a cluster of flowers just above the medium in which the plant is growing. This last type of growth is exhibited by a number of other Tibetan plants, notably by *Corydalis Hendersoni*, Hemsl., *Capsella Thomsoni*, Hook. f., *Cochlearia scapiflora*, Hook. f. et Thoms., *Braya sinensis*, Hemsl., *Thermopsis inflata*, Camb., *Microula tibetica*, Maxim., *Nepeta longibracteata*, Benth., *Dracocephalum heterophyllum*, Benth., and *Euphorbia tibetana*, Boiss.

GRAMINEÆ *and* CYPERACEÆ.

The total number of grasses is thirty species, belonging to fourteen genera; of sedges nine, belonging to three genera. To these may be added one rush, making a total of forty species of this class of plants. This probably does not exhaust the number existing in Tibet; partly due to their similarity, and partly to close grazing which would prevent flowers being produced. We have the evidence of the travellers, repeated in their respective "Itineraries," that relatively luxuriant pasturage was found in certain valleys and sweet-water lake districts, and it is further clear that abundance of pasturage must exist somewhere within the range of the enormous herds of roaming animals that so astonished some of the travellers. On the other hand, long stretches of country were traversed in which grasses occurred only in tufts, like the majority of the other plants.

Cushion-like Plants.

Foremost amongst these is *Thylacospermum rupifragum*, Schrenk, Caryophyllaceæ. This is like a coarse moss with the stems so crowded together as to form a consolidated mass. *Arenaria musciformis*, Wall., and *Stellaria decumbens*, Edgew., belonging to the same natural order, are similar in growth, but the cushions do not attain the great size and density of *Thylacospermum*. *Androsace Tapete*, Maxim., and other species of Primulaceæ display the same peculiarities.

Woody Plants.

The woody element in the vegetation of Tibet within our limits is exceedingly small, including nothing more than a foot above ground, and, with the exception of the *Astragali* and *Artemisiæ*, described in preceding paragraphs, such woody plants as exist are extremely rare and mostly near the confines of the country. *Clematis orientalis*, L., is the tallest, so far as our specimens go, being just about a foot to the top of the inflorescence. Rockhill collected it in longitude 94° 45′, where it was abundant at 14,000 ft., and Deasy and Pike collected it in 82° 41′, and note that it had been observed three days before. There is no evidence of its existence between the longitudes given. *Nitraria Schoberi*, which grows five or six feet high in favourable situations outside of Tibet, is represented by a fragment collected by Hedin in S. Tsaidam. *Myricaria prostrata*, Hook. f. et Thoms., is widely spread, but it is quite prostrate and makes branches at the most six inches long. The variety of *Potentilla fruticosa*, L., attains similar dimensions. Of *Caragana pygmæa*, DC., there is only a single specimen from Gugé. *Lonicera hispida*, Pall., collected only by the Littledales, in the Goring Valley, grows larger in the locality named, where vegetation is not so sparse as in many parts; but its size could not be determined from a detached branch. *Hippophaë Rhamnoides*, L., like *Caragana*, is only from the Plains of Gugé, where it was collected by Strachey and Winterbottom. One species of *Salix* from the Goring Valley and another from the Plains of Gugé and *Ephedra Gerardiana* complete our list of woody plants. The willows are represented only by very small specimens. The *Ephedra* is perhaps the most woody of all, having very stout root-stocks and trailing branches a quarter of an inch thick; it is common in Western Tibet at elevations between 16,000 and 17,000 ft. The absence of *Juniperus* from all the collections is remarkable.

Fleshy-leaved Plants.

With the exception of the Crassulaceæ—*Sedum* and *Sempervivum*, of which there are ten species—fleshy plants are rare in Tibet. The species of *Sedum* inhabiting the Himalayan and Tibetan regions are in need of revision, consequently we are not quite sure of our names in all instances. Several species are apparently not uncommon in the west, and the species we have named *quadrifidum* with some doubt was collected in very distant localities, and as far eastward, at least, as the ninetieth meridian.

Large-leaved Plants.

Rheum spiciforme, Royle, is the only plant having leaves of considerable surface; but the specimens collected probably do not bear the largest produced by this species. The blade of the largest leaf is only about four by three inches. Still, in certain districts, of considerable area, this plant must be very conspicuous in the vegetation. Kew possesses specimens collected by Przewalski, Hedin, the Littledales, and Deasy and Pike in very distant localities. Pike notes that it was plentiful over an area of about two square miles in 81° 41′ and 34° 52′, and "seen once or twice afterwards, but not common." Further particulars of this plant are given under "Useful Plants."

Aquatic *and* Marsh Plants.

Ranunculus aquatilis, *Hippuris vulgaris*, *Myriophyllum verticillatum*, and *Potamogeton pectinatus* are the only true aquatics in the Kew collections, and each one is in only one collection. It seems highly probable that the freshwater lakes and water-courses have not been exhausted in this direction. Marsh plants and plants inhabiting the moist ground near the shores of the lakes are also fewer than might have been expected. The genera *Ranunculus*, *Selinum*, *Cremanthodium*, *Pleurogyne*, *Gentiana*, *Pedicularis*, *Polygonum*, and *Triglochin* are represented by moisture-loving species. Some of the sedges and grasses are most likely confined to wet ground, but evidence is wanting. *Phragmites communis* may be classed here. *Zannichellia palustris*, mentioned at p. 142 as having been found by Hooker at Bhomtso, proves to be *Potamogeton pectinatus*.

BULBOUS *and* TUBEROUS PLANTS.

The small number of species coming under this head is one of the most inexplicable facts connected with the vegetation of Tibet, though it is also true that bulbous plants are rare among the high-level plants in all parts of the world. *Gagea pauciflora*, collected by Rockhill only, and three or four species of *Allium* are the only bulbous plants in the collections. One species of *Allium*—*A. Semenovi*—is widely distributed and very abundant in some localities. This species was collected by Hedin, and Wellby and Malcolm, and it is probably the one referred to by Rockhill as being very plentiful at altitudes above 15,000 ft., though they sought it in vain below this level. Wellby and Malcolm, who had to subsist largely on this onion during part of their journey, note that it was commonly distributed between 88° 20′ and 96° along the thirty-fifth parallel. *A. Jacquemontii*, collected by Strachey and Winterbottom in W. Tibet, has also an edible bulb.

ANNUAL PLANTS.

The conditions are not favourable to the development of "annual" plants—that is to say plants which have only one growing season, springing from seed and flowering within a few weeks, or at all events before the end of season. The following appear to belong to this category:—*Hypecoum leptocarpum*, *Pleurogyne brachyanthera*, *Gentiana tenella*, *G. humilis*, *G. Thomsoni*, *G. aquatica*, *G. Rockhillii*, *Salsola collina*, *S. Kali*, and *Halogeton glomeratus*. All of these plants are apparently very rare in Tibet, and, with one or two exceptions, represented in only one of the collections. Thus *Gentiana tenella*: "only one or two specimens seen, although I looked closely" (Pike). *G. humilis*: "very scarce" (Pike). *Pleurogyne brachyanthera*: "the only specimen I have seen" (Pike)—a diminutive plant bearing one flower.

In addition to the foregoing, some of the plants taken for perennials may be monocarpic, but of biennial or two seasons' duration, as many plants of this class form large tap-roots in which is stored during the first season the food required for the flowering and fruiting season.

Meconopsis horridula, one of the most conspicuous and widely-spread plants of Tibet, probably flowers only once though of two seasons' duration.

Diminutive Plants.

In more than one place stress has been laid on the fact that Tibetan plants generally are of small dimensions; but some of them are so exceedingly small as to merit attention on that account; and it is among the annuals that some of the smallest are found, notably *Pleurogyne brachyanthera*, *Gentiana Thomsoni*, and *G. aquatica*, which are sometimes not more than an inch high with a solitary terminal flower. Among others of exceptionally reduced proportions are: ***Ranunculus tricuspis***, ***R. similis***, ***R. involucratus***, *Anemone imbricata*, *Corydalis Boweri*, *Eutrema Przewalskii*, ***Arenaria Littledalei***, *Saxifraga parva*, and *Sedum Przewalskii*. So many others are small for their respective genera that it is sufficient to put the fact on record. But *Iris Thoroldi*, having narrow, grass-like leaves, rising at the most six inches above the ground, and solitary, yellow flowers, barely emerging from the ground, specially deserves mention as the miniature of its genus. Going back to the first of these diminutive plants, ***Ranunculus tricuspis***; there are specimens of this at Kew from Mongolia, collected by Przewalski, and from Tibet, collected by Rockhill and Pike; therefore from very distant habitats; and the specimens all appear to have attained normal dimensions. Pike collected his specimens in moist soil, near a small stream, in about 82° and 34°, at an elevation of 17,000 ft. The largest specimen is less than three inches long, including the tap-root, which is not whole, having been broken off when removing the plant from the ground. It has about half-a-dozen stalked leaves with a three-lobed blade, about a quarter of an inch long, and one flower. Only the blade of the leaf appears above ground and that is spread out horizontally. The solitary flower, about a quarter of an inch in diameter, is scarcely raised above the outspread leaves which encircle it. This interesting little plant is evidently a perennial, which propagates itself vegetatively by very short stolons.

COLOURS *of the* FLOWERS *or* FRUIT.

For our purpose colour in flowers includes everything excepting green. Excluding the Cyperaceæ, the Gramineæ, and a few other plants which have very inconspicuous flowers mostly exhibiting colour only in the anthers, which are usually yellow, rarely red, there are 241 species to account for. Roughly classed as white or some shade of yellow, of red, or of blue, according to the dominant primary, the following figures are obtained:—

Flowers white	44
,, some shade of yellow....	81
,, ,, red	70
,, ,, blue	46
	241

We have no precise data for comparisons, but it may be safely asserted that there is as much variety and brilliancy of colour in the Tibetan Flora as there is in the British Flora. Here the comparison ends, because there is nothing in Tibet to match the masses of colour produced by bluebells, buttercups, primroses, heather, and other native plants. On the other hand, the intensity of colour characteristic of the Alpine flora of Europe is not equalled in Tibet, even individually. Compared with the remote Insular Flora of St. Helena, the advantage of colour, if any, is with Tibet. In St. Helena, for example, blue and red are almost wholly wanting in the native flowers, which are usually white, or white and yellow. In a less degree this is the case in the Sandwich Islands.

The connection between colours and insects in relation to pollination we shall not attempt to discuss; but in the "Itineraries" we have repeated all the references to insects, including a list of butterflies observed by Dr. Thorold.

The Tibetan species of familiar genera have mostly flowers of the same colour as the predominating one in British species. Thus *Ranunculus*, yellow; *Sedum*, red or yellow; *Artemisia*, yellow; *Gentiana*, blue; *Saussurea*, red; *Astragalus*, blue or red; *Potentilla*, yellow; *Delphinium*, blue; and *Aster*, blue. The Cruciferæ are mostly white or yellow, and the Caryophyllaceæ mostly white.

A better idea of the appearance of colour in the vegetation may perhaps be conveyed by means of a selection of plants having either conspicuous individual flowers, or conspicuous inflorescences—heads or clusters of flowers. It will perhaps be as well to present this information in a tabular form. The colour is that noted by the collectors; the diameter is that of individual flowers or inflorescences (Leguminosæ, Compositæ, etc.) taken from the specimens; and the degree of prevalence is deduced from the number of collectors partly, and partly from collectors' remarks accompanying the specimens, and has reference to them only as components of the Flora of Tibet.

Name.	Colour.	Diameter or length.	Prevalence.
Clematis orientalis	Yellow.	1½ in.	Rare.
Delphinium	Blue.	1 ,,	Common.
Meconopsis horridula......	Blue.	1½ ,,	Common.
Braya sinenis............	White.	½ ,,	Rare.
Parrya macrocarpa	Purple.	1 ,,	Rare.
Geranium collinum	Blue.	¾ ,,	Rare.
Thermopsis..............	Yellow.	2 ,,	Frequent
Astragalus	Purple.	1 ,,	Common.
Saxifraga	Yellow.	1½ ,,	Frequent.
Aster	Blue.	1½ ,,	Common.
Cremanthodium	Yellow.	1½ ,,	Frequent.
Saussurea	Purple.	2 ,,	Common.
Pedicularis	Red.	2 ,,	Frequent.
Rheum spiciforme	Red.	2 ,,	Frequent.
Allium senescens	Pink.	1 ,,	Frequent.

Where only the generic name is given in the preceding table it should be understood that there are several similar species and that, taken collectively, they constitute a more or less conspicuous feature in the vegetation. To the foregoing might be added several genera of cushion-like growth belonging to the Cruciferæ, Caryophyllaceæ, Primulaceæ, etc., which produce a profusion of flowers, individually small, though collectively conspicuous.

Reproduction, Propagation, *and* Dispersion.

One of the most interesting questions connected with this inquiry is: How does this scanty vegetation maintain its hold under such adverse conditions? And this leads to another: Is the vegetation increasing or decreasing? The first question is much easier to answer than the second, because we have the evidence before us. There are two modes by which reproduction or propagation may be effected; namely, by seed and by vegetative increase. It has already been explained that few of the Tibetan plants are annual or monocarpic, and that most of those species which are, are exceedingly rare and only met with as solitary individuals. It is possible, however, that individuals are much more numerous in some years than in others. With regard to the production and maturation of seed, there seems no reason why every species or almost every species in the Flora should not do so, as it seems to be quite independent of altitude. About twenty-five per cent. of the species are represented by dried specimens bearing ripe fruits and seeds, and these species comprise members of almost every natural order in the Flora. Many of those not represented by fruiting specimens were collected too early in the season to secure fruit. Some of the plants produce seeds very copiously, and, given the conditions favourable to germination and subsequent growth, there ought to be an increasing vegetation; but the perennial drought, the shifting sands, and the large herds of herbivorous animals, conjointly, are probably sufficient to prevent the spread of most plants. Among the plants which undoubtedly increase vegetatively are the species of *Allium*, from bulbs; the cushion-like plants, by successive branchings or offsets; and the trailing plants, by runners or rooting of the new branches. Doubtless most of the grasses increase in this way, but perhaps only enough to make good the previous season's consumption. But under any circumstances and conditions the spread of plants vegetatively in Tibet must be a very slow process, because none of them, so far as we know, produce runners or rooting branches of great length.

The dispersal of the seeds and fruits of plants by wind and other agencies in Tibet is certainly much greater than the probabilities of successful germination in the localities to which they are transported. It is a significant fact, however, that the achenes of *Saussurea*, one of the commonest and most widely spread genera, have a plumose pappus, and might be carried almost any distance and height by the prevailing winds. Further, there is not a seed produced in Tibet which might not be conveyed in the great sand-storms; but the chances of their meeting with favourable conditions must be very remote. The few berry-bearing plants, such as *Ephedra*, *Hippophaë*, and *Nitraria*, have an equally small chance of being successfully dispersed by birds. On the whole it seems probable that the increase in vegetation in Tibet, if any, must be exceedingly slow. On the other hand, there is apparently no positive evidence that it ever was more general than at the present day.

VEGETATION

As illustrated by the Altitudinal limits of Flowering Plants in Tibet and the adjoining Countries.

At the meeting of the Society on April 19th, 1900, my colleague, Mr. H. H. W. Pearson, and I gave a preliminary account of the collections made by Deasy and Pike, Wellby and Malcolm, and Sven Hedin, illustrated by a selection of their plants. Special attention was directed to the great altitudes at which some of Deasy and Pike's plants were obtained, based on the figures given on the labels accompanying them. These particulars were published in 'Nature,' lxii. (1900) p. 46, and in the 'Gardeners' Chronicle,' xxvii. (1900) p. 303, and probably elsewhere. It is there stated that the highest point at which flowering plants had been found was 19,200 ft. above sea-level, and a list of nine species, purporting to have been collected at 19,000 ft. and upwards, is given. Subsequently it was ascertained that the altitudes of this expedition had been erroneously calculated, and Captain Deasy has since supplied the corrected determinations, which appear in our "Enumeration." According to these corrections, 17,300 ft. was the hightest point at which they collected, and only one plant, *Cheiranthus himalayensis*, was found at this elevation. *Astragalus Heydei* and *Oxytropis tatarica*, originally recorded from 19,200 ft., were actually taken at 17,100 ft. It is possible that some of the other observâtions on record in this paper are too high, and some of those previously published are certainly so.

Dr. O. Drude (Petermann's 'Geographische Mitteilungen,' 1894, p. 92), in a review of the report on Bower and Thorold's collection, which is in the Society's *Journal*, vol. xxx., questions the correctness of the assumption, there enunciated, that 19,000 ft. was the greatest altitude at which a flowering plant had been collected or observed; and he goes on to say that Hemsley appears to have overlooked the record of Schlagintweit's discoveries. It is true that the original record had been overlooked, as well as subsequent versions of it and references to it; and it seems desirable to subject Schlagintweit's data to a critical examination here. Drude himself states, in the place cited, that Schlagintweit ('Reisen in Hochasien,' vol. iv.) places the extreme upper limit of flowering plants at 6038 metres (=19,804 ft.), in a higher latitude even than Tibet. The name of no plant is given by Drude, and we have not been able to refer to the German work from which he professes to quote. But in Schlagintweit's English work ('Results of a Scientific Mission to India and High Asia,' ii. p. 501) is the following paragraph :—"The very extreme limit of phanerogamic plants appeared in Western Tibet, on the north-eastern slopes of the Ibi-gamin pass at a height of 19,809 ft., next in order come those of Gunshankar, in Guari Khorsum, at 19,237 ft., or 572 ft. above the limit of snow. In the Himalaya the highest plants were found at 17,500 ft., on the slopes of the Janti pass." Incidentally it may be mentioned that Schlagintweit gives the height of Ibi-gamin as 25,550 ft., and the height reached as 22,259 ft. Here, again, no names of plants are given; and Tchihatchef ('Végétation du Globe,' ii. p. 615), who refers to Schlagintweit's writings, and gives the limit as 6037 metres, is also silent on this point. Schlagintweit's "Einleitung" to Klatt's 'Die Compositæ des Herbarium Schlagintweit,' repeated in the 'Journal of Botany' (vi. 1868), is almost as indefinite. He takes the genera *Artemisia* and *Saussurea* to illustrate the distribution of the Compositæ, and of the latter genus he says that it begins to predominate at the upper limit of trees, and that some of the species are among the phanerogams reaching the greatest altitudes. Further on, he mentions *S. Schlagintweitii* as a species ascending almost to the snow-line, on the south side of the Kuen Luen range, having just before stated that the snow-line on the south side of the Karakorum range is at about 19,400 ft. Turning to the description of this species, where its localities are given in detail, the altitudinal range is from 13,800 to 15,500 ft.; and of two other species, *S. subulata* and *S. Thomsonii,* specially designated as high-level species, 17,000 ft. is the upper limit recorded.

Taking all things into consideration, and especially the light of later explorations, there seem to be strong reasons for doubting the correctness of the highest altitudes recorded. At the same time it must be admitted that, given nooks and crevices free from snow and seed conveyed thither by wind or birds, a plant might thrive as well at 20,000 ft. as it does at 17,000. Indeed Ball, Christ, Whymper, and others agree that the only upper limit is perpetual snow.

Before entering upon a discussion of the altitudinal distribution of the Tibetan Flora, it may be instructive to glean some data from collections made in adjoining countries.

The collection made by Sir Martin Conway and Mr. McCormick when exploring the Hispar and other glaciers of the Karakorum range, in 1892, was worked out at Kew, and is useful for comparisons. Its composition follows:—

	Orders.	Genera.	Species.
Polypetalæ	17	54	96
Gamopetalæ	15	50	80
Incompletæ	6	8	12
Gymnospermæ	2	2	2
Monocotyledones	6	9	10
Totals	46	123	200

The predominating natural orders are:—

	Species.
Compositæ	30
Cruciferæ	17
Rosaceæ	17
Leguminosæ	14
Boraginaceæ	13
Caryophyllaceæ	8
	99
Brought forward	99
Ranunculaceæ	7
Saxifragaceæ	7
Crassulaceæ	7
Gentianaceæ	7
Labiatæ	7
Primulaceæ	6
	140

With the exception of the Boraginaceæ, the orders and the proportions of species are very nearly the same as in the Flora of Tibet.

This collection was made between 74° 30′ and 76° 42′, and between 35° 38′ and 36° 15′—that is to say between Nagyr, at 7790 ft., and Skoro La, at 17,320 ft.; and the highest point reached was Pioneer Peak, 22,600 ft. Eleven species of flowering plants were collected at 16,000 ft. and upwards, namely:—

Isopyrum grandiflorum	16,000 ft.
Parrya exscapa	16,500 ,,
Cheiranthus himalayensis	16,500 ,,
Lychnis apetala	16,400 ,,
Astragalus confertus	16,500 ,,
Potentilla Inglisii	17,000 ,,
Saxifraga imbricata	16,000 ft.
,, *oppositifolia*	17,000 ,,
,, *Hirculus*	17,320 ,,
Sedum tibeticum	16,500 ,,
Leontopodium alpinum	16,500 ,,

No new species were discovered on this expedition and only one orchid, *Orchis latifolia*, was collected.

Another collection presented to Kew, a collection which was confidently supposed to contain a number of novelties, was made near Yatung by H. E. Hobson, Esq., in 1897. Yatung belongs politically to Tibet, and is situated on a strip of territory that wedges into Sikkim. It is in 88° 35′ and 27° 51′, at an elevation of about 11,000 ft., and is really within the humid region of the Himalayas. The following is a rough analysis of the composition of the collection, which, contrary to expectation, contains no striking novelty, though it may prove to include a few undescribed species when the material comes to be more critically examined.

Orders.	Genera.	Species.
Ranunculaceæ	9	23
Berberidaceæ	1	2
Papaveraceæ	2	4
Fumariaceæ	1	6
Cruciferæ	11	16
Violaceæ	1	2
Caryophyllaceæ	5	14
Tamariscaceæ	1	1
Hypericaceæ	2	5
Geraniaceæ	3	9
Aceraceæ	1	1
Coriariaceæ	1	1
Leguminosæ	6	9
Rosaceæ	11	32
Saxifragaceæ	9	22
Crassulaceæ	1	6
Droseraceæ	1	1
Onagraceæ	1	4
Cucurbitaceæ	1	1
Umbelliferæ	5	11
Araliaceæ	2	4
Caprifoliaceæ	4	7
Rubiaceæ	3	5
Valerianaceæ	2	3
Dipsaceæ	4	4
Compositæ	20	54
Campanulaceæ	4	9
Ericaceæ	6	15
Primulaceæ	3	20
29	121	291

	Orders.	Genera.	Species.
	29	121	291
Oleaceæ		1	1
Asclepiadaceæ		2	2
Gentianaceæ		4	12
Boraginaceæ		5	7
Convolvulaceæ		1	1
Solanaceæ		1	1
Scrophulariaceæ		4	17
Orobanchaceæ		1	1
Lentibulariaceæ		1	2
Acanthaceæ		1	1
Selaginaceæ		1	1
Labiatæ		12	17
Plantaginaceæ		1	1
Polygonaceæ		4	17
Euphorbiaceæ		1	1
Urticaceæ		2	2
Coniferæ		3	6
Orchidaceæ		12	23
Scitamineæ		1	1
Iridaceæ		1	2
Amaryllidaceæ		1	1
Liliaceæ		9	15
Juncaceæ		2	10
Commelinaceæ		1	1
Araceæ		1	1
Cyperaceæ		3	7
Gramineæ		12	13
Ferns & Allies		17	36
Totals	57	226	491

The foregoing list offers many interesting points of comparison with the Flora of Tibet. The proportions of orders, genera, and species are much the same, whilst the totals are much higher, though the area over which they were collected is very small. Leguminosæ and Compositæ are relatively much less numerously represented, whereas sixteen additional orders come in, and the number of petaloid monocotyledons is proportionately much larger. The Orchidaceæ, for example, absent from our Tibetan collections, though *Orchis salina* was collected in the Koko Nor region by Przewalski, are represented by no fewer than twelve genera and twenty-three species. And ferns and other vascular cryptogams number seventeen genera and thirty-six species. Figuratively speaking, a step further north we enter the dry barren region of Tibet.

Flora of the Himalayas from 15,000 *ft. and above.*

	Genera.	Species.
Ranunculaceæ	8	21
Berberidaceæ	1	1
Papaveraceæ	2	3
Fumariaceæ	1	8
Cruciferæ	17	34
Violaceæ	1	1
Caryophyllaceæ	6	28
Tamariscaceæ	1	1
Geraniaceæ	2	2
Leguminosæ	9	28
Rosaceæ (*Potentilla*)	1	15
Saxifragaceæ (*Saxifraga*, 20)	3	25
Crassulaceæ	2	12
Halorrhagidaceæ	1	1
Umbelliferæ	5	10
Caprifoliaceæ	1	3
Valerianaceæ	1	1
Compositæ (*Saussurea*, 21)	19	73
Campanulaceæ	3	5
Ericaceæ	2	5
Primulaceæ (*Primula*, 17)	3	22
Gentianaceæ (*Gentiana*, 13)	4	16
Boraginaceæ	6	10
Scrophulariaceæ (*Pedicularis*, 13) ..	4	20
Selaginaceæ (*Lagotis*)	1	4
Labiatæ	10	18
Chenopodiaceæ	3	4
Polygonaceæ (*Polygonum*, 13)	3	15
Euphorbiaceæ (*Euphorbia*, 3)	1	3
Urticaceæ	1	1
Salicaceæ (*Salix*)	1	8
Coniferæ (*Juniperus*)	1	2
Orchidaceæ (*Herminium*)	1	3
Liliaceæ	3	4
Juncaceæ (*Juncus*)	1	4
Naiadaceæ	3	4
Cyperaceæ (*Carex*, 12)	3	20
Gramineæ (*Poa*, 8)	14	35
Totals........ 38	149	470

The preceding summary of the Himalayan Flora from 15,000 ft. and upwards was compiled by Mr. Pearson from Hooker's 'Flora of British India,' and can only claim to be a very rough approximation, whether as affecting the author or ourselves. It is sufficiently correct to afford a basis for comparisons, a few of which are given :—

	Orders.	Genera.	Species.
Himalaya	38	149	470
Tibet	41	119	283

This brings out the fact that the poorer Flora in species is the richer, relatively, in genera and orders, which is in accord with most poor Floras, and especially with those of remote Oceanic Islands.

Generally speaking the natural orders are the same in both Floras, and the preponderating orders likewise; but the following are not in our collections from Tibet :—Berberidaceæ, Violaceæ, Valerianaceæ, Ericaceæ, Coniferæ, and Orchidaceæ. Of course no importance can be attached to this circumstance. It is interesting to compare this general summary of the Himalayan Flora with that of Hobson's Yatung collection, a few pages back, especially the relative increase of Leguminosæ and Compositæ at the higher level.

Plants ascending to 18,000 *ft. in the Himalayas and Little Tibet.*

Ranunculus pulchellus	10,000 to 18,000 ft.
Delphinium glaciale	12,000 ,,
Parrya exscapa	15,000 ,,
,, *macrocarpa*	,, ,,
Braya rosea	,, ,,
,, *tibetica*	,, ,,
Capsella Thomsoni	,, ,,
Lychnis apetala	,, ,,
Stellaria decumbens	,, ,,
Arenaria pulvinata	,, ,,
,, *oreophila*	18,000 ft.
,, *glanduligera*	14,000 to 18,000 ft.
,, *melandryoides*	,, ,,
Thylacospermum rupifragum ..	15,000 ,,
Potentilla tetrandra	14,000 ,,
,, *microphylla*	,, ,,
Saxifraga aristulata	,, ,,
,, *saginoides*	10,000 ,,
,, *hemisphærica*	17,000 ,,

Saxifraga Jacquemontiana	13,000 to	18,000 ft.
Sedum crenulatum	12,000	,,
,, *quadrifidum*...........	11,000	,,
Cortia Hookeri	13,000	,,
Aster heterochæta	14,000	,,
Erigeron andryaloides	9,000	,,
Antennaria muscoides	16,000	,,
Leontopodium alpinum	10,000	,,
Allardia glabra	15,000	,,
Tanacetum gossypinum	16,000	,,
Artemisia desertorum	17,000	,,
,, *Campbelli*	16,000	,,
,, *minor*	15,000	,,
Saussurea Thomsoni	17,000	,,
,, *wernerioides*	16,000	,,
,, *subulata*	15,000	,,
,, *sacra*	14,000	,,
,, *tridactyla*	,,	,,
,, *sorocephala*	,,	,,
Taraxacum officinale	1,000	,,
Androsace Selago	15,000	,,
Gentiana amœna..............	14,000	,,
,, *nubigena*	16,000	,,
Pleurogyne Thomsoni	15,000	,,
Lagotis decumbens	16,000	,,
Nepeta tibetica	17,500	
Oxyria digyna................	17,500	
Juncus minimus	16,000 to	18,000 ft.
Avena subspicata..............	10,000	18,500 ft.
Poa hirtiglumis	16,000	18,000 ft.
Elymus sibiricus..............	10,000	,,

Excepting *Nepeta tibetica* and *Oxyria digyna*, at 17,500 ft., these fifty species are recorded as ascending to 18,000 ft., unless we are to understand that they were collected somewhere between the two altitudes given in each instance. The only safe inference, for the majority of these data, is that the Collector, with imperfect means of determination, believed that he collected the plants in question somewhere between the points named. From subsequent explorations it appears highly improbable that many of them were collected at so great an altitude as 17,000, to say nothing of 18,000 ft. This number, fifty, as compared with the fifty-two species gathered between 17,000 and 18,000 ft. in Tibet, affords further proof that plants ascend higher in the plateaux than they do in the peaks. A further comparison brings out the fact that it is the same genera, and often the same species, that attain the upper limits of phanerogamic vegetation in both Tibet and the Himalayas.

Plants collected at Altitudes of 16,000 *feet and upwards in Tibet.*

	Altitude.	Collectors.
Clematis alpina	16,200 ft.	Thorold.
Callianthemum cachemiricum	16,294	Wellby & Malcolm.
Adonis cærulea	17,200	Thorold.
Ranunculus hyperboreus	16,200	,,
,, *similis*	17,500	,,
,, *tricuspis*	17,000	Deasy & Pike.
,, *Cymbalariæ*	16,400	,, ,,
,, *pulchellus*	16,200	,, ,,
	17,300	Thorold.
,, *lobatus*	17,300	Deasy & Pike.
,, *involucratus*	16,400	,, ,,
	17,500	Thorold.
Delphinium cæruleum	16,386	Wellby & Malcolm.
	17,800	Thorold.
Meconopsis horridula	16,000	Wellby & Malcolm.
	16,500	Littledale.
Corydalis Hendersoni	17,100	Deasy & Pike.
	17,500	Thorold.
Parrya prolifera	16,480	Wellby & Malcolm.
,, *lanuginosa*	17,000	Deasy & Pike.
	17,600	Thorold.
Cheiranthus himalayensis	17,300	Deasy & Pike.
Alyssum canescens	16,150	Wellby & Malcolm.
Draba incompta	16,500	Thorold.
,, *alpina*	17,600	,,
Christolea crassifolia	16,800	,,
Lepidium capitatum	16,200	,,
Cochlearia scapiflora	17,100	Wellby & Malcolm.
	17,800	Thorold.
Sisymbrium humile	17,500	,,
Eutrema Przewalskii	16,400	Deasy & Pike.
Erysimum funiculosum	17,600	Thorold.
Braya uniflora	17,000	Deasy & Pike.
	17,600	Thorold.
,, *sinensis*	16,400	Deasy & Pike.
,, *rosea*	17,800	Thorold.
Capsella Thomsoni	17,000	Deasy & Pike.
	17,500	Thorold.

	Altitude.	Collectors.
Dilophia salsa	16,800 ft.	Deasy & Pike.
Arenaria musciformis	17,000	" "
" *Stracheyi*	16,800	" "
Thylacospermum rupifragum	17,100	Wellby & Malcolm.
Myricaria prostrata	16,900	Deasy & Pike.
	17,300	Thorold.
Thermopsis inflata	18,540	"
" *lanceolata*	16,500	Littledale.
Astragalus melanostachys	16,500	"
" *Heydei*	16,400	Wellby & Malcolm.
	16,800	Thorold.
	17,100	Deasy & Pike.
" *Arnoldi*	17,500	" "
	"	Thorold.
" *nivalis*	16,290	Wellby & Malcolm.
" *Malcolmii*	16,400	" "
" *confertus*	17,100	Deasy & Pike.
	18,000	Thorold.
Oxytropis densa	17,500	"
" *microphylla*	16,400	Wellby & Malcolm.
	17,500	Deasy & Pike.
	17,800	Thorold.
" *tatarica*	16,140	Wellby & Malcolm.
	17,100	Deasy & Pike.
	17,800	Thorold.
" *Stracheyana*	16,200	"
	16,600	Wellby & Malcolm.
" *lapponica*	17,800	Thorold.
" *cachemirica*	16,500	Littledale.
Potentilla fruticosa	"	"
" *bifurca*	16,300	Wellby & Malcolm.
" *sericea*	17,500	Thorold.
Chamærhodos sabulosa	16,700	Deasy & Pike.
	17,000	Thorold.
Saxifraga parva	16,800	Deasy & Pike.
	17,000	Thorold.
" *Jacquemontiana*	16,800	Wellby & Malcolm.
Sedum quadrifidum	16,500	Littledale.
	17,000	Thorold.
" *Rhodiola*	17,000	Deasy & Pike.
" *tibeticum*	17,100	" "
	17,500	Thorold.
Myriophyllum verticillatum	16,500	Littledale.
Peucedanum Malcolmii	16,140	Wellby & Malcolm.
Pleurospermum stellatum	16,400	Thorold.
Aster Heterochæta	16,300	Wellby & Malcolm.

	Altitude.	Collectors.
Aster Boweri	16,140 ft.	Wellby & Malcolm.
	16,500	Littledale.
	17,000	Deasy & Pike.
	18,000	Thorold.
,, *tibeticus*	17,800	,,
,, *tricephalus*	16,500	Littledale.
Leontopodium alpinum	16,500	,,
	17,000	Deasy & Pike.
Anaphalis xylorrhiza	16,500	Littledale.
Tanacetum tibeticum	16,200	Deasy & Pike.
Artemisia Stracheyi	16,500	Littledale.
,, *salsoloides*	,,	,,
,, *Wellbyi*	16,200	Wellby & Malcolm.
	17,000	Deasy & Pike.
	17,100	Thorold.
,, *minor*	16,290	Wellby & Malcolm.
Cremanthodium goringensis	16,200	Deasy & Pike.
	16,500	Littledale.
	16,400	Wellby & Malcolm.
,, *Fletcheri*	16,500	Littledale.
,, *Deasyi*	17,000	Deasy & Pike.
	17,600	Thorold.
Saussurea Thoroldi	16,140	Wellby & Malcolm.
	16,400	Thorold.
	16,500	Littledale.
,, *subulata*	16,500	,,
	16,520	Wellby & Malcolm.
	16,900	Deasy & Pike.
	17,000	Thorold.
,, *sorocephala*	16,300	Wellby & Malcolm.
	17,000	Thorold.
	,,	Deasy & Pike.
,, *Aster*	16,300	Wellby & Malcolm.
	16,400	Deasy & Pike.
	17,800	Thorold.
,, *Kunthiana*	16,520	Wellby & Malcolm.
,, *Wellbyi*	16,800	,, ,,
,, *bracteata*	,,	Deasy & Pike.
,, *pygmæa*	17,800	Thorold.
,, *glanduligera*	16,600	Deasy & Pike.
	17,800	Thorold.
,, *tridactyla*	19,000	,,
,, *Thomsoni*	16,520	Wellby & Malcolm.
Crepis flexuosa	16,100	Deasy & Pike.
	16,520	Wellby & Malcolm.
	17,200	Thorold.

	Altitude.	Collectors.
Crepis sorocephala	16,300 ft.	Wellby & Malcolm.
	17,500	Thorold.
Taraxacum bicolor	16,100	Deasy & Pike.
	17,300	Thorold.
,, *lanceolatum*	16,000	,,
	16,900	Deasy & Pike.
,, *palustre*	16,500	Littledale.
Androsace Tapete	16,400	Deasy & Pike.
	16,480	Wellby & Malcolm.
,, *Chamæjasme*	16,200	Deasy & Pike.
	17,500	Thorold.
Gentiana aquatica	16,800	Deasy & Pike.
,, *tenella*	16,800	,, ,,
	16,800	Wellby & Malcolm.
Pleurogyne brachyanthera	16,800	Thorold.
	16,900	Deasy & Pike.
Microula tibetica	16,600	Wellby & Malcolm.
	17,000	Deasy & Pike.
	18,000	Thorold.
Pedicularis cheilanthifolia	16,200	Deasy & Pike.
,, *Przewalskii*	16,500	Littledale.
,, *rhinanthoides*	,,	,,
Oreosolen unguiculatus	,,	,,
Lagotis decumbens	17,000	Deasy & Pike.
Nepeta longibracteata	16,200	,, ,,
,, *decolorans*	16,500	Littledale.
Dracocephalum heterophyllum	16,200	Deasy & Pike.
	16,230	Wellby & Malcolm.
	17,700	Thorold.
Phlomis rotata	16,500	Littledale.
Halogeton glomeratus	16,290	Wellby & Malcolm.
Rheum spiciforme	16,200	Deasy & Pike.
	16,500	Littledale.
Polygonum tibeticum	16,500	,,
,, *viviparum*	,,	,,
,, *sibiricum*	16,480	Wellby & Malcolm.
Urtica hyperborea	16,200	Thorold.
	16,500	Littledale.
	17,000	Deasy & Pike.
Salix Lapponum	16,500	Littledale.
Ephedra Gerardiana	16,500	Thorold.
	16,700	Deasy & Pike.
Iris Thoroldii	16,300	Wellby & Malcolm.
	17,800	Thorold.
Allium senescens	16,200	,,
,, *Semenovii*	17,000	Wellby & Malcolm.

	Altitude.	Collectors.
Juncus Thomsoni	16,100 ft.	Deasy & Pike.
	16,200	Thorold.
Carex ustulata	16,500	Littledale.
" *Moorcroftii*	16,480	Wellby & Malcolm.
	17,600	Thorold.
" *sabulosa*	16,160	Hedin.
" *stenophylla*	16,200	Thorold.
Kobresia schœnoides	16,300	Deasy & Pike.
Stipa purpurea	16,500	Thorold.
Poa attenuata	18,000	"
Atropis distans	17,000	"
Festuca valesiaca	16,500	"
	16,400	Deasy & Pike.
Littledalea tibetica	16,500	Littledale.
Agropyrum Thoroldianum	16,500	Thorold.
" *striatum*	"	Littledale.
Elymus lanuginosus	16,520	Wellby & Malcolm.

The above list is doubtless imperfect and incomplete. For instance, it is doubtful whether so many of Littledale's plants were collected above 16,000 ft., because only a general indication of altitude of "about 16,500 ft." was given, and some of the plants may have been collected a thousand feet or more lower. Still, as may be seen, many of the plants of the Littledale collection were found at greater elevations by other travellers. It is also probable that Thorold's altitudes are all susceptible to some reduction. The general result is :—

Species from 16,000 and below 17,000 ft.	72
" 17,000 " " 18,000	52
" 18,000 " above	6
	130

According to these figures, nearly half of the Tibetan species in our Enumeration have been collected at 16,000 ft. and upwards. Whether these figures are very exact or not, they go to prove that there is no altitudinal limit to flowering plants except perpetual snow. In the Alps of Europe, as proved by the late John Ball and others, plants exist in snow-free nooks and corners far above the ordinary snow-line. The species recorded from 18,000 ft. and upwards are :—*Thermopsis inflata*, 18,540 ft.; *Astragalus confertus*, 18,000 ft.; *Aster Boweri*, 18,000 ft.; *Saussurea tridactyla*, 19,000 ft.; *Microula tibetica*, 18,000 ft. and *Poa attenuata*, 18,000 ft.

The Useful Plants of Tibet.

In a sense, almost all the plants of Tibet are useful, if only as food for animals; but some are injurious, or at least one is injurious, to animals; and it is of importance to know what this is. Both Rockhill ('Mongolia and Tibet,' p. 139) and Malcolm (Geogr. Journ. ix. 1897, p. 216) mention a "poisonous weed," which in each instance cost them the lives of several mules in one night. It is mentioned as though it were well known, yet we have not succeeded in identifying it with any of the plants collected. Possibly it was *Stipa sibirica*, a grass which is injurious to animals at a certain stage of growth; but it is a mechanical irritant rather than a poison. By useful plants, however, we mean those directly useful to the traveller, either for food or fuel. The only really valuable plant for food, or perhaps we should say the only one much used, because there was no choice, was a kind of onion, *Allium Semenovi*, which was eaten by several of the travellers, and Wellby and Malcolm nearly lived on it for several days. Happily it was abundant in the country where it was most needed. The bulbs of *A. senescens* and *A. Jacquemontii* are also eaten.

The following plants are noted as being used as vegetables; in some cases it is the leaves which are eaten, in others the roots:—*Braya uniflora*, *Crambe cordifolia*, *Peucedanum Malcolmii*, *Saussurea Thoroldii*, *S. tangutica*, and *Polygonum sibiricum*. Most likely other plants are used for food, such, for instance, as the species of *Taraxacum* and *Crepis*. Concerning rhubarb, there is nothing to add to the notes in the "Itineraries" and in the "Enumeration."

A few native names appear on the labels and in the narratives of some of the travellers. Dama=*Caragana pygmæa*, of which we have seen no specimen from within our limits, except one collected by Strachey and Winterbottom in Gugé. Kumbuk=*Peucedanum Malcolmii*. Hann=*Saussurea Thoroldii*. Cumtchen=*Artemisia macrocephala*. Tami is the name applied to various shrubby species of *Artemisia*, according to Schlagintweit, who also states that *Eurotia* is called Burzu. On the authority of Deasy and Pike, *Tanacetum tibeticum* bears the name of Boortze in Tibet. The name is variously spelt by different travellers, and it is probable that this name is applied to more than one species of *Tanacetum* and perhaps also to species of *Artemisia.* The dried berries of *Ephedra Gerardiana* are mixed with tobacco and carried in the mouth.

Table of the Distribution of the Plants of Tibet.

The following Table is intended to show the distribution of the vascular plants collected in Tibet Proper by the travellers whose names appear in the heading. It is probable that half a dozen species are included that have not been collected within our limits, and as many perhaps omitted that should have been included. It was not considered necessary for our purposes to have strictly defined areas to illustrate the general distribution of the plants, and the results seem to justify this view. The regions adopted, roughly described, are:—

1. *Himalayan Region.*—Himalayan and Karakorum mountains, and most of the country designated Tibet in the 'Flora of British India,' as pointed out more fully at p. 128.
2. *Mongolian Region.*—Chinese Turkestan, Mongolia, and Tangut or North-western Kansuh.
3. *Chinese Region.*—China Proper, Japan, Korea.
4. *Siberian Region.*—Temperate Siberia, Mandshuria, and Kamtschatka.
5. *Persian Region.*—Russian Turkestan, Afghanistan, Baluchistan, Persia, extratropical Arabia.
6. *Mediterranean Region.*—Caucasus, Asia Minor, South Europe, and extratropical North Africa.
7. *Arctic Region.*—Arctic Europe, Asia, and America.
8. *Other Regions.*—Asia south of the mountains of Northern India and south of China Proper; Europe, between the Arctic circle and the country bordering the Mediterranean Sea; America south of the Arctic circle; Africa, tropical and south; tropical Arabia; Australasia and Polynesia.

As may be learnt from the analysis following the table, we are able to give fuller information than the table itself supplies, because we compiled a much more detailed one for working purposes.

TABULAR VIEW of the Distribution of the Plants collected in Tibet by Thorold & Bower, Rockhill, the Littledales, Wellby & Malcolm, Deasy & Pike, and Hedin, with some additional species from the earlier collections of Hooker and Strachey & Winterbottom.

	Regions.							
TIBET.	Himalayan.	Mongolian.	Chinese.	Siberian.	Persian.	Mediterranean.	Arctic.	Of wider Distribution.
1. RANUNCULACEÆ.								
Aconitum dissectum	...	...	*					
Adonis cærulea..................	...	...	*					
Anemone imbricata.								
Callianthemum cachemirianum	*	...	*	...	*			[N. Am.
Clematis alpina....................	...	...	*	*	...	...	...	Temp. Eur., As.,
,, orientalis	*	*	*	...	*			
Delphinium Brunonianum	*	*						
,, cæruleum	*							
,, grandiflorum	...	...	*	*				
,, Pylzowii	...	*	*					
Ranunculus aquatilis	*	*	*	*	*	*	*	N. & S. Temp. Reg.
,, Cymbalariæ.........	*	...	*	*	*	...	*	N. Am., Andes.
,, hyperboreus.........	*	...	...	*	...	...	*	
,, involucratus.								
,, lobatus..............	*							
,, pulchellus	*	*	*	*	*			
,, similis.								
,, tricuspis	...	*						
Thalictrum alpinum..............	*	...	*	*	*	*	*	
2. PAPAVERACEÆ.								
Hypecoum leptocarpum	*							
Meconopsis horridula	*	*	*					
,, integrifolia	...	...	*					
3. FUMARIACEÆ.								
Corydalis Boweri.								
,, Hendersoni	*	*						
,, Moorcroftiana	*	...	...	...	*			
,, tibetica	*							
4. CRUCIFERÆ.								
Alyssum canescens	*	...	...	*				
Braya rosea	*	...	...	*	...	...	*	
28	17	8	13	9	7	2	5	3

	Regions.							
Tibet.	Himalayan.	Mongolian.	Chinese.	Siberian.	Persian.	Mediterranean.	Arctic.	Of wider Distribution.
28	17	8	13	9	7	2	5	3
4. Cruciferæ (*continued*).								
Braya sinensis	...	...	*					
,, uniflora	*							
Capsella Thomsoni	*	*	*					
Cheiranthus himalayensis	*							
Christolea crassifolia	*	*						
Cochlearia scapiflora	*	*						
Crambe cordifolia	*	*	...	...	*	*		
Dilophia salsa	*	*	*					
Draba alpina	*	*	...	...	*	...	*	N. Alpine Regions.
,, fladnitzensis	*	...	...	...	...	...	*	,, ,,
,, incompta	*	...	...	...	*	*		
,, lasiophylla	*	*						
Erysimum Chamæphyton.								
,, funiculosum	*							
Eutrema Przewalskii.								
Iberidella Andersonii	*							
Lepidium capitatum	*							
,, cordatum	...	...	...	*				
,, latifolium	*	*	*	...	*	*	...	Temp. Europe.
Parrya exscapa	*	...	...	*				
,, lanuginosa	*							
,, macrocarpa	*	...	...	*	*	...	*	
,, prolifera.								
Sisymbrium humile	*	*	...	*	...	...	*	
5. Caryophyllaceæ.								
Arenaria festucoides	*							
,, Littledalei.								
,, musciformis	*	*						
,, Stracheyi	*							
Lychnis apetala	*	*	...	*	...	...	*	N. Alpine Regions.
,, macrorhiza	*							
Silene Moorcroftiana	*	...	...	...	*			
Stellaria decumbens	*							
,, graminea	*	*	*	*	*	*	*	Europe.
,, subumbellata	*							
Thylacospermum rupifragum	*	*						
6. Tamariscaceæ.								
Myricaria elegans	*							
,, prostrata	*							
65	48	21	18	15	14	6	11	8

Tibet.	Regions. Himalayan.	Mongolian.	Chinese.	Siberian.	Persian.	Mediterranean.	Arctic.	Of wider Distribution.
65	48	21	18	15	14	6	11	8
7. Zygophyllaceæ.								
Nitraria Schoberi	...	*	*	*	*	*	...	Australia.
8. Geraniaceæ.								
Biebersteinia Emodi	*							
Geranium collinum	*	...	...	*	*			
9. Leguminosæ.								
Astragalus Arnoldi.								
,, confertus	*							
,, Heydei	*	*						
,, Malcolmii.								
,, melanostachys	*							
,, nivalis	*	...	...	*				
,, tribulifolius	*							
,, Webbianus	*							
Caragana pygmæa	*	*	...	*	*			
Oxytropis cachemirica	*	*	...	*				
,, densa	*							
,, lapponica	*	...	...	*	...	...	*	Mts. of Europe.
,, microphylla	*	...	...	*				
,, Stracheyana	*							
,, tatarica	*	*						
Stracheya tibetica	*							
Thermopsis inflata	*							
,, lanceolata	...	*	*	*				
10. Rosaceæ.								
Chamærhodos sabulosa	*	...	*	*				[Austral.
Potentilla Anserina	*	*	*	*	*	*	*	N. Temp. S. Am.
,, bifurca	*	*	*	*	...	*		
,, fruticosa	*	*	*	*	*	*	*	N. Temp. Regions.
,, multifida	*	*	*	*	*	*	*	,, ,,
,, nivea	*	*	*	*	*	*	*	,, ,,
,, sericea	*	*	*	*	*	*	*	,, ,,
11. Saxifragaceæ.								
Parnassia ovata	*	...	...	*				
Saxifraga flagellaris	*	*	...	*	...	*	*	N. Temp. Regions.
,, Hirculus	*	*	*	*	*	*	*	,, ,,
,, Jacquemontiana	*	...	...	*				
97	76	35	28	34	23	15	19	17

Tibet.	Regions.							
	Himalayan.	Mongolian.	Chinese.	Siberian.	Persian.	Mediterranean.	Arctic.	Of wider Distribution.
97	76	35	28	34	23	15	19	17
11. Saxifragaceæ (*continued*).								
Saxifraga parva.								
,, saginoides	*							
,, tangutica	...	*						
12. Crassulaceæ.								
Sedum algidum	...	*	...	*	*			
,, crenulatum	*							
,, Ewersii	*							
,, fastigiatum	*							
,, Przewalskii	...	*						
,, quadrifidum	*	...	...	*	...	...	*	
,, Rhodiola	*	*	...	*	...	...	*	N. Temp. Regions.
,, rotundatum.								
,, tibeticum	*	...	...	...	*			
Sempervivum acuminatum	*							
13. Halorrhagidaceæ.								
Hippuris vulgaris	*	*	*	*	*	*	*	N. Temp. Regions, S. Amer.
Myriophyllum verticillatum	*	*	*	*	*	*	...	
14. Umbelliferæ.								
Peucedanum Malcolmii.								
Pleurospermum Hookeri	*							
,, stellatum	*	*						
Selinum striatum	*							
15. Caprifoliaceæ.								
Lonicera hispida	*	...	...	*	*			
16. Dipsaceæ.								
Morina Coulteriana	*							
17. Compositæ.								
Allardia tomentosa	*							
Anaphalis mucronata	*							
,, xylorrhiza	*							
Antennaria nana	*							
Artemisia Campbellii	*							
123	96	42	30	40	28	17	22	20

Tibet.	Regions. Himalayan.	Mongolian.	Chinese.	Siberian.	Persian.	Mediterranean.	Arctic.	Of wider Distribution.
123	96	42	30	40	28	17	22	20
17. Compositæ (*continued*).								
Artemisia desertorum	*	*	...	*				
,, macrocephala	*	*	...	...	*			
,, minor	*							
,, Roxburghiana	*							
,, sacrorum	*	...	*	*	...	...	...	E. Europe.
,, salsoloides	*	*	...	*	...	*	...	,, ,,
,, Stracheyi	*							
,, Wellbyi.								
Aster altaicus	*	*	*	*	*			
,, Boweri.								
,, Heterochæta	*	...	*	*				
,, molliusculus	*							
,, tibeticus	*	*						
,, tricephalus	*							
Cremanthodium Deasyi.								
,, Fletcheri.								
,, goringensis.								
Crepis flexuosa	*	*	...	*				
,, glomerata	*							
,, sorocephala.								
Lactuca Deasyi.								
,, Lessertiana	*							
Leontopodium alpinum	*	*	*	*	...	...	...	Alps of Europe.
,, Stracheyi	*							
Saussurea alpina	...	...	...	*	*	...	*	N. Temp. Regions.
,, Aster.								
,, bracteata	*							
,, glanduligera	*							
,, Hookeri	*							
,, Kunthiana	*							
,, pumila.								
,, pygmæa	...	*	...	*				
,, sorocephala	*	*	...	*				
,, subulata	*	*						
,, tangutica	*	*						
,, Thomsoni	*							
,, Thoroldii	...	*	*					
,, tridactyla..............	*							
,, Wellbyi.								
Senecio arnicoides..................	*							
,, coronopifolius	*	...	...	...	*	*	...	Temp. Europe.
Tanacetum fruticulosum	*	...	...	*	*			
,, gracile	*							
,, tibeticum	*							
167	127	54	35	51	33	19	23	25

Tibet.	Regions.							
	Himalayan.	Mongolian.	Chinese.	Siberian.	Persian.	Mediterranean.	Arctic.	Of wider Distribution.
167	127	54	35	51	33	19	23	25
17. Compositæ (*continued*).								
Taraxacum bicolor	*	*	...	*				
,, lanceolatum	...	...	...	*	...	...	...	Temp. Europe.
,, officinale	*	*	*	*	*	*	*	N. & S. Temp. Reg.
,, palustre	*	...	...	...	...	*	*	
18. Campanulaceæ.								
Cyananthus incanus	*	...	*					
19. Plumbaginaceæ.								
Statice aurea	...	*	...	*				
20. Primulaceæ.								
Androsace Chamæjasme	*	...	..	*	...	*	*	N. Temp. Regions.
,, Tapete.								
,, villosa	*	*	*	*	*	*		
Glaux maritima	*	*	*	*	*	*	*	N. Temp. Regions.
Primula purpurea	*	...	...	...	*			
,, rotundifolia	*							
,, tibetica	*							
21. Gentianaceæ.								
Gentiana aquatica	*	*	*	*	*			
,, falcata	...	...	...	*				
,, humilis	*	...	...	*	...	*	...	N. Temp. Regions.
,, nubigena	*							
,, Rockhillii.								
,, squarrosa	*	...	*	*				
,, tenella	*	...	...	*	...	...	*	Alps of Europe.
,, thianschanica	*	*						
,, Thomsoni	*	*						
Pleurogyne brachyanthera	*							
22. Boraginaceæ.								
Microula sikkimensis	*	...	*					
,, tibetica	*	...	*					
23. Solanaceæ.								
Physochlaina præalta	*	*						
193	148	63	43	63	38	25	28	31

Tibet.	Regions. Himalayan.	Mongolian.	Chinese.	Siberian.	Persian.	Mediterranean.	Arctic.	Of wider Distribution.
193	148	63	43	63	38	25	28	31
24. Scrophulariaceæ.								
Oreosolen unguiculatus.								
Pedicularis alaschanica	*	*	*					
„ cheilanthifolia	*	...	*	*				
„ longiflora	*	*	*	*				
„ Oederi	*	...	*	*	...	...	*	N. Alpine Regions.
„ Przewalskii	*	...	*					
„ rhinanthoides	*	*	*	...	*			
Scrophularia dentata	*							
25. Selaginaceæ.								
Lagotis brachystachya	...	*	*					
„ decumbens	*	*						
„ glauca	*	*	*	*	...	...	*	N. Temp. Regions.
26. Labiatæ.								
Dracocephalum heterophyllum	*	*	...	...	*			
„ Hookeri	*							
Lamium rhomboideum	*	*	...	...	*			
Nepeta decolorans.								
„ discolor	*	...	...	...	*			
„ longibracteata	*	...	...	...	...	*		
„ supina	*							
„ Thomsoni	*							
„ thibetica	*							
Phlomis rotata	*							
27. Chenopodiaceæ.								
Eurotia ceratoides	*	*	*	*	*	*	...	Eur., N.W. America.
Halogeton glomeratus	*	...	...	*	*			
Kalidium gracile	...	*						
Salsola collina	*	...	*	*	*	...	...	E. Europe.
„ Kali	*	*	*	*	*	*	...	N. & S. Temp. Reg.
28. Polygonaceæ.								
Polygonum Bistorta..............	...	*	*	*	...	*	*	N. Temp. Regions.
„ bistortoides	...	...	...	...	*	*		
„ Deasyi.								
„ sibiricum	*	*	*	*	...	...	*	
„ sphærostachyum ...	*							
224	172	76	56	73	47	30	32	37

Tibet.	Regions. Himalayan.	Mongolian.	Chinese.	Siberian.	Persian.	Mediterranean.	Arctic.	Of wider Distribution.
224	172	76	56	73	47	30	32	37
28. Polygonaceæ (*continued*).								
Polygonum tibeticum.								
„ tortuosum	*							
„ viviparum	*	*	...	*	...	*	*	N. Alpine Regions.
Rheum spiciforme	*	...	*	...	*			
29. Thymelæaceæ.								
Stellera Chamæjasme	*	*	*	*	*	*		
30. Elæagnaceæ.								
Hippophaë Rhamnoides	*	...	*	*	*	*	...	Temp. Europe.
31. Euphorbiaceæ.								
Euphorbia tibetica	*	*						
32. Urticaceæ.								
Urtica hyperborea	*	*						
33. Salicaceæ.								
Salix Lapponum	...	...	...	*	...	*	*	Alps of Europe.
„ sclerophylla	*							
34. Gnetaceæ.								
Ephedra Gerardiana	*							
35. Iridaceæ.								
Iris Thoroldii.								
36. Liliaceæ.								
Allium Jacquemontii	*							
„ Semenovii	*	*						
„ senescens	...	*	...	*	...	...	...	E. Europe.
Gagea pauciflora	...	*	*	*	*			
240	183	83	60	79	51	34	34	41

Tibet.	Regions.							
	Himalayan.	Mongolian.	Chinese.	Siberian.	Persian.	Mediterranean.	Arctic.	Of wider Distribution.
240	183	83	60	79	51	34	34	41
37. JUNCACEÆ.								
Juncus Thomsoni	*	*						
38. NAIADACEÆ.								
Potamogeton pectinatus	*	*	*	*	*	*	*	N. & S. Temp. Reg.
Triglochin palustre	*	*	*	*	*	*	*	„ „
39. CYPERACEÆ.								
Carex incurva	*	*	*	*	*	*	*	N. Temp. Regions.
„ Moorcroftii	*	*	*					
„ rigida	*	...	...	...	...	...	*	„ „
„ sabulosa	...	*	...	...	...	*		
„ stenophylla	*	...	*	*	...	*	*	
„ ustulata	*	...	*	...	...	...	*	„ „
Kobresia Sargentiana.								
„ schœnoides	*	...	...	*	...	*		
Scirpus Caricis	*	...	...	*	...	...	...	Mts. of Europe.
40. GRAMINEÆ.								
Agropyron longiaristatum	*	...	...	...	*	...	...	Abyssinia.
„ striatum	*							
„ Thoroldianum.								
Atropis distans	*	*	...	*	...	*	*	Temp. Europe.
Avena subspicata	*	*	*	*	*	*	*	N. & S. Temp. Reg.
Deschampsia cæspitosa	*	*	*	...	...	*	*	„ „
Deyeuxia compacta	*	*						
Diplachne Thoroldi.								
Elymus dasystachys	*	*	*	*				
„ junceus	...	*	...	*	*			
„ lanuginosus	...	...	...	*				
„ sibiricus	*	*	...	*	*	...	...	N. Am. Abyssinia.
Festuca Deasyi.								
„ nitidula	*							
„ sibirica	*	...	...	*	...	*		
„ valesiaca	*	*	*	*	*	*	...	Europe. N. Am.
Littledalea tibetica	...	...	*					
Oryzopsis lateralis	*	...	...	...	*			
Pennisetum flaccidum	*	*	*	...	*			
Phragmites communis	*	*	*	*	*	*	*	N. & S. Temp. Reg.
272	207	99	73	94	62	46	44	54

Tibet.	Regions. Himalayan.	Mongolian.	Chinese.	Siberian.	Persian.	Mediterranean.	Arctic.	Of wider Distribution.
272	207	99	73	94	62	46	44	54
40. Gramineæ (*continued*).								
Poa alpina	*	*	*	...	...	*	*	N. Alp. Regions.
,, *attenuata*	*	*	...	*	*			
,, *nemoralis*	*	*	*	*	...	*	*	N. Temp. Regions.
,, *pratensis*	*	*	*	...	...	*	*	,, ,,
,, *tibetica*	*							
Stipa Hookeri	*							
,, *mongolica*	*	*	...	*				
,, *orientalis*	*	*	*	*	*			
,, *purpurea*	*	*	...	...	*			
,, *sibirica*	*	*	*	*	*			
41. Filices.								
Polypodium hastatum	...	...	*					
Total number of the 283 Tibetan species extending to each region	217	107	79	99	66	49	47	57
Approximate percentage of the 283 Tibetan species extending to each region	76·6	38·1	27·9	35	23·3	17·3	16·2	20·1

Analysis and Discussion of the Table.

The foregoing table comprises 283 species of vascular plants belonging to 119 genera and 41 natural orders. As pointed out elsewhere, these totals can only be regarded as approximations; yet it seems probable that these 283 species of plants constitute, or nearly so, the entire flora of Dry Tibet. The uniform composition and smallness of the collections, coupled with the fact that the various explorers traversed the country in the most distant longitudes and latitudes, favour this view, which is also supported by the independent observations of the collectors themselves. Considering that the country stretches across about twenty degrees of longitude, by ten degrees of latitude, the numbers are indeed very low. Members of several other natural orders, such as the Violaceæ (*Viola*), the Onagraceæ (*Epilobium*), and the Ericaceæ (*Rhododendron niveum*), have been found on the borders of the adjoining countries, and it is therefore probable that they may be represented within our limits. At the same time it is improbable that further researches will considerably increase the number of species, genera, or natural orders,—that is to say in Dry Tibet. On the other hand, if we keep strictly to longitudinal and latitudinal limits, say from 80° to 102°, and 28° to 39°, the numbers would be considerably augmented, especially from the country south of Lhassa between 28° and 30°; and the contiguous parts of Chinese Turkestan and Mongolia, though also poor, have a more varied flora than Tibet. Strachey and Winterbottom's collections illustrate this point, and so does Przewalski's so far as it has been published. Of Hedin's small collection, nearly a third was from the Arka Tag mountains, where he entered Tibet; and the only new species, *Gentiana Hedini* and *G. cordisepala*, were from this region. It is probable, therefore, that some of the species included in the list of his plants should have been left out. The two species of *Gentiana* in question were originally left out, because we had seen no specimens, and subsequently because it was ascertained that they were from Sarik Kol. Under the head of "Vegetation" we give some particulars of the botanical collection made by Bonvalot and Prince Henry of Orleans, chiefly between Lhassa and Tachienlu, and our reasons for not including them. In the same place an account is given of several other collections from the countries adjoining Tibet.

Natural Orders.

The forty-one natural orders found in Tibet are either nearly cosmopolitan, or at least widely spread in the northern hemisphere, and all are represented in the British flora by indigenous species except the Tamariscaceæ, Zygophyllaceæ, Selaginaceæ, and Gnetaceæ, and all are represented in the European flora.

The ordinal representation, taken systematically, is as follows:—

	Genera.	Species.
Ranunculaceæ	8	19
Papaveraceæ	2	3
Fumariaceæ	1	4
Cruciferæ	15	26
Caryophyllaceæ	5	11
Tamariscaceæ	1	2
Zygophyllaceæ	1	1
Geraniaceæ	2	2
Leguminosæ	5	18
Rosaceæ	2	7
Saxifragaceæ	2	7
Crassulaceæ	2	10
Halorrhagidaceæ	2	2
Umbelliferæ	3	4
Caprifoliaceæ	1	1
Dipsaceæ	1	1
Compositæ	13	53
Campanulaceæ	1	1
Plumbaginaceæ	1	1
Primulaceæ	3	7
Gentianaceæ	2	10
Boraginaceæ	1	2
Solanaceæ	1	1
Scrophulariaceæ	3	8
Selaginaceæ	1	3
Labiatæ	4	10
Chenopodiaceæ	4	5
Polygonaceæ	2	9
Thymelæaceæ	1	1
Elæagnaceæ	1	1
Euphorbiaceæ	1	1
Urticaceæ	1	1
Salicaceæ	1	2
Gnetaceæ	1	1
Iridaceæ	1	1
Liliaceæ	2	4
Juncaceæ	1	1
Naiadaceæ	2	2
Cyperaceæ	3	9
Gramineæ	14	30
Filices	1	1
Totals......41	119	283

Out of forty-one natural orders fourteen, or just over a third, are represented by only one genus and one species each. Fifteen other natural orders comprise 83 genera and 234 species, or, approximately, 70 per cent. and 82·7 per cent. respectively of the total number of genera and species. We have little information on the relative individual abundance of the species of the predominating natural orders and genera, but such remarks as "common" and "rare," and "only seen once" are attached to some of the specimens and are reproduced in our Enumeration; and it may perhaps be a legitimate inference that the natural orders most numerous in genera and species constitute the greater part of the vegetation. Admitting this, the following figures should enable us to picture, if only imperfectly, the appearance of the vegetation of the country, always bearing in mind that certain species grow gregariously, whilst others grow sporadically. For instance, many species of *Saussurea* occur as solitary individuals; *Thylacospermum* forms large tufts; some species of *Allium* grow in large masses, and grasses, generally speaking, form a continuous carpet, though some of the Tibetan species grow in tufts. The fifteen natural orders preponderating both in genera and species are:—

Orders.	Genera.		Species.	
Ranunculaceæ	8=	6·7 per cent.	19=	6·7 per cent.
Cruciferæ	15	12·6	26	9·2
Caryophyllaceæ	5	4·2	11	3·9
Leguminosæ..........	5	4·2	18	6·3
Rosaceæ	2	1·7	7	2·4
Saxifragaceæ	2	1·7	7	2·4
Crassulaceæ	2	1·7	10	3·5
Compositæ	13	11	53	18·7
Primulaceæ	3	2·5	7	2·4
Gentianaceæ	2	1·7	10	3·5
Scrophulariaceæ	3	2·5	8	2·8
Labiatæ	4	3·3	10	3·5
Polygonaceæ	2	1·7	9	3·1
Cyperaceæ	3	2·5	9	3·1
Gramineæ	14	11·7	30	10·6
Totals: 15	83		234	

These totals are equal to about 70 per cent. of the genera, and 82·7 per cent. of the species of the whole flora. Similar proportions are found in the richest floras, and they therefore call for no special remarks. There is no great development in Tibet of any order of restricted distribution or of any order of peculiar structure or habit. The number and percentages of the Compositæ call for some remark. Some years ago the late C. J. Maximowicz drew up a table showing the predominating natural orders in seven floral regions, ranging from the Caspian through Central Asia, North China, and Mandshuria to Japan, and in each of these regions the Compositæ considerably exceed any other natural order; in most instances by a third, varying from 15·4 per cent. in the Aralo-Caspian region to 7·7 per cent. in Japan. The decline was almost uniform from West to East. In Tibet nearly 11 per cent. of the genera and 18·7 per cent. of the species belong to this natural order; and it may be added that the preponderance of Compositæ among the high-level plants obtains almost throughout the world. Whether this is altogether due to the special means for dispersion possessed by members of this order would require much investigation to prove, but it may be put forward as probable.

The total absence of certain orders and the poverty of others offer, indeed, points of greater interest. One of the most surprising facts is the extreme rarity of bulbous plants in a country where the conditions seem so favourable to the existence and propagation of this class, and this more especially, because bulbous plants abound in the dry regions of the surrounding countries, though at lower levels. Possibly more may depend on elevation, and the concomitant temperatures of the soil, than is obvious. But the fact remains that petaliferous monocotyledons are exceedingly rare; and not a single species of the Orchidaceæ occurs in the Tibetan collections dealt with in this paper, but Przewalski collected *Orchis salina*, a near ally of the widely diffused *O. latifolia*, in the Koko Nor region. Considering the extent of saline country, a more numerous representation of the Chenopodiaceæ might have been expected.

Genera.

Out of the 119 genera less than a dozen are peculiar to the region; that is, to Tibet and the immediately contiguous countries, and it is exceedingly doubtful whether any genus is endemic in, or confined to, Tibet. The few more or less local genera are:—

Dilophia (Cruciferæ), a diminutive monotype ranging from Ladak in the south-west across Tibet to Kansuh in the north-east.

Thylacospermum (Caryophyllaceæ), a monotype widely spread in the Himalayas, Turkestan, Tibet, and Mongolia. A moss-like plant forming excessively dense cushions.

Stracheya (Leguminosæ), an almost stemless monotypic herb having prickly pods, limited to the Himalayas and the extreme west of Tibet.

Allardia (Compositæ), a genus of about half-a-dozen dwarf herbaceous species inhabiting the Himalayas, Tibet, and Chinese Turkestan.

Cremanthodium (Compositæ), better treated as a section of *Senecio*, which consists of eight or ten almost stemless herbaceous species inhabiting the Himalayas and Tibet.

Cyananthus (Campanulaceæ), a genus of about eight tufted herbaceous species inhabiting the Himalayas, Tibet, and Western China.

Microula (Boraginaceæ), a genus of two or three dwarf herbaceous species inhabiting the Himalayas, Tibet, Kansuh, and Western China.

Oreosolen (Scrophulariaceæ), two stemless herbaceous species, one in the Himalayas and the other in Tibet.

Gooringia, Williams, is a genus founded on *Arenaria Littledalei*, Hemsl., which, if accepted, would constitute, so far as our present knowledge goes, an endemic genus; but we prefer retaining it in *Arenaria*, at least until this group has been more thoroughly investigated.

In contrast to this poverty of local genera is the numerically large representation of families and widely dispersed genera, as the following list shows:—

	Species.		Species.
		Brought up ..	96
Saussurea	15	*Nepeta*	6
Sedum	9	*Carex*	6
Artemisia	9	*Poa*	5
Gentiana	9	*Stipa*	5
Ranunculus	8	*Delphinium*	4
Astragalus	8	*Corydalis*	4
Polygonum	8	*Draba*	4
Oxytropis	6	*Parrya*	4
Potentilla	6	*Arenaria*	4
Saxifraga	6	*Taraxacum*	4
Aster	6	*Elymus*	4
Pedicularis	6	*Festuca*	4
	96	Total	150

These figures show that twenty-four (or 20·1 per cent. of the total) genera furnish 150 (or 50·3 per cent. of the total) species. Against this there are sixty-eight genera each represented by only one species. In other words, 57·1 per cent. of the genera yield only 24 per cent. of the species. It will be seen that the percentages in these two comparisons are almost exactly reversed.

Species.

The ultimate elements or components of the flora, so far as we subdivide, are species of unequal value, it should be remembered, both as to distinctness from other species and individual representation in the vegetation. Two hundred and eighty-three species is indeed a small number in so large an area; and the question naturally arises, why is it so restricted? But before attempting an answer to this question we will give some of the more striking particulars concerning these 283 species *. It has been shown that there is not a genus of flowering plants that is strictly endemic, or peculiar to Tibet; and very few indeed are endemic in a wider area embracing the contiguous countries

* It should be mentioned here that slight discrepancies may possibly exist in the figures given in various parts of this paper in consequence of some of the latest corrections not having been made all through; but there are very few, if any, and they can affect no question of importance.

which might, from their physical conditions, be considered as forming a part of the same botanical region. But, what is more surprising, the number of species restricted to Tibet is also very small. Taking our arbitrary boundaries, only thirty-four species out of 283 have hitherto, so far as we are aware, not been found outside of Tibet. They are :—

Ranunculus involucratus.
,, similis.
Anemone imbricata.
Corydalis Boweri.
Erysimum Chamæphyton.
Eutrema Przewalskii.
Parrya prolifera.
Arenaria Littledalei.
Astragalus Arnoldi.
,, Malcolmii.
Saxifraga parva.
Sedum rotundatum.
Peucedanum Malcolmii.
Artemisia Wellbyi.
Aster Boweri.
Cremanthodium Deasyi.
,, Fletcheri.
Cremanthodium goringensis.
Crepis sorocephala.
Lactuca Deasyi.
Saussurea Aster.
,, pumila.
,, Wellbyi.
Androsace tapete.
Gentiana Rockhillii.
Oreosolen unguiculatus.
Nepeta decolorans.
Polygonum Deasyi.
,, tibeticum.
Iris Thoroldii.
Kobresia Sargentiana.
Agropyron Thoroldianum.
Diplachne Thoroldi.
Festuca Deasyi.

This gives about 12 per cent. of endemic species, which is very low compared with most countries and especially Asiatic, though high as compared with the British Islands, for example. Moreover, we are convinced that further researches will result in a reduction rather than an augmentation of this number or proportion.

Considering, for our present purpose, Tibet as the centre, the extensions of the remaining 249 species are :—

1. Himalayan	Region	.. 217	species,	or about	76·6	per cent.
2. Mongolian	,,	.. 107	,,	,,	38	,,
3. Chinese	,,	.. 79	,,	,,	27·8	,,
4. Siberian	,,	.. 99	,,	,,	35	,,
5. Persian	,,	.. 67	,,	,,	23·3	,,
6. Mediterranean	,,	.. 50	,,	,,	17·3	,,
7. Arctic	,,	.. 47	,,	,,	16·2	,,
8. Other regions		.. 57	,,	,,	20	,,

It is clear from this summary that the bulk of the Tibetan plants have a wide range. This is more strongly emphasized by the fact that fifty-three species, or 18·7 per cent., occur in five or more of the regions tabulated. Forty-seven species extend to the Arctic regions, and of these twenty-nine occur in Arctic Europe, Asia, and America. Against this very few are common to Tibet and the European Alps.

The most noteworthy point in connection with the distribution of the species is the great preponderance of the Himalayan element, or rather of plants common to Tibet and the Himalayas, amounting to 217 species, or 76·6 per cent. of the whole. Out of these 217 species 119 are not recorded from Sikkim-Himalaya. Seventy-three species, or 25·8 per cent., are apparently restricted to Tibet and the Himalayas; but the almost unexplored mountains of Western China may yield some of these species. A glance down the table is sufficient to enable us to realize how very few species are restricted to Tibet and any one other of the surrounding countries, as Mongolia or China, for example. Indeed our table shows only eight.

Among plants of extraordinary distribution *Nitraria Schoberi* is specially interesting. It is only reported from the Koko Nor district; but it is abundant in Mongolia, Siberia, Turkestan, Afghanistan, and Persia, and extends westward to Southern Russia and Egypt. It is also found in Upper Guinea and Australia, being widely dispersed in the latter country, where it occurs in all the colonies, usually inhabiting more or less saline districts. The fruit is a berry varying in colour from yellow through various shades of red and purple to black. It is greedily eaten by birds and various animals, even by the Tibetan bear, according to Maximowicz, who ascribes its presence in Australia to migratory birds.

Saussurea alpina, *Polygonum Bistorta*, and *Salix Lapponum*, three very generally diffused plants in North temperate and arctic regions, are not recorded from the Himalayas. *Myriophyllum verticillatum* is not known to occur within the Arctic zone, though both *M. spicatum* and *M. alterniflorum* reach Arctic Europe and America.

The plants common to the Alps of Europe and Tibet are:—*Clematis alpina*, *Thalictrum alpinum*, *Draba alpina*, *D. fladnitzensis*, *Oxytropis lapponica*, *Potentilla fruticosa*, *P. multifida*, *P. nivea*, *Sedum Rhodiola*, *Saxifraga Hirculus*, *Leontopodium alpinum*, *Saussurea alpina*, *Taraxacum officinale*, *T. palustre*, *Androsace Chamæjasme*, *A. villosa*, *Gentiana tenella*, *Pedicularis Œderi*, *Polygonum viviparum*, *Salix Lapponum*, *Carex incurva*, *C. rigida*, *C. ustulata*, *Scirpus Caricis*, *Avena subspicata*, *Festuca valesiaca*, *Poa alpina*, *P. nemoralis*, *P. pratensis*. Altogether twenty-nine species, and rather less than ten per cent. Adding the following eleven subalpine species — *Ranunculus aquatilis*, *Stellaria graminea*, *Potentilla Anserina*, *Hippuris vulgaris*, *Myriophyllum verticillatum*, *Polygonum Bistorta*, *Potamogeton pectinatus*, *Triglochin palustre*, *Atropis distans*, *Deschampsia cæspitosa*, and *Phragmites communis*—brings it up to nearly fourteen per cent. But it will be seen at once that they are all plants of wide distribution, so there can be no question about special affinities or connections between the two floras.

The plants common to the Arctic regions and Tibet are forty-seven in number, and of these forty-one are of very wide distribution, and thirty-four of them are included in the above list as extending to the Alps. The species not common to the Alps and the Arctic regions are:—*Clematis alpina*, *Myriophyllum verticillatum*, *Leontopodium alpinum*, *Androsace villosa*, *Scirpus Caricis*, and *Festuca valesiaca*. Curiously enough, each of these plants is peculiar in its distribution, as may be seen by consulting the table showing the general distribution of the Tibetan plants. *Clematis alpina* extends eastward to China, but misses the Himalayas. *Leontopodium alpinum* has the same eastward distribution and also occurs in the Himalayas; and the genus *Leontopodium* has its greatest concentration in China, where there are several very distinct and elegant species. But we need not pursue this investigation any further, because these are clearly just vicissitudes of distribution.

The material for comparisons offered by our table is by no means exhausted; but all comparisons lead to such very obvious conclusions, that we do not propose extending them beyond a short list of species not found in the Himalayas.

List of Tibetan Plants not known to occur in the Himalayan Region.

	Mongolia.	China.	Siberia.	Persia.
Clematis alpina	..	1	1	
Delphinium grandiflorum	..	1	1	
„ Pylzowii	1	1		
Ranunculus tricuspis	1			
Meconopsis integrifolia	..	1		
Braya sinensis	..	1		
Lepidium cordatum	..	..	1	
Nitraria Schoberi	1	1	1	1
Saxifraga tangutica	1			
Sedum algidum	1	..	1	1
„ Przewalskii	1			
Saussurea alpina............	..	..	1	1
„ pygmæa..........	1	..	1	
„ Thoroldii	1	1		
Taraxacum lanceolatum	..	..	1	
Statice aurea	1	..	1	
Androsace Tapete	..	1		
Gentiana falcata............	..	..	1	
Lagotis brachystachya	1	1		
Kalidium gracile	1			
Polygonum Bistorta	1	1	1	
Salix Lapponum............	..	..	1	
Carex sabulosa	1			
Elymus junceus	1	..	1	1
„ lanuginosus	..	..	1	
Littledalea tibetica	..	1		
Totals .. 26	14	11	14	4

Against these twenty-six species, there are seventy-three restricted to Tibet and the Himalayas; and, as already mentioned, 217, or about 76·6 per cent. of the total Tibetan species, also occur in the Himalayas.

Conclusions.

No elaborate arguments are required to prove that the Tibetan is a derived Flora; that is to say derived since the Tertiary period; and its composition is so largely Himalayan that there can be little doubt as to its origin. It may be well to repeat that "Himalaya," as here understood, includes the mountains to the west of the Himalaya Proper, and northward to, and including, the Karakorum. In fact it is from what we have termed Western Himalaya that the greater migration seems to have proceeded. Whether the local conditions generally, both past and present, favour this view, we will not attempt to prove, but the prevalence of westerly winds is one factor which might be expected to operate actively in bringing about the present condition of things. Whether the precarious vegetation of Tibet is on the whole increasing, is a question for the traveller rather than for the closet botanist, but there is no doubt that if there is an increase in one place there is temporary or permanent destruction in other places, due to the shifting sands.

BIBLIOGRAPHY.

This bibliography is not put forward as complete, but it comprises, it is believed, all sources of information, and it also includes some works from which little or nothing was extracted, but which may be of service to persons interested in carrying their investigations further.

BAKER, E. G. Introductory Note on Botanical Collections in Deasy's 'In Tibet and Chinese Turkestan,' pp. 394–396.

BATALIN, A. Notæ de Plantis Asiaticis. Acta Horti Petropolitani, xi. *et seqq.* 1891–1898.

BOGLE, G. *See* MARKHAM, C. R.

BOISSIER, E. Flora Orientalis sive Enumeratio Plantarum in Oriente....ad Indiæ Fines. 1867–1888.

BONVALOT, G. Du Caucase aux Indes à travers le Pamir. Map and illustrations. 1889. English edition, 1889.

—— De Paris au Tonkin à travers le Tibet inconnu. 1891. Map and illustrations. List of Plants, pp. 465–481.—English translation by C. R. Pitman: 1891; Botany and Zoology omitted.

BOWER, Captain H. A Journey across Tibet. Geographical Journal, i. (1893) pp. 385–408 with a map.

—— Diary of a Journey across Tibet, with maps and illustrations. Calcutta: Office of the Superintendent of Government Printing, India. 1893. (Not for sale.) Includes a preliminary list of the plants approximately determined by W. B. Hemsley, pp. 108–114.

BRETSCHNEIDER, Dr. E. Map of China and the surrounding Regions, compiled to illustrate the author's 'History of Botanical Discoveries in China.' 1896.

N.B. The map issued by the China Inland Mission, in 1899, is practically an authorised reproduction of the above.

Bretschneider, Dr. E. History of European Botanical Discoveries in China, 1898. (This includes an account of the Russian explorations in Mongolia and Tibet, by Przewalski, Potanin, and others.)

Bureau, Prof. Ed., & A. R. Franchet. Plantes Nouvelles du Thibet, etc. Journal de Botanique, v. 1891.

Conway, Sir William Martin. Climbing and Exploration in the Karakoram-Himalayas. Scientific Reports. 1894.

Curzon, Right Hon. G. N. (Lord Curzon of Kedleston). The Pamirs and adjoining Territories, with a map. Geographical Journal, viii. (1896) pp. 15–54, 97–119, and 239–264.

Das, Sarat Chandra. Journey to Lhasa in 1881–2. 1885.

Deasy, Captain H. H. P. Journeys in Central Asia. Geographical Journal, xvi. (1900) pp. 141–164 and 501–527. With figures and a map.

—— In Tibet and Chinese Turkestan, being the Record of three years' Exploration. With Illustrations and a Map. 1901. Botany, pp. 394–405.

Diener, Dr. C. General N. M. Przewalski's vierte Forschungsreise in Zentralasien, mit einer Uebersichtskarte von seinen Reisen während der Jahre 1871–1885. Petermann's Geographische Mitteilungen, xxxv. (1889) pp. 33–40.

Drude, Dr. O. Flora von Tibet. Petermann's Geographische Mitteilungen, 1894.

(A notice of W. Botting Hemsley's paper in Journ. Linn. Soc. xxx.)

Duthie, J. F. List of Plants collected in Kumaon and the adjoining parts of Tibet by R. Strachey and J. E. Winterbottom, in E. T. Atkinson's 'Gazetteer of the North-western Provinces,' vol. x. chap. viii. pp. 403–670. 1882.

Engler, A. Versuch einer Entwicklungsgeschichte der Pflanzenwelt, insbesondere der Florengebiete seit der Tertiärperiode. Erster Theil, 1879. (Especially pp. 120–146.)

Forbes, F. B., & W. Botting Hemsley. Enumeration of all the Plants known from China Proper, etc. Journal of the Linnean Society, xxiii. & xxvi.

Forsyth, Sir T. D. Ost-Turkestan und das Pamir-Plateau. Petermann's Mitteilungen, Ergänzungsheft nr. 52. 1877. Mit einer Karte. (Vegetation, p. 65.)

Franchet, A. R. Plantæ Davidianæ. Deuxième Partie: Plantes du Thibet Oriental. Nouvelles Archives du Muséum, 2^{me} série, viii. & x. 1885–8.

FUTTERER, Dr. K. Die allgemeinen geologischen Ergebnisse der neueren Forschungen in Zentral-Asien und China, mit einer Karte und Profilen. Peterm. Mitteil., Ergänzungsheft nr. 119. 1896.

HEDIN, Dr. Sven. Four years' Travel in Central Asia. Geographical Journal, xi. 1898, pp. 240–258 and 397–415, with a map.

—— Die Geographisch-Wissenschaftlichen Ergebnisse meiner Reisen in Zentralasien, 1894–1897. Petermann's Mitteilungen, Ergänzungsheft nr. 131. 1900. With six maps and numerous illustrations in the text.—Dr. Hedin's maps 4, 5, and 6 indicate also the routes of Carey and Dalgleish, of Przewalski, of Bonvalot and Prince Henry of Orleans, of Rockhill, of Littledale, of Grenard (Dutreuil de Rhins), of Roborowsky and Kosslow, and of Wellby and Malcolm.

HEMSLEY, William Botting. List of the Plants collected in the Gilgit and Hindu Kush Districts, by Dr. G. M. J. Giles, 1885. Manuscript in Bibl. Kew.

This list appears (unrevised) in the Confidential Report of the Mission, printed for the Government in 1889.

—— Observations on a Botanical Collection made by Mr. A. E. Pratt in Western China. Journal of the Linnean Society, Botany, xxix. (1892) pp. 288–322, tt. 29–33.

—— On two small collections of Dried Plants from Tibet. Journal of the Linnean Society, Botany, xxx. (1894) pp. 101–140, plates 4 & 5.

—— Enumeration of a small collection of Plants made by Captain H. P. Picot on the Kuen Luen Plains at about 17,000 ft. Journal of the Linnean Society, Botany, xxx. (1894) p. 123.

—— Enumeration of the Plants collected in the Karakorum-Himalayas by W. M. Conway and McCormick: in Conway's Scientific Reports, pp. 75–84. 1894.

—— Central Tibet Plants: in Rockhill's Diary of a Journey through Mongolia and Tibet, Appendix iii. pp. 380–385. 1894.

—— Hooker's Icones Plantarum, tt. 2467–2472 (1896).

—— The Flora of Tibet. Kew Bulletin, 1896, pp. 207–216.

HEMSLEY, William Botting, & H. H. W. PEARSON. Die botanischen Ergebnisse von Dr. Sven Hedin's Reisen. Petermann's Mitteilungen, Ergänzungsheft nr. 131, pp. 372–375. 1900.

This enumeration is repeated in Hedin's 'Die Geographisch-Wissenschaftlichen Ergebnisse,' pp. 372–375.

—— —— Abstract of paper read on High-level Plants exhibited at the Linnean Society, April 19th, 1900. Gardeners' Chronicle, xxvii. (1900) p. 803; in Nature, lxii. (1900) p. 46, and in Journal of Botany, 1900, p. 238.

Deasy & Pike's altitudes there given are corrected in the present paper.

HERBERTSON, Dr. A. G. The Distribution of the Rainfall over the Land. Royal Geographical Society of London, 1901.

HOOKER, Dr. (Sir) J. D. The Rhododendrons of the Sikkim-Himalaya. 1849.

—— Himalayan Journals. 1854.

—— The Flora of British India. 1875–1897.

HOOKER, Dr. (Sir) J. D., & THOMSON, Dr. T. Flora Indica, Introduction. 1855.

JACQUEMONT, Victor. Voyage dans l'Inde, pendant les Années 1828 à 1832. 1841–1844.

KANITZ, A. Plantarum in Expeditione Speculatoria Comitis Bela Széchenyi a Ludovico de Lóczy in Asia Centrali collectarum Enumeratio. 1891. With plates.

KLATT, Dr. F. W. Enumeration of the Primulaceæ, etc. collected in High Asia by Messrs. Schlagintweit. Journal of Botany, vi. (1868) pp. 116–127.—Contains extracts on distribution from Schlagintweit's 'Results of a Scientific Mission to India and High Asia,' iv.

—— Die Compositæ des Herbarium Schlagintweit aus Hochasien. . . . Mit einleitenden Angaben über das Auftreten, sowie über topographische und klimatische Verhältnisse, nebst einer Karte der Reisewege. Von Herm. Schlagintweit-Sakuenluenski. Nova Acta K. Leop.-Carol. Akad. Naturf. xli. 2, pp. 347–419, tt. 36–38. 1880.

LIPSKY, W. Contributio ad Floram Asiæ Mediæ. Acta Horti Petropolitani, xviii., 1900.

LITTLEDALE, St. George R. A Journey across Tibet. Geographical Journal, vii. (1896) pp. 453–483, with maps.

LOCKHART, Colonel Sir W. S. A., Colonel R. G. WOODTHORPE, and Dr. G. M. J. GILES. Report of the Gilgit Mission, 1885–6. Printed for the Government. London, 1889.—Botany, pp. 224–233 and pp. 244–262. (Confidential.)

MALCOLM, Lieut. N. Journey of Captain Wellby and Lieut. Malcolm across Tibet. Geographical Journal, ix. (1897) pp. 215–217 ; xi. (1898) p. 295.

MANNING, T. *See* MARKHAM, C. R.

MARKHAM, C. R. Narratives of the Mission of George Bogle to Tibet (1774), and of the Journey of Thomas Manning to Lhasa (1811–12) : ed. 2, 1879.

MAXIMOWICZ, C. J. Diagnoses Plantarum Novarum Asiaticarum. Mélanges Biologiques, vi.–xii. (1866–1893), tirés du Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg.

—— Sur les Collections Botaniques de la Mongolie et du Tibet septentrional, &c. Bulletin du Congrès International de Botanique et d'Horticulture réuni à St. Pétersbourg, 1884, pp. 135–196.

—— Flora Tangutica. Fasciculus 1 : Thalamifloræ et Discifloræ. 1889.

—— Enumeratio Plantarum hucusque in Mongolia . . . . lectarum. Fasciculus 1 : Thalamifloræ et Discifloræ, cum tabulis 14. 1889.

MEYEN, F. J. F. Vergleichende Bemerkungen über die Verbreitung der Vegetation in den grössten Höhen des Himalaya und in Hoch Peru. Wiegmann's Archiv, ii. 1836, pp. 315–328. Edinburgh New Phil. Journ. xxiii. 1837, pp. 34–45.

MOORE, S. Le Marchant, and others. New Plants collected in Central Asia by Captain H. H. P. Deasy. Journal of Botany, 1900, pp. 428–430.

MORGAN, E. Delmar. Journal of Carey and Dalgleish in Chinese Turkistan. Royal Geographical Society's Supplementary Papers, iii. (1890) pp. 3–86, with a map.

PALIBIN, J. Plantæ Sinico-Mongolicæ. Acta Horti Petropolitani, xiv. (1895) pp. 101–145.

—— Conspectus Floræ Koreæ. Acta Horti Petropolitani, xvii. *et seq.*, 1899–1901.

PEARSON, H. H. W. List of the Plants collected at Yatung by Commissioner H. Edgar Hodson, 1897. Manuscript in Bibl. Kew.

PRAIN, D. The Species of *Pedicularis*. Annals of the Royal Botanic Garden, Calcutta, iii. 1891, pp. 1–196, tt. 1–37.

—— Noviciæ Indicæ. Journal Asiatic Society of Bengal, lviii. (1889) –lxv. (1896).

PRZEWALSKI, N. M. Reise durch Kuku-noor und das nördliche Tibet zum Oberlauf des Yang-tse-kiang, September 1872 bis

Juni 1873. Petermann's Geographische Mitteilungen, xx. (1874) pp. 41–49.

Regel, E. Descriptiones Plantarum novarum, in 'Acta Horti Petropolitani.' Various volumes, with a map of Central Asia showing the routes of A. Regel, Fedtschenko, Kaulbars, Kuropatkin, Osten-Sacken, Przewalski, and Sewerzow, in vol. vii. (1880), together with an "Index locorum natalium Plantarum."

Rockhill, W. Woodville. The Land of the Lamas, with maps and illustrations. 1891.

—— Diary of a Journey through Mongolia and Tibet. 1894.

Royle, Dr. J. Forbes. Illustrations of the Botany .... of the Himalaya Mountains. 1839 [1833–40].

Schlagintweit, Hermann & Robert von. Results of a Scientific Mission to India and High Asia. 1861–66.

Schlagintweit-Sakuenluenski, H. von. Bericht über Anlage des Herbariums während der Reisen (1854–1858), nebst Erläuterung der topographischen Angaben. Abhandl. d. z. Cl. d. Muench. Akad. d. Wissensch. xii. 3 Abth. (1876), pp. 135–243.

—— *See* Klatt. Die Compositæ etc.

Strachey, Sir Richard. Narrative of a Journey to the Lakes Rakas-tal and Manasarowar in 1848. Geographical Journal, xv. (1900) pp. 150–170, 243–264, and 394–415, with numerous illustrations and a map.

Supan, A. Die Vertheilung des Niederschlags auf der festen Erdoberfläche. Petermann's Mitteilungen, Ergänzungsheft nr. 124, 1898.

Tchihatchef, P. de. La Végétation du Globe: Domaines des Steppes. Vol. i. pp. 557–704.

Thomson, Dr. T. Western Himalaya and Tibet. 1852.

Turner, Capt. S. An Account of an Embassy to the Court of the Teshoo Lama in Tibet. 1800.

Wellby, Captain M. S. Through Unknown Tibet. One vol. 8vo. 1898. A preliminary List of Plants furnished by Kew, p. 423. Meteorological Observations, pp. 429–431.

—— Through Tibet to China. Geographical Journal, xii. (1898) pp. 262–280, with a map.

Wellby, Capt. M. S., & Lieutenant N. Malcolm. Road Report of Route across Tibet, with maps. Issued by the Government Printing Press at Simla, 1897. "Confidential and Secret."

WILLE, Dr. N. Algen aus dem nördlichen Tibet, von Dr. S. Hedin im Jahre 1896 gesammelt. Petermann's Geographische Mitteilungen, Ergänzungsheft nr. 131 (1900), pp. 370–1.

WINKLER, C. Diagnoses Compositarum Novarum Asiaticarum. Acta Horti Petropolitani, xiii. et xvi. 1893–1898.

INDEX.

Where not otherwise stated the references are to conditions in Tibet.

[W. B. H., *March* 1902.]

On a Method of Investigating the Gravitational Sensitiveness of the Root-tip *. By Francis Darwin, M.B., F.R.S., F.L.S.

[Read 6th February, 1902.]

The theory put forth in the 'Power of Movement in Plants,' that the tip of the root is the part of that member which is sensitive to gravitation, has gone through some vicissitudes which it is needless to recapitulate. It is sufficient to refer to the most recent development of the subject. Since the appearance of Pfeffer's † and Czapek's ‡ papers, physiologists have, broadly speaking, agreed that the long-desired proof has been supplied. But no confirmatory experiments were published, while, on the other hand, the work of Wachtel § gave a direct contradiction to Czapek's paper. Last year we had Czapek's able reply ||, which shows that Wachtel's contradictory results depend on a difference in the manner of making the bent tubes used in the experiments. In this position of the question a confirmation by another method is desirable; and this is what I have tried to give in the following paper, which is an application to roots of the method successfully employed with *Setaria* and *Sorghum*, &c. ¶

A seedling of one of these grains, e. g. *Sorghum*, when prepared for use by the removal of the root, consists of the grain and the straight hypocotyl surmounted by the cotyledon, shaped like a spear-head. If such a seedling is supported by means of the grain (S in fig. 1) in a horizontal position, the hypocotyl bends upwards until the cotyledon C is vertical, and the further growth is in the vertical direction. But if the cotyledon is supported as in figs. 2 and 3, the part of the plant which is sensitive to the gravitational stimulus remains horizontal, and therefore continues to perceive the stimulus, and the curvature of the hypocotyl therefore continues. In this way coils and spirals in the hypocotyl are formed even more complex than those shown in figs. 2 and 3.

* A brief note on this subject was published in Proc. Cambridge Phil. Soc. 1901.

† Pfeffer, Annals of Botany, 1894.

‡ Czapek, Pringsheim's Jahrbücher, 1895, 1898.

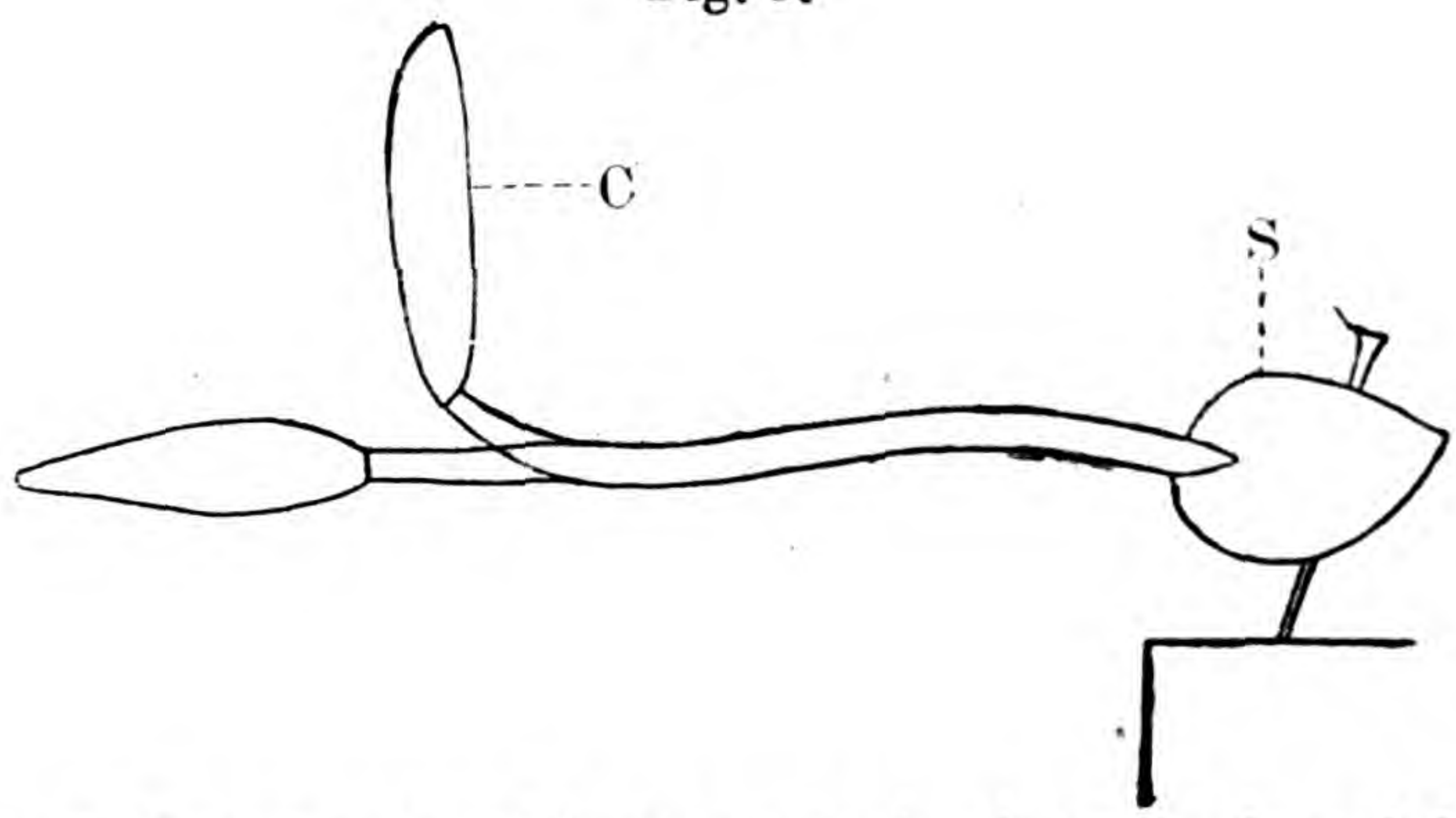
§ Wachtel, Bot. Zeitung, 1899.

|| Czapek, Pringsheim's Jahrbücher, 1900.

¶ Francis Darwin, Annals of Botany, 1899.

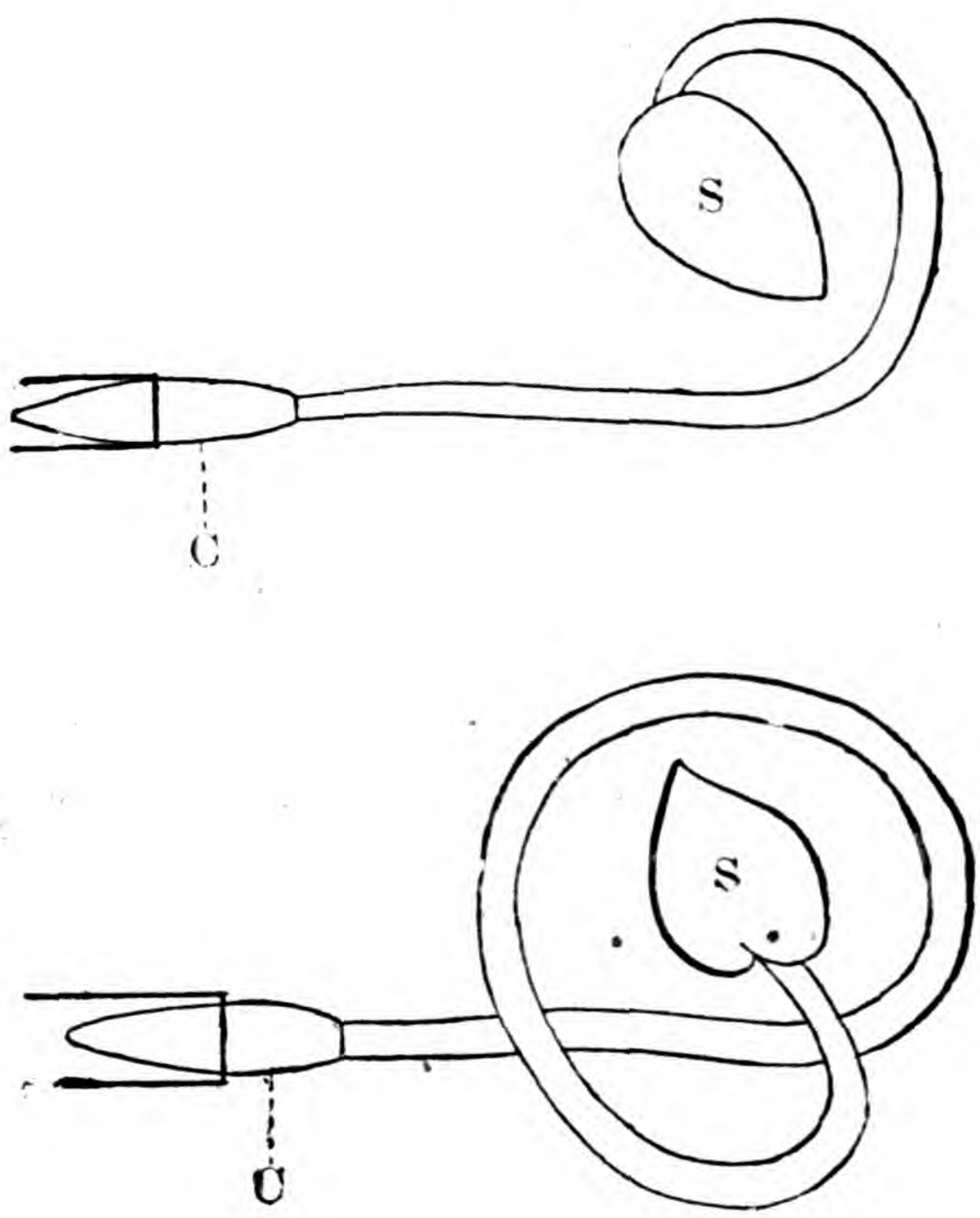
To apply this method to roots is not easy, since the tip is slimy and slippery, and in leguminous plants, which are especially

Fig. 1.



Sorghum-seedling supported by its grain, S: the vertical cotyledon, C, shows the result of geotropism.

Figs. 2 & 3.



Sorghum-seedlings supported by the cotyledon C; the hypocotyl bearing the grain S at its base shows geotropic curvature.

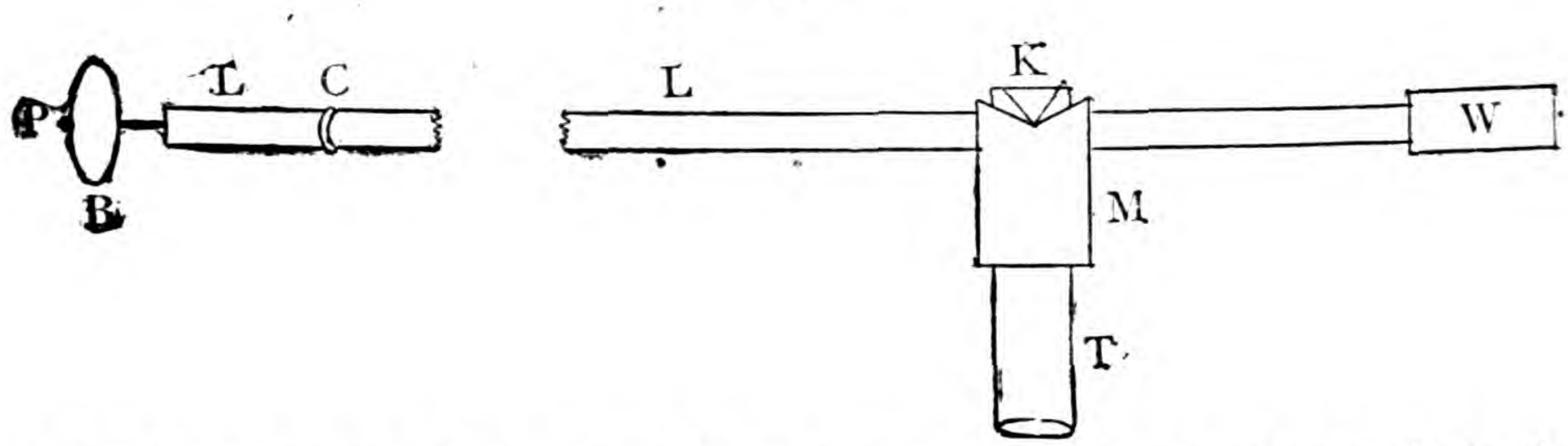
adapted to geotropic experiments, the weight of the cotyledon is considerable *.

* With *Lathyrus articulatus*, in which the seeds had been lightened by cutting off a part, I managed to fix the tip of the root in horizontal glass tubes, but no definite results were obtained.

Various attempts were made to support the weight of the cotyledons, and some success was obtained with a vertical wheel by means of which the counter-weighted cotyledon could rotate, the tip of the root being fixed at a point opposite the centre of rotation. But the apparatus finally adopted was one suggested by my brother, Mr. H. Darwin, and made for me by the Cambridge Scientific Instrument Co.

A wooden lever 53 cm. in length (L in fig. 4) turns on a knife-edge K, fixed about 7 cm. from one end; the metal bearing M, on which K turns in the vertical plane, is able to rotate in the horizontal plane by means of a supporting-rod fitting into the vertical tube T.

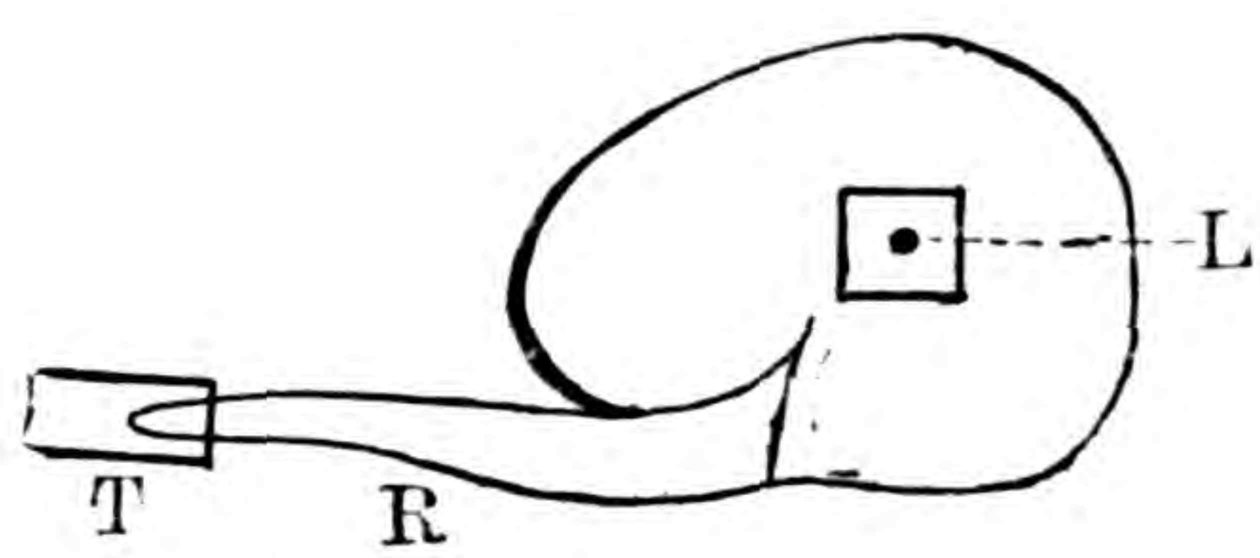
Fig. 4.



L, the lever; K, the knife-edge; M, its bearing; T, bearing for vertical rod (not shown); W, the counter-weight; P, the pin supporting B, the bean; C, a second counter-weight.

The cotyledons of the bean B are fixed to the lever by a pin P on which B can rotate in a vertical plane, and the weight of the bean is counterbalanced by the lead block W, the balance being finally adjusted by the counter-weight C, a ring of lead wire which slides on the lever L. By this arrangement the cotyledons can move freely in any direction on the surface of the sphere of radius PK (46 cm.). Fig. 5 gives a view from the point P in fig. 4.

Fig. 5.

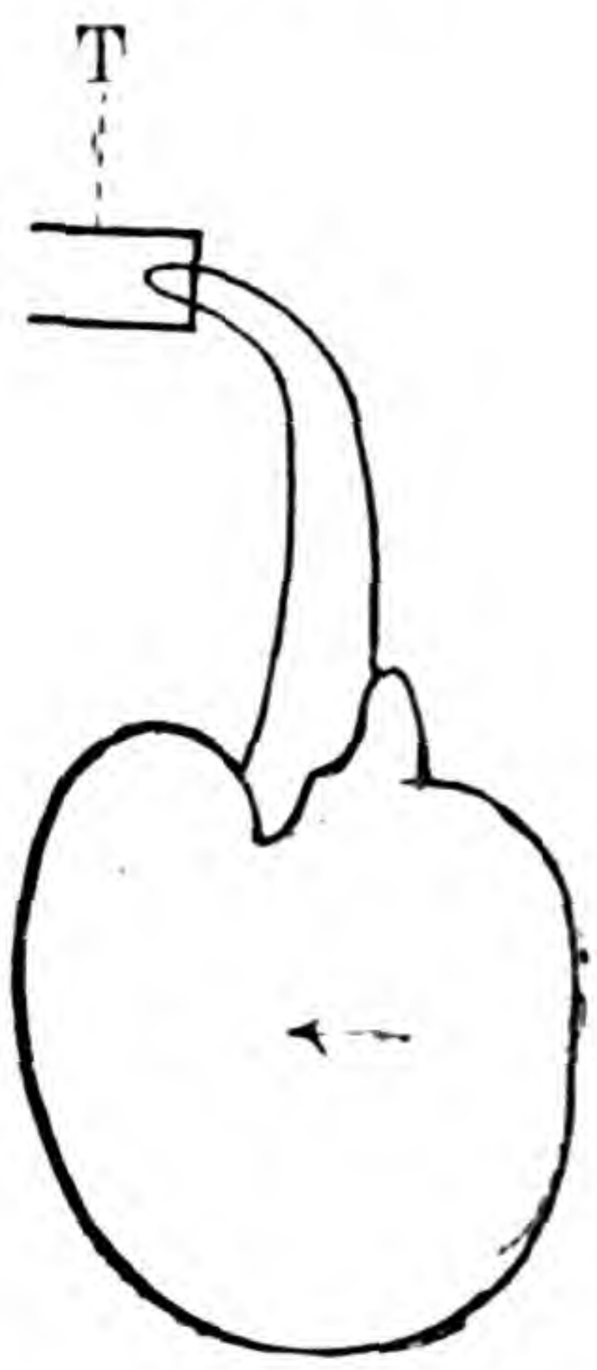


T, the tube in which the tip of R, the radicle, is fixed; L, the lever.

The square L is the lever seen in section, and the dot in the middle is the head of the pin P; L would, as a fact, be invisible, being hidden by the bean B.

The radicle, R, of the bean is horizontal, and about 2–3 mm. of its tip is placed in a cavity in T, which may be conveniently described as the "tube." When the root begins to curve geotropically, it is clear that the cotyledons must move, since the tip is fixed. It will take on the form shown in fig. 6; the

Fig. 6.



A bean-seedling which has curved geotropically: the arrow gives the direction in which the cotyledons will continue to move.

amount of rotation being recorded by a pin stuck into the cotyledons (not shown in fig. 6), which served as an index of angular movement, also as a counter-weight to balance the seed on the pin P. If the tip is the percipient of the stimulus, it is clear that the cotyledons will continue to describe a circle in the direction shown by the arrow. As a fact, there proved to be a strong tendency for the root to continue curving past the vertical in a way which points to the tip being the percipient organ for gravitation. Before giving the details of these experiments, I must give further description of the difficulties of the method.

The first necessity in the conduct of the experiment is to keep the root from withering. Bean-roots will geotrope fairly well in a closed space in which the air is kept damp, but it is not easy to place an apparatus of the size here employed in damp air; and I adopted instead the plan of keeping the root and cotyledons damp by drops of water falling on them. This has the great disadvantage of making the geotropic curvature a very slow process, as will be seen in the details of some of the experiments.

Another difficulty was to find the right material for the tube in which the tip of the root rests. Glass tubes were at first used, but afterwards straws were employed closed at one end by wooden plugs or by cotton-wool; quills were also found serviceable.

Tubes were also successfully made from the nectaries of *Tropæolum* and from the corolla-tubes of various flowers and the hollow scape of *Taraxacum*; and these have the advantage of not being hard like glass, quills, or straw, and thus not likely to injure the root-tip. But the greatest difficulty was to prevent the tip of the root slipping out of the tube. This frequently occurred, and spoilt a large majority of the experiments made with beans.

In some experiments I placed a piece of fine gauze in such a way that it hung over the closed end of the tube, and also wrapped round about a centimetre of the root. The gauze was kept wet by the dripping water, and, without interfering with the growth of the root, it tended by its close contact with the root to keep the tip in place. At the close of my work I hit upon another plan which is perfectly successful in keeping the root in place. A very fine brass wire is coiled into a spiral spring and slipped over the tube, which is thus continued by a tubular spring. The root is placed in the tube, and the spring, very slightly extended, is fixed by a thread and a pin to the cotyledon. The root cannot slip out of the tube; and since the force needed to produce a lateral bend is very slight, there is no obvious reason why curvature should not occur. As the root grows in length, the spring is of course elongated and must be occasionally re-adjusted. I have not made many experiments with this method, but I have seen enough to convince me that it is the most hopeful for future work.

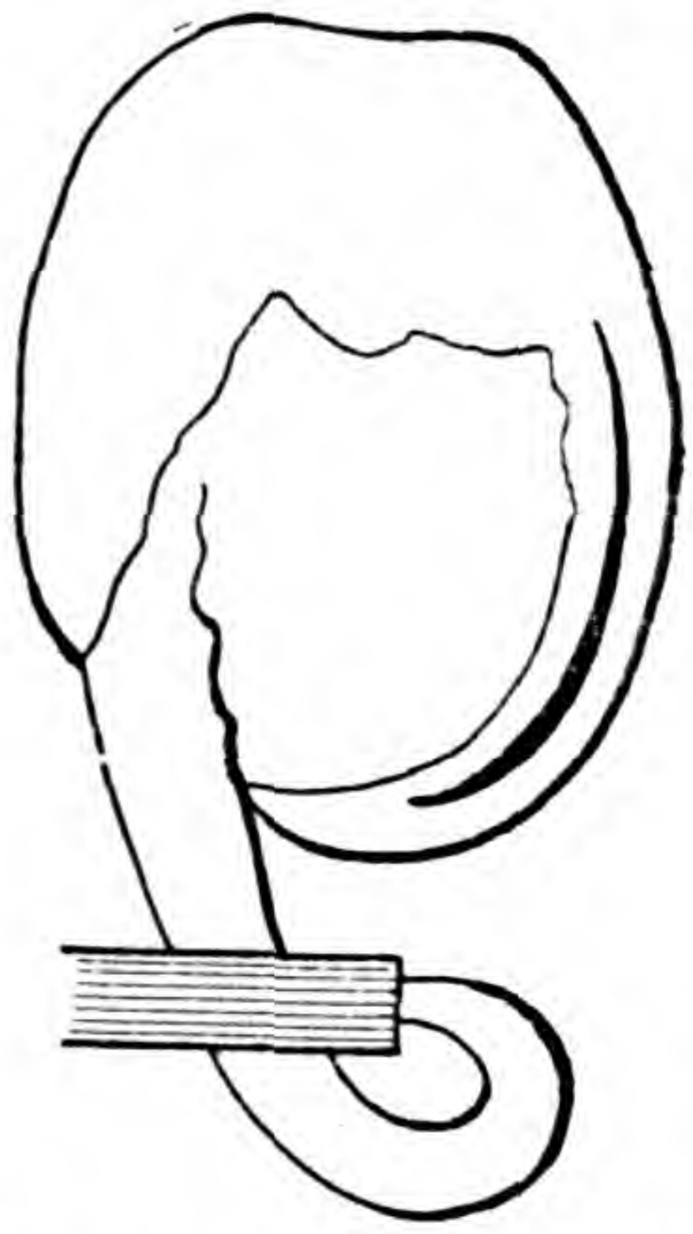
Results with Beans (Vicia Faba).

Forty-four experiments were made in the manner here described, and out of these only fourteen showed any result worth consideration. Of these, six showed striking curvature of the root past the vertical. In the other eight the curvature was continued beyond the vertical, but not to any considerable extent.

Among the failures are a few cases in which the root hardly bent geotropically at all, whether from too low a temperature or from too copious water-supply it is impossible to say. But the great majority failed because the root slipped out of the tube: they cannot therefore be fairly held to invalidate the general principle, but rather to show the difficulties of the method.

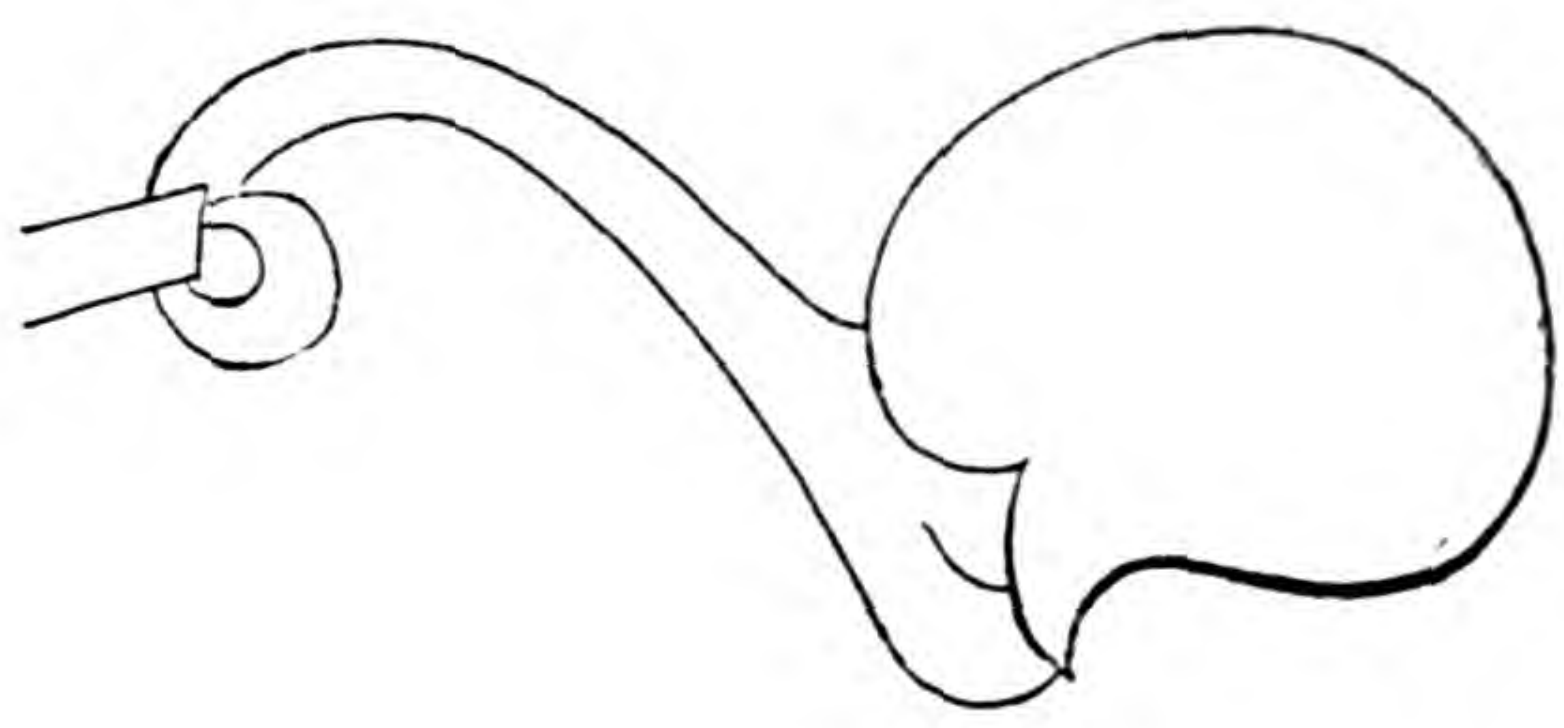
Figs. 7 and 8 are reproduced from drawings, kindly made for me by Miss D. F. M. Pertz, of the results of the experiments of March 30 and May 24, 1900.

Fig. 7.



Curvature of a bean-root produced in two days (March 30, 1900).

Fig. 8.



Curvature of a bean-root produced in three days (May 24, 1900). The tube in which the root is fixed was somewhat oblique.

The following notes refer to fig. 7:—

March 27, 1900, 10 P.M.—*Vicia Faba* fitted in a horizontal straw-tube, a piece of wet gauze hanging over the tube and the apical part of root and tending to keep the root in place.

		Curvature.	
March 28,	6.30 A.M.	60°	*i. e.*, the root had geotroped through 60°.
,,	12.47 P.M.	87	*i. e.*, nearly vertical.
,,	10 P.M.	120	(30° beyond vertical.)
March 29,	8.35 A.M.	200	
,,	10.23 A.M.	230	*i. e.*, the base of root is 50° above the horizon.
March 30,	8.20 A.M.		Growth stopped, root becoming unhealthy.

Experiments with Peas.

My assistant Mr. Elborn made a series of observations on peas with the root-lever, of which the results were in one respect more satisfactory than my own experiments on beans.

The tips were fixed in small quills filled with gypsum at the beginning of each experiment. A very thin and flexible silver wire was wound spirally round root and tube; it was not fixed at either end, but merely tended by friction to keep the root in place. The water-supply was led by a thread so that the disturbance of water actually falling on to the root was avoided.

In something like half the experiments a distinct result was obtained *—that is to say, the cotyledonary end of the seedlings curved downwards and then beyond the vertical. In a considerable number of experiments the root curved through 180°, *i. e.*, 90° beyond the downward position. But it never reached such a degree of curvature as is shown in figs. 7 and 8.

Conclusions.

The evidence (in spite of the numerous failures in the case of the bean) seems to point clearly to the conclusion that there is a strong tendency, in the root of the bean and pea, to continue curving when the tip is fixed horizontally and the other end of the seedling is free to move.

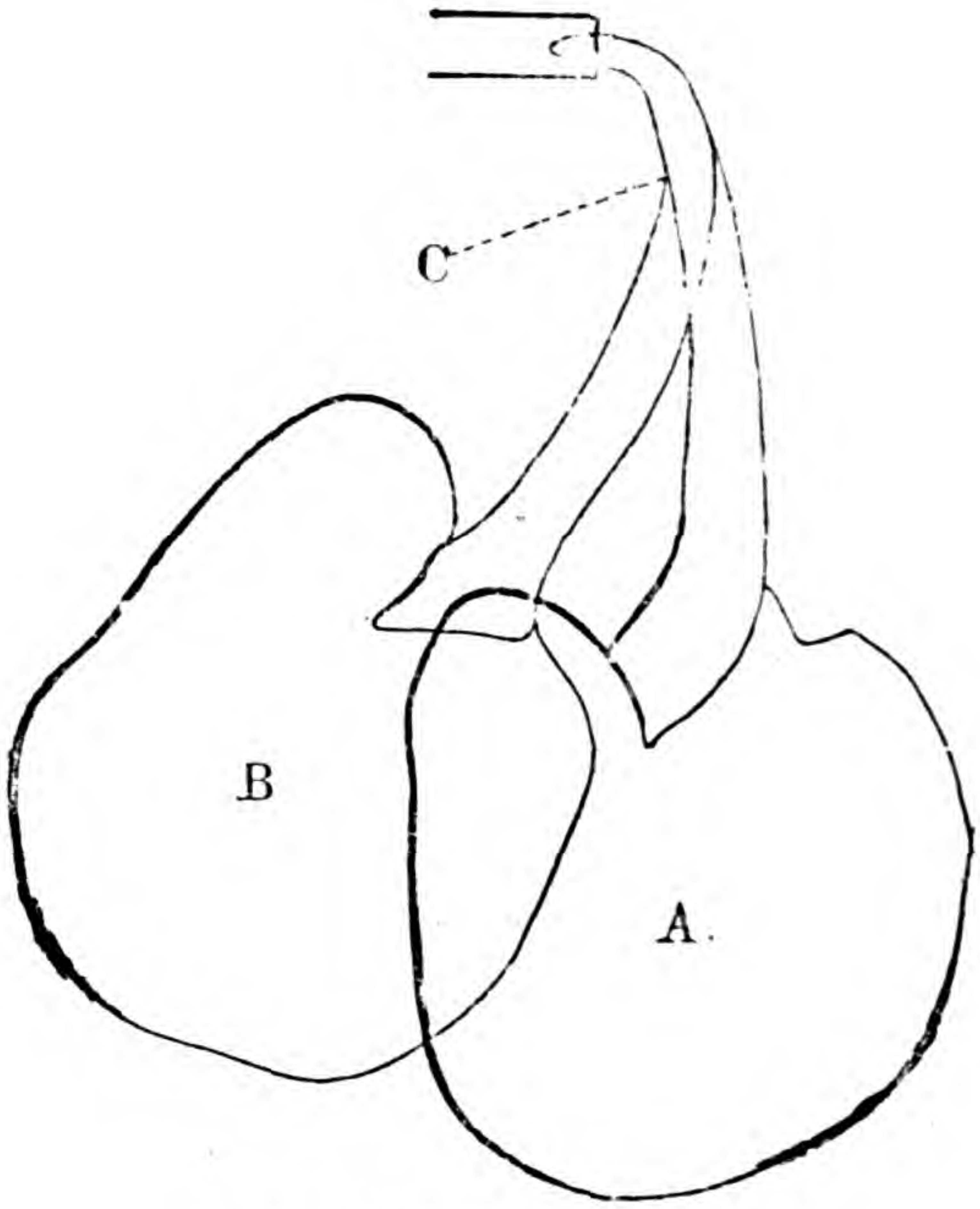
The conclusion to be drawn from this result is not so simple as at first appears. It is certain that the results are explicable on the assumption that the tip is the only part of the root which is sensitive to gravitation. But is this the only possible explanation?

It seems possible that just as apogeotropic organs curve until their free ends are far beyond the vertical, so roots *supported by their apices* might, by the geotropism of the region close to the tube (A, fig. 9), assume the appearance shown in fig. 9, B, in which the base of the root between C and the cotyledons is beyond the vertical. In apogeotropic stems this over-shooting of the vertical is corrected by a new gravitational stimulus arising in the oblique part. But in roots in which the region of curvature is short it is conceivable that the region C may have ceased to grow, and therefore that the curvature may not be reversible: in other words,

* In 7 out of 18 experiments the curvature was through 180°, in 3 it was between 135° and 180°.

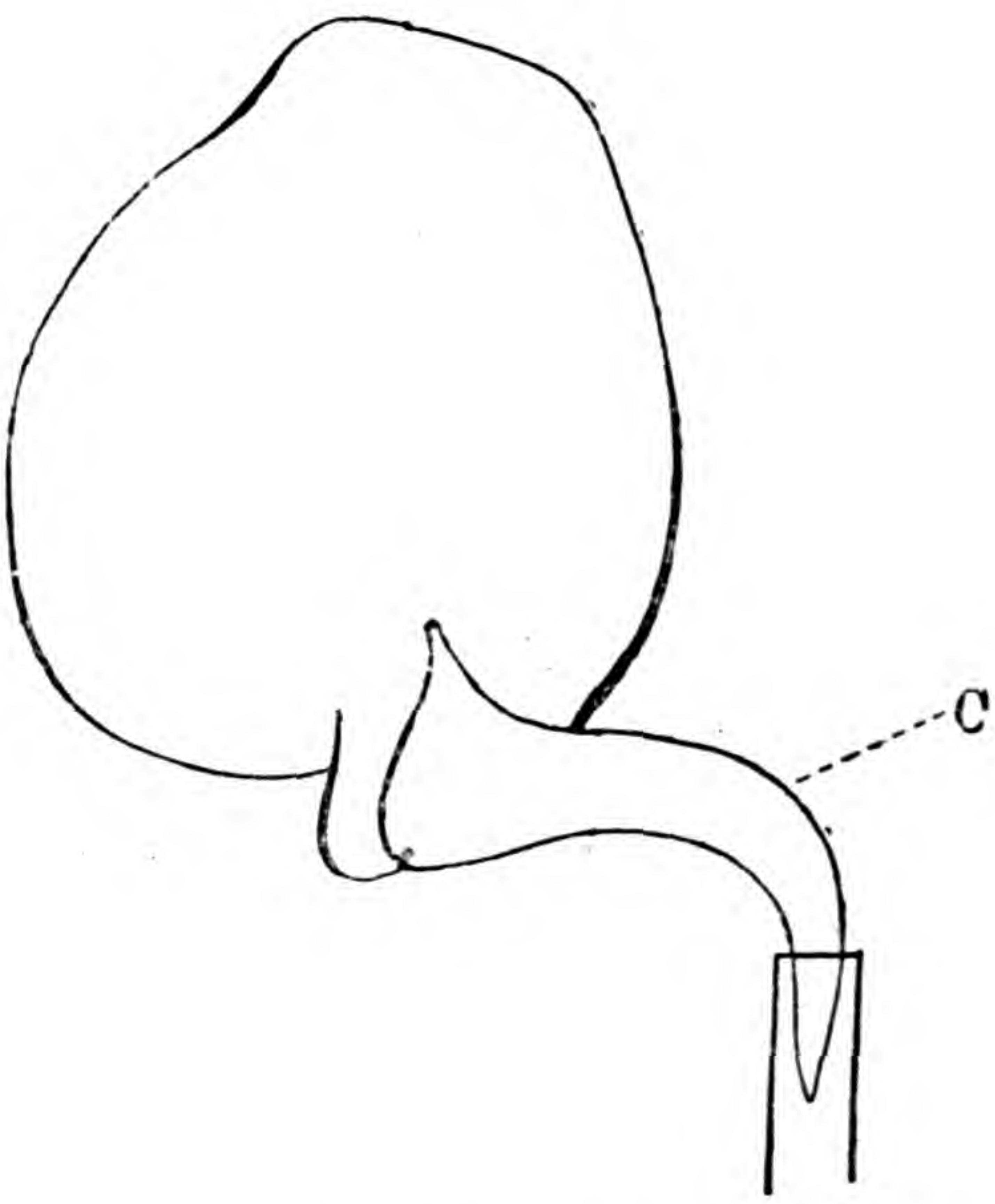
that the root could not regain the vertical position A. If this were so we should have a series of permanent irreversible curves

Fig. 9.



See text for explanation.

Fig. 10.



A bean-root, after curving geotropically, has been fixed in a vertical tube.

occurring, which would lead to just such a continued movement past the vertical of the cotyledons as has been described.

I have found it impossible to make sure whether this supposed curvature could actually occur, but from experiments on the power of reversal in the curved region of bean-roots, I believe it could not.

It is, however, possible to test the matter in another way, namely, to ascertain whether the part of the root which curves has any *direct* independent geotropic sensitiveness—that is, any sensitiveness independent of the stimulus transmitted from the tip.

A seedling is placed horizontally in damp sawdust until the root has curved geotropically: the seed is then fixed to the lever with the tip of the root in a *vertical tube* (fig. 10). If the region C is directly and independently sensitive to gravitation, it ought to continue to curve so that the cotyledons would descend. But this is not what happens. In my experiments, only one root showed increased curvature, seven showed distinct diminution, and two slight or doubtful diminution. The balance of evidence is thus clearly against the existence of independent sensitiveness in the motile part of the root. This of course agrees entirely with Pfeffer's and Czapek's results; and if this is granted, the only conceivable explanation of the continued curvature of the root in a horizontal tube is that the tip is the percipient region. It has been already pointed out that this explanation is consistent with the observed facts.

The experiments illustrated by fig. 10 are of value also in another way. In these experiments I found that though there is a tendency to the diminution of the existing curve, yet that the increment to the root due to new growth remains vertical. This disposes of the possible objection that the continuous curvature, occurring when the tip of the root is fixed in a horizontal tube, is due to contact-irritation, and is only a form of the curvature produced by injuring one side of a root-tip *. If this were the cause of the curvature, it should occur whether the tube is horizontal or vertical; and since this is not the case, we are supported in referring the continuous curvature to the continued stimulation of the tip.

* Darwin, 'Power of Movement in Plants.'

Electric Response in Ordinary Plants under Mechanical Stimulus. By Prof. Jagadis Chunder Bose, M.A., D.Sc. (Communicated by the President.)

[Read 20th March, 1902.]

Contents.

Introduction.

The effect of stimulus on living substance is usually detected by two different methods. In the case of motile organs, stimulus causes a change of form. Mechanical response may thus be obtained in a contractile tissue such as muscle. But in others—nerve for example—stimulus causes no visible change: the excitation of the tissue may, however, be detected by certain electromotive changes. The advantage of the electric mode of detecting response is its universal applicability. In cases where mechanical response is available, as in muscle, it is found that simultaneous mechanical and electrical records are practically identical.

The intensity of electrical response is found to depend on the physiological activity of the tissue. When this activity is diminished by anæsthetics, the intensity of electrical response is also correspondingly diminished. When the tissue is killed, the electrical response disappears altogether.

Electric response has been found by Burdon Sanderson, Munck, and others to occur in sensitive plants. We have seen that in animal tissues this mode of response was not confined to contractile tissues, but present in others which exhibit no mechanical movement. It would therefore be interesting to find out whether the responsive electric variation was confined merely to organs of plants which exhibit such remarkable mechanical movements, or whether such effects are not also exhibited by every plant and by all its different organs.

In connection with this, Kunkel made the very interesting observation that an electrical disturbance was produced in stems by injury or by flexion, the point in the neighbourhood of injury becoming negative.

My own attempt has been directed not towards the obtaining of mere qualitative response, but rather to the determination if throughout the whole range of response phenomena a parallelism between animal and vegetable could not be detected. That is to say, I desired to know, with regard to plants, what was the relation between the intensity of stimulus and the corresponding response, what were the effects of superposition of stimuli; whether fatigue was present, and in what manner it affected the response; what were the effects of extremes of temperature on the response; whether chemical reagents could exercise any influence on the plant-response, as anæsthetics and poisonous drugs have been found to do with nerve and muscle.

Finally: if it could be proved that the electric response served as a faithful index of the physiological activity of plants, it would then be possible successfully to attack problems the solution of which at present offers many experimental difficulties.

But before obtaining satisfactory and conclusive results regarding plant-response, many difficulties had to be surmounted. It is obvious that if we wish to find out the influence of various external agencies on the modification of response, we must first of all succeed in devising experimental arrangements by which uniform responses may be obtained and recorded with unfailing certainty. I shall presently describe how this has been accomplished.

Conditions for obtaining Electric Response.

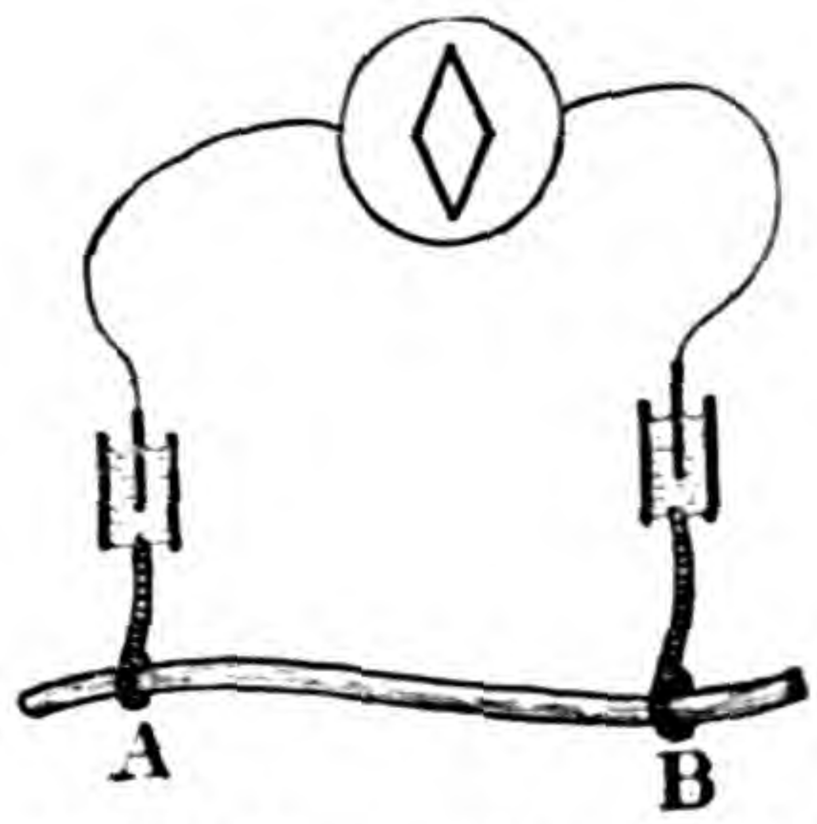
If we take a piece of uninjured living tissue, and two contacts be made on its surface by means of non-polarizable electrodes at A and B, connection being made with a galvanometer, no current will be observed, as both A and B are in the same physico-chemical condition: the two points, that is to say, are iso-electric. If now the tissue be excited by stimulus, similar disturbances will be evoked at both A and B. If, further, these disturbances, reaching A and B almost simultaneously, cause any electrical change, then, similar changes taking place at both points, and there being thus no relative difference between the two, the galvanometer will still indicate no current. This null effect is due to the balancing action of B as against A.

If the electrical effect at A is represented by E_A, that at B by E_B, then the resultant electromotive force round the circuit $E_R = E_A - E_B$; when $E_A = E_B$, $E_R = 0$. If we wish to obtain any resultant effect in the galvanometer, we may employ two different means:—(1) We may so arrange matters that the disturbing stimulus reaches one point, say A, and not B. This may be accomplished by interposing a block between A and B. (2) Or even when the disturbance reaches both A and B, the balance might be destroyed by rendering A and B unequally responsive. This may be accomplished by physico-chemical means. For example, one point, say B, may be rendered more or less permanently irresponsive by injuring it by a cut, a burn, or the action of strong chemical reagents. In that case, stimulus will cause greater electrical disturbance at the more responsive point A, and this will be shown by the galvanometer as the resultant current of response. I may mention here in passing, that, in addition to the above method of relative depression, it is possible to obtain a resultant response by a relative exaltation of the sensitiveness of B.

Method of Injury, or Negative Variation.

In obtaining electric response in animal tissues, one of the two contacts, say B, is injured. This gives rise to a "current of injury" which usually flows in the tissue from the injured B to uninjured A (fig. 1). On stimulating the tissue, there is

Fig. 1.



Method of negative variation.

produced, in muscle and in nerve, a diminution of current of injury. This may be expressed in another way by saying that stimulus gives rise to an "action current," the direction of which is from the more responsive or excitable A to the less responsive B *.

An experiment with plants will presently be described which will exhibit the responsive negative variation.

For exhibiting electric response, it is preferable to use a non-electrical form of stimulus, for there is then a certainty that the observed electric variation is solely due to the action of stimulus, and not, as might be the case with the electric mode of stimulation, to mere escape of stimulating current through the tissue. For this reason the mechanical form of stimulation is the most suitable.

I find that all parts of the living plant give electric response to a greater or less extent. In favourable cases, we may have an electromotive variation as high as ·1 volt. It must, however, be remembered that the response, being a function of physiological activity of the plant, is liable to undergo changes in different seasons of the year. Each plant has its particular season of maximum sensitiveness. The leaf-stalk of horse-chestnut, for example, exhibits fairly strong response in spring and summer, but on the approach of autumn the responsive power undergoes a marked diminution. I give here a list of specimens which will be found to exhibit fairly strong response.

Root.—Carrot (*Daucus Carota*), radish (*Raphanus sativus*).

Stem.—Geranium (*Pelargonium*), vine (*Vitis vinifera*).

Leaf-stalk.—Horse-chestnut (*Æsculus Hippocastanum*), turnip (*Brassica Napus*), cauliflower (*Brassica oleracea*), celery (*Apium graveolens*), Eucharis lily.

Flower-stalk.—Arum lily.

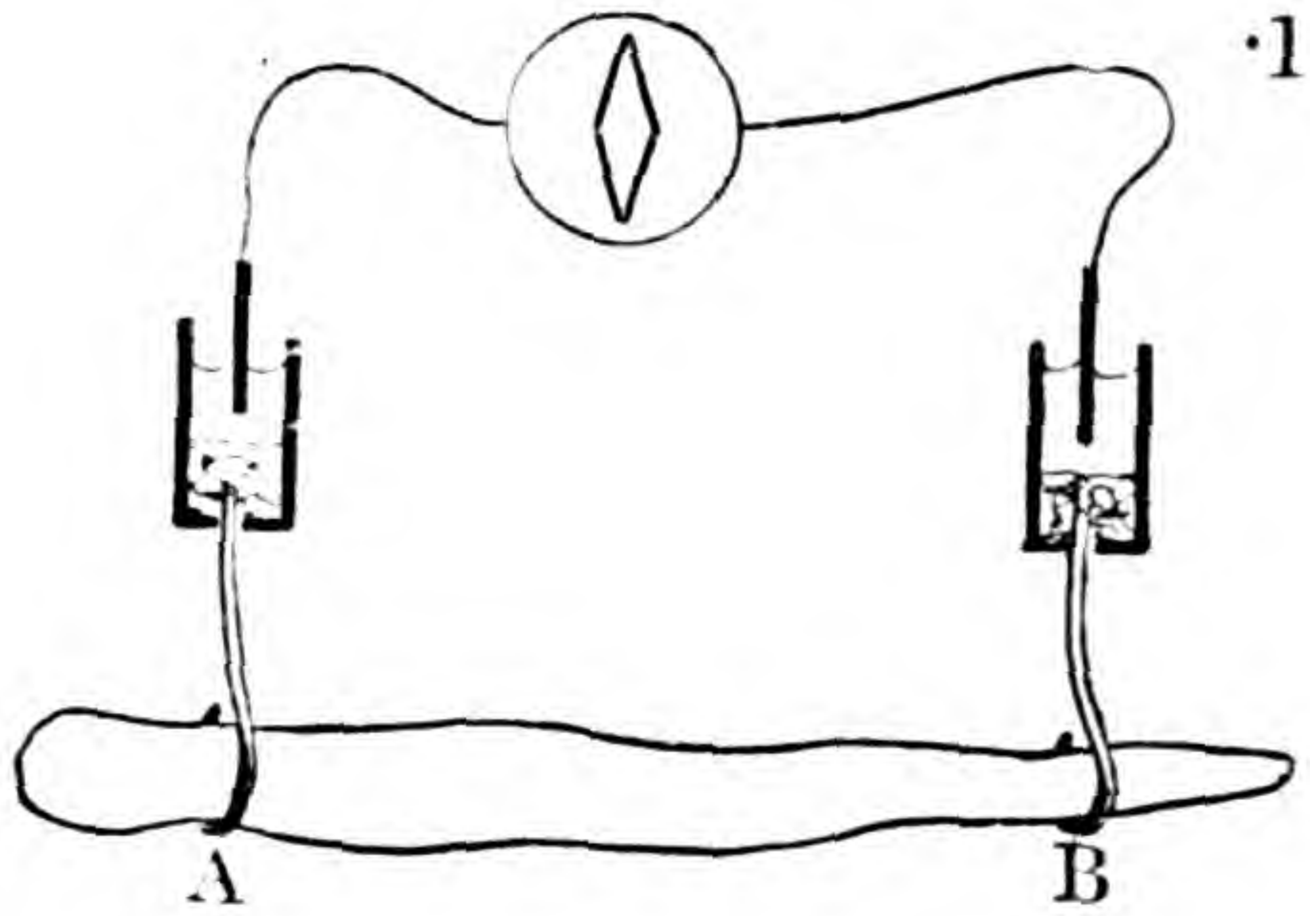
Fruit.—Egg-plant (*Solanum Melongena*).

* It must be remembered that "negative variation" presupposes an antecedent current of injury in reference to which the "action current" is negative. It will be shown that a responsive current may be obtained without any antecedent injury; negative variation has then no meaning. Again, the injury current—the current of reference—sometimes has its sign reversed. There is thus a likelihood of confusion arising from the reversal of direction of current of injury. Current of injury in plants due to cross sectional cuts often undergoes reversal. No confusion can, however, arise if the current of response is indicated as from the more excitable to the less excitable.

Negative Variation in Plants.

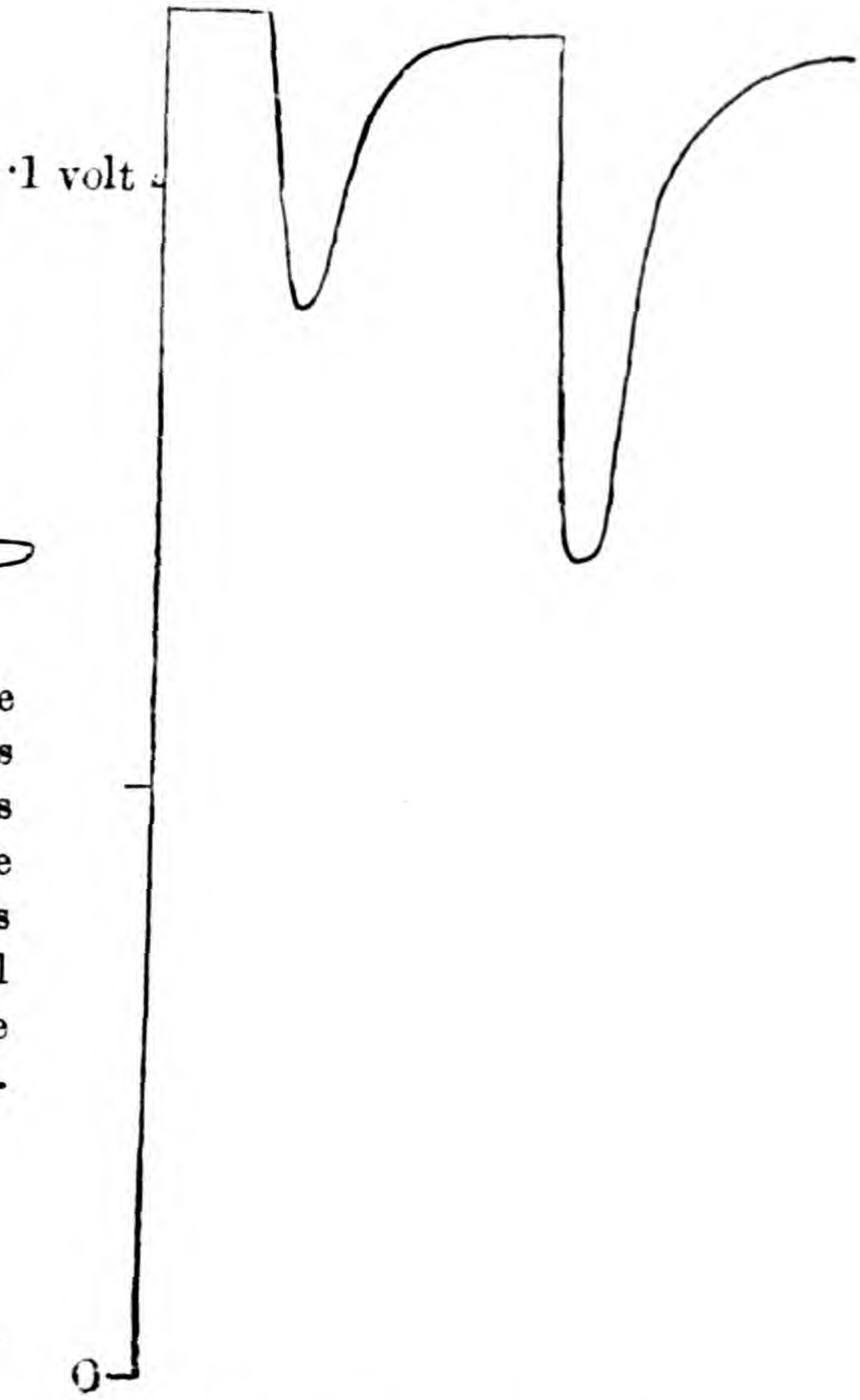
Taking the leaf-stalk of turnip, we kill an area on its surface, say B, by a burn or application of a few drops of strong potash, the area A being left uninjured (fig. 2 *a*). A current is now observed

Fig. 2 *a*.



Response by method of negative variation in plants. Contacts shown in this and other figures are diagrammatic. They are securely made by tying strips of cloth moistened with NaCl solution round A and B. These lead to non-polarizable electrodes.

Fig. 2 *b*.



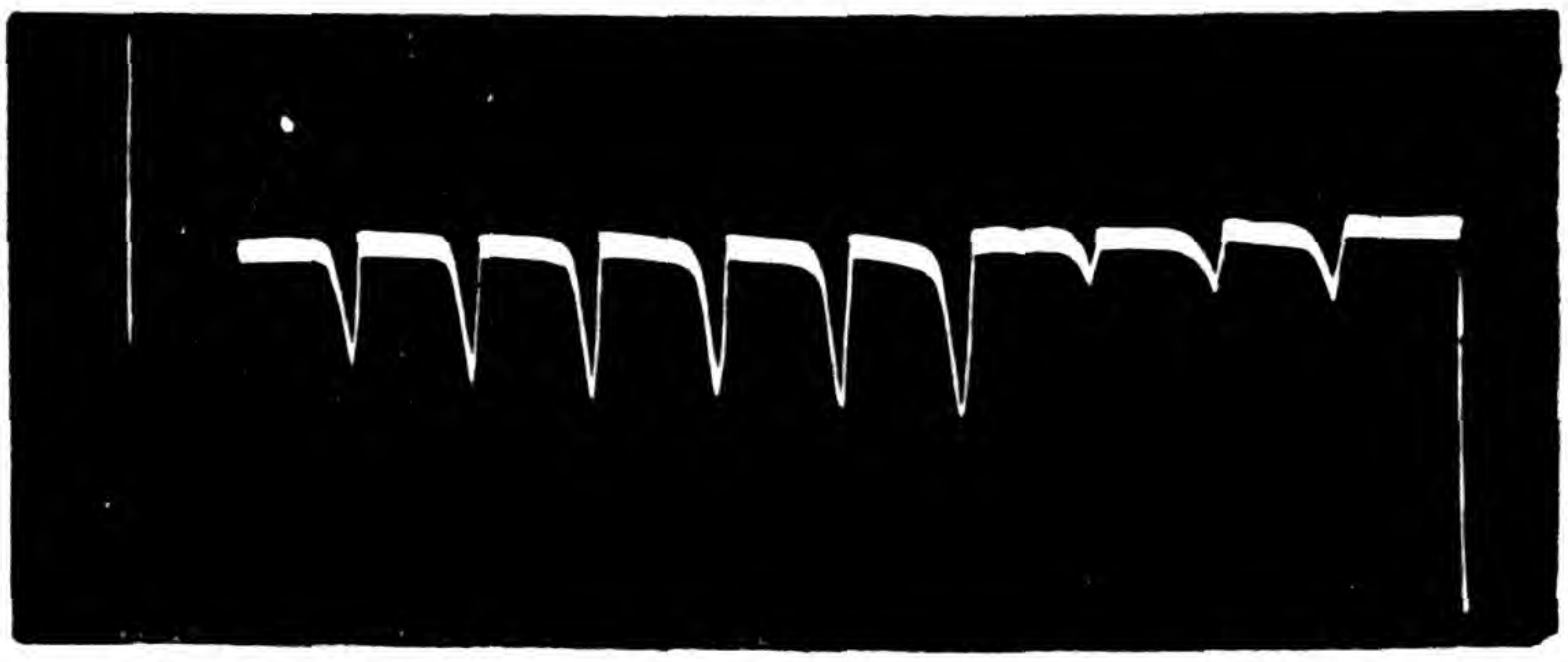
to flow, in the stalk, from the injured B to the uninjured A, as is found to be the case in the animal tissue. The Potential-Difference depends on the condition of the plant and the season in which it may have been gathered. In the experiment here described its value was ·12 volt.

A sharp tap was now given to the stalk, and a sudden diminution, or negative variation, of current occurred, the resting potential-difference being decreased by ·026 volt. The transitory E.M. variation gradually disappeared with the recovery of the tissue from the excitation caused by the stimulus. A second, and stronger, tap produced a second response, causing a greater diminution of P.D. by ·047 volt (fig. 2 *b*). The accompanying figure is a photographic record of another set of response-curves (fig. 3), which should be read from right to left.

The first three responses are for a given intensity of stimulus, and the next six in response to stimulus nearly twice as strong. It will be noticed that fatigue is exhibited in these responses.

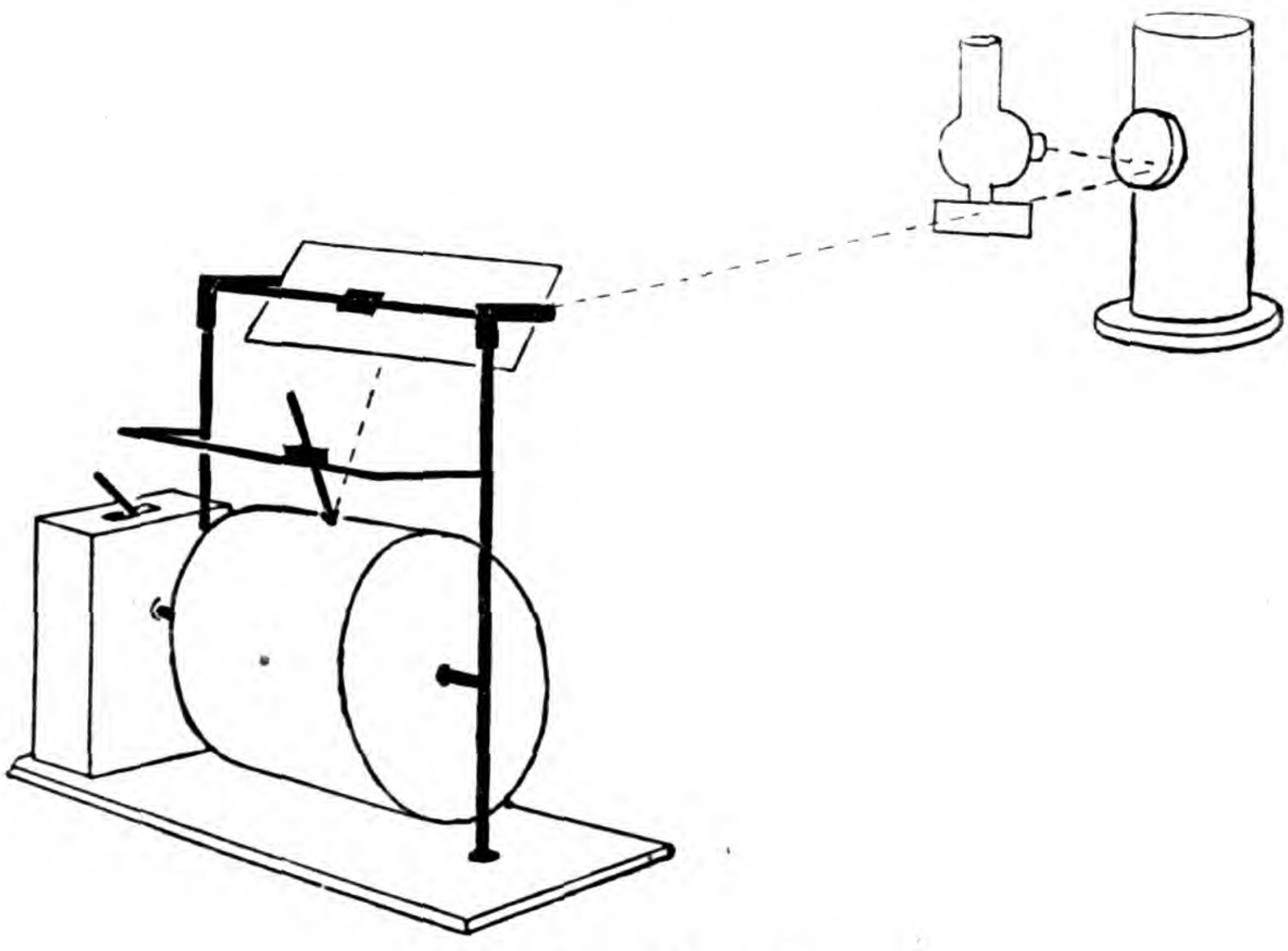
Other experiments will be described which show conclusively that the response was not due to any accidental circumstance, but was a direct result of stimulation. But I shall first discuss the experimental arrangements and the method of obtaining these graphic records.

Fig. 3.



Photographic record of negative variation in plants.

Fig. 4.



Response Recorder.

Experimental Arrangements.

The galvanometer used is a sensitive dead-beat D'Arsonval. A current of 10^{-9} ampere gives a deflection of 1 mm. at a distance of 1 metre.

Response Recorder.—In these response-curves the ordinate represents the intensity of variation of current, and the abscissa the time. The curves are obtained (1) directly, by tracing the excursion of the galvanometer spot of light on a revolving drum. The drum, on which is wrapped the paper for receiving the record, is driven by clockwork (fig. 4). Different speeds of revolution can be given to it by adjustment of the clock-governor, or by changing the size of the driving-wheel. The galvanometer spot is thrown down on the drum by an inclined mirror. A stylographic pen attached to a carrier rests on the writing surface. The carrier slides over a rod parallel to the drum. On stimulation, the resulting excursion of the spot of light is followed by moving the carrier which holds the pen; the rising portion of the response-curve is thus obtained. On the cessation of stimulus the excitatory effect will gradually disappear, and the galvanometer spot will then return more or less gradually to its original position, and that part of the curve which is traced during this process constitutes the recovery. As said before, the ordinate in these curves represents the E. M. variation, and abscissa the time. We can calibrate the value of the deflection by applying a known E.M.Force to the circuit from a compensator, and noting the deflection which results. The speed of the clock is previously adjusted so that the recording surface moves exactly through, say, one inch a minute. Of course this speed can be increased to suit the particular experiment, and in some it is as high as 6 inches a minute. In this simple manner very accurate records may be made. It has the additional advantage that it can at once be seen whether the specimen is suitable for the purpose of investigation. A large number of records might be taken by this means in a comparatively short time.

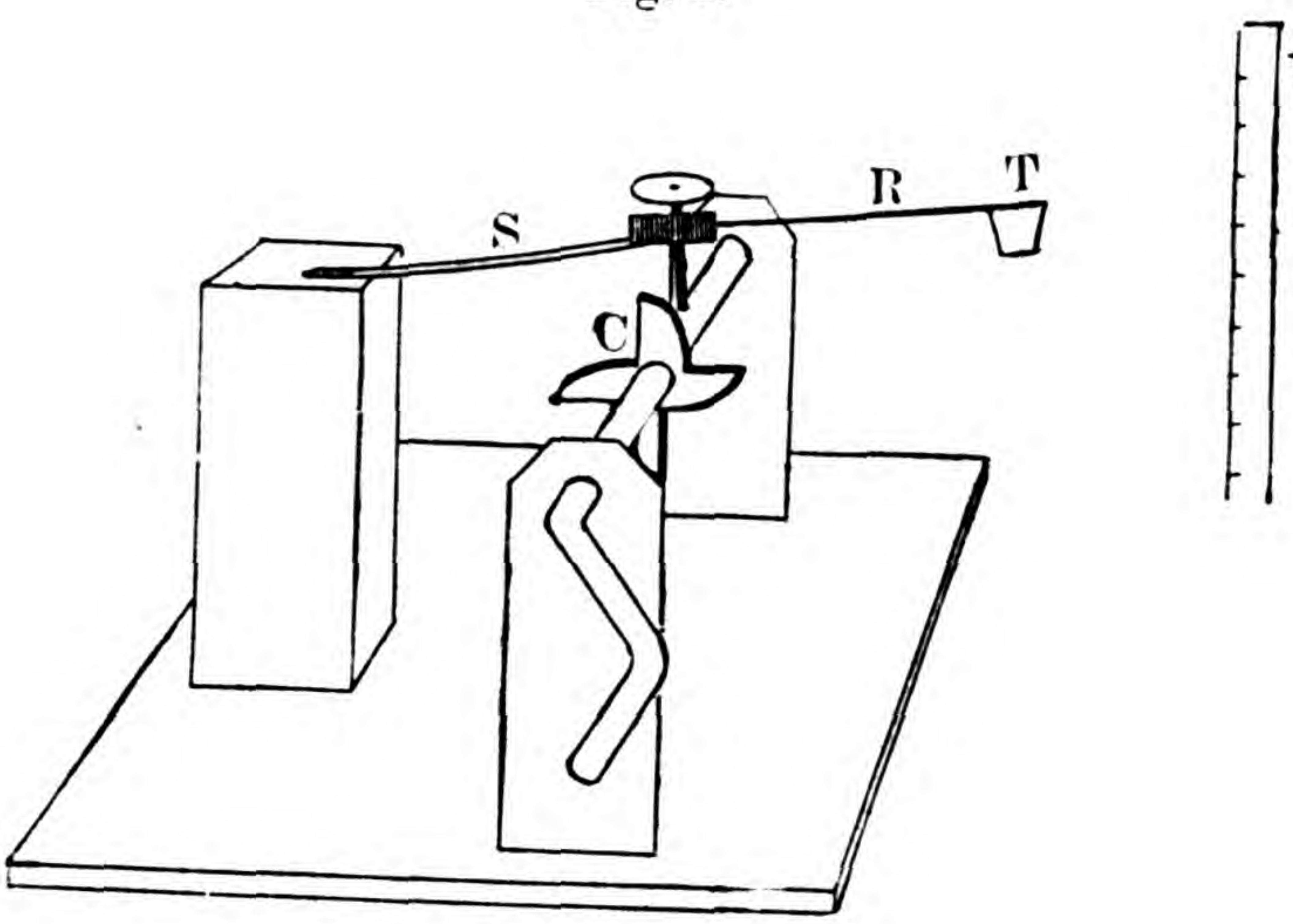
Photographic Recorder.—Or the records may be made photographically. A clockwork arrangement moves a photographic plate at a known uniform rate, and a curve is traced on the plate by the moving galvanometer spot of light. All the records that will be given are accurate reproductions of those obtained by one of those two methods. Photographic records are reproduced in white against a black background.

Means of Graduating the Intensity of Stimulus.

One of the necessities in connection with quantitative measurements is to be certain (1) that the intensity of successive stimuli is constant, or (2) capable of gradual increase by known amounts. No two taps given by the hand can be made exactly alike. I have therefore devised the two following methods of stimulation, (1) by taps, (2) by vibration, both of which have been found to act satisfactorily.

Spring-Tapper.—This consists of an arrangement by which a tapping-head in connection with a spring is lifted by means of the spokes of a cog-wheel, and then allowed to fall and strike the plant (fig. 5). The height of the lift, and therefore the intensity of the stroke, can be measured by means of a graduated scale.

Fig. 5.



Spring-Tapper.

Vibrational Stimulus.—I find that torsional vibration affords another very effective method of stimulation. The plant-stalk may be fixed at one end, the other end being held in a tube provided with clamping jaws (figs. 6 *a* and 20). A rapid torsional to-and-fro vibration may now be imparted to the stalk by means of the handle H. The amplitude of vibration, which determines the intensity of stimulus, can be accurately measured by means of a graduated circle.

Intensity of Stimulus dependent on Amplitude of Vibration.

I shall now describe an experiment which shows that torsional vibration is as effective as stimulation by taps or the blow delivered by a falling weight, and that the stimulating-intensity increases, length of stalk being constant, with the amplitude of vibration. I took a leaf-stalk of turnip and fixed it in the torsional vibrator. I then took a record of the responses to two successive taps, the intensity of one being nearly double that of the other (response-curves *a*, *b*). Having done this, I applied to the same stalk two successive torsional vibrations of 45° and 67° respectively, and obtained the responses

Fig. 6 *a*.

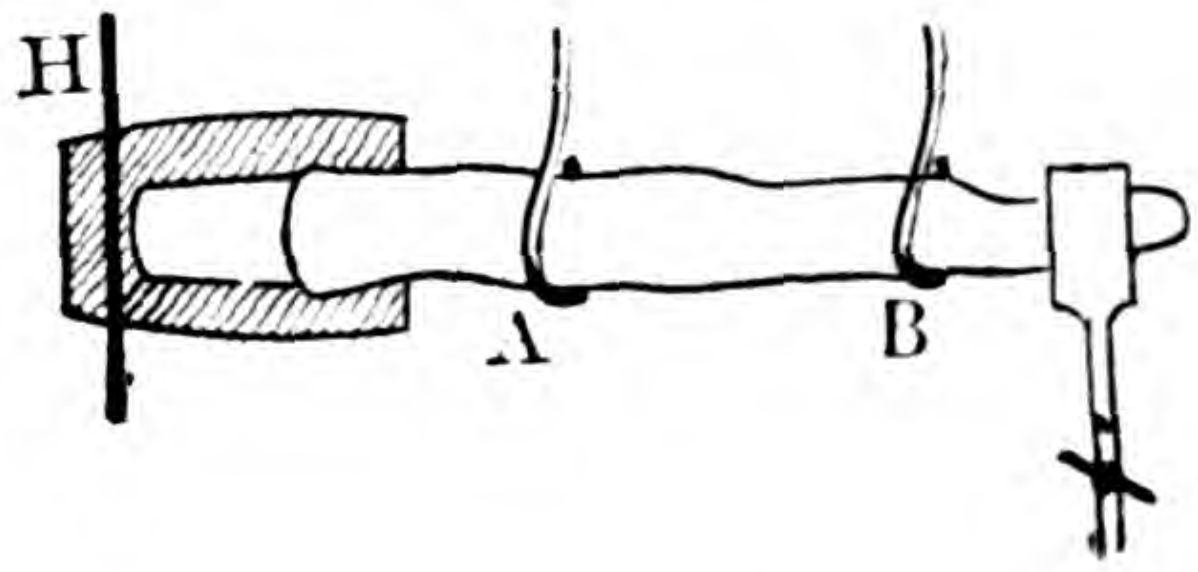
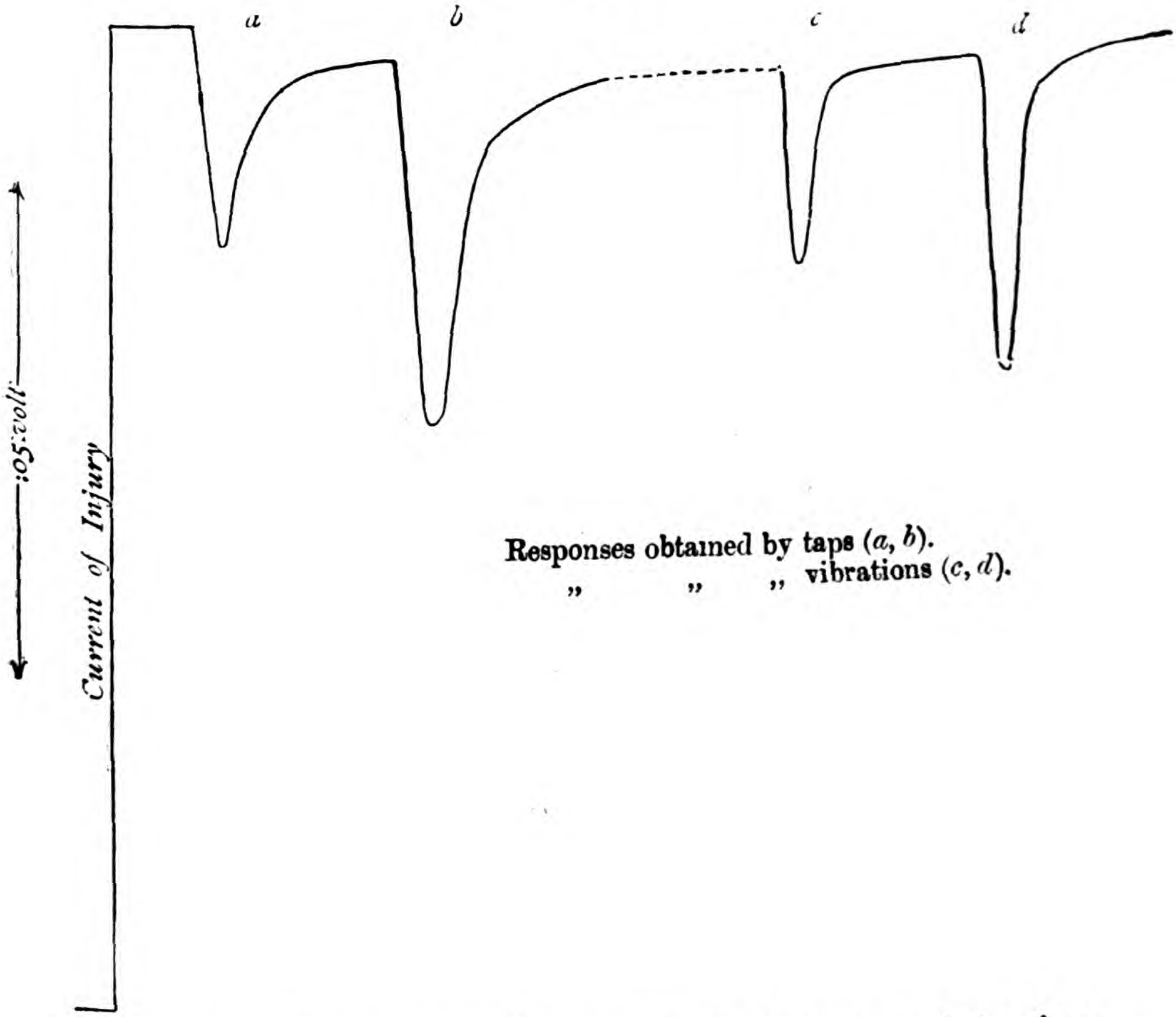


Fig. 6 *b*.



Responses obtained by taps (*a*, *b*).
" " " vibrations (*c*, *d*).

c and *d*. These successive responses to taps and torsions are given in fig. 6 *b*, and from them it will be seen that these two modes of stimulation may be used indifferently, with equal effect.

The torsional method, however, has the advantage over tapping that, while with the latter the stimulus is somewhat localized, with torsional vibration the tissue subjected to stimulus is uniformly stimulated throughout its length. Successive taps applied to the same point are again productive of injury to the plant.

Effectiveness of Stimulus dependent on Rapidity also.

In order that successive stimuli may be equally effective, another point has to be borne in mind. In all cases of stimulation of living tissue it is found that the effectiveness of a stimulus to arouse response depends on the rapidity of the onset of the disturbance. It is thus found that the stimulus of the "break" induction-shock on a muscle, for example, is more effective, by reason of its greater rapidity, than the "make" shock. So also with the torsional vibration of plants, I find response depending on the quickness with which the vibration is effected.

Thus if we wish to maintain stimulus constant, we must meet two conditions:—(1) The amplitude of vibration must be kept the same: this is done by means of the graduated circle. (2) The vibration period must be kept the same: with a little practice this requirement is easily fulfilled.

The uniformity of stimulation which is thus attained solves the great difficulty of obtaining reliable quantitative values, by whose means alone can rigorous demonstrations of the phenomena we are studying become possible.

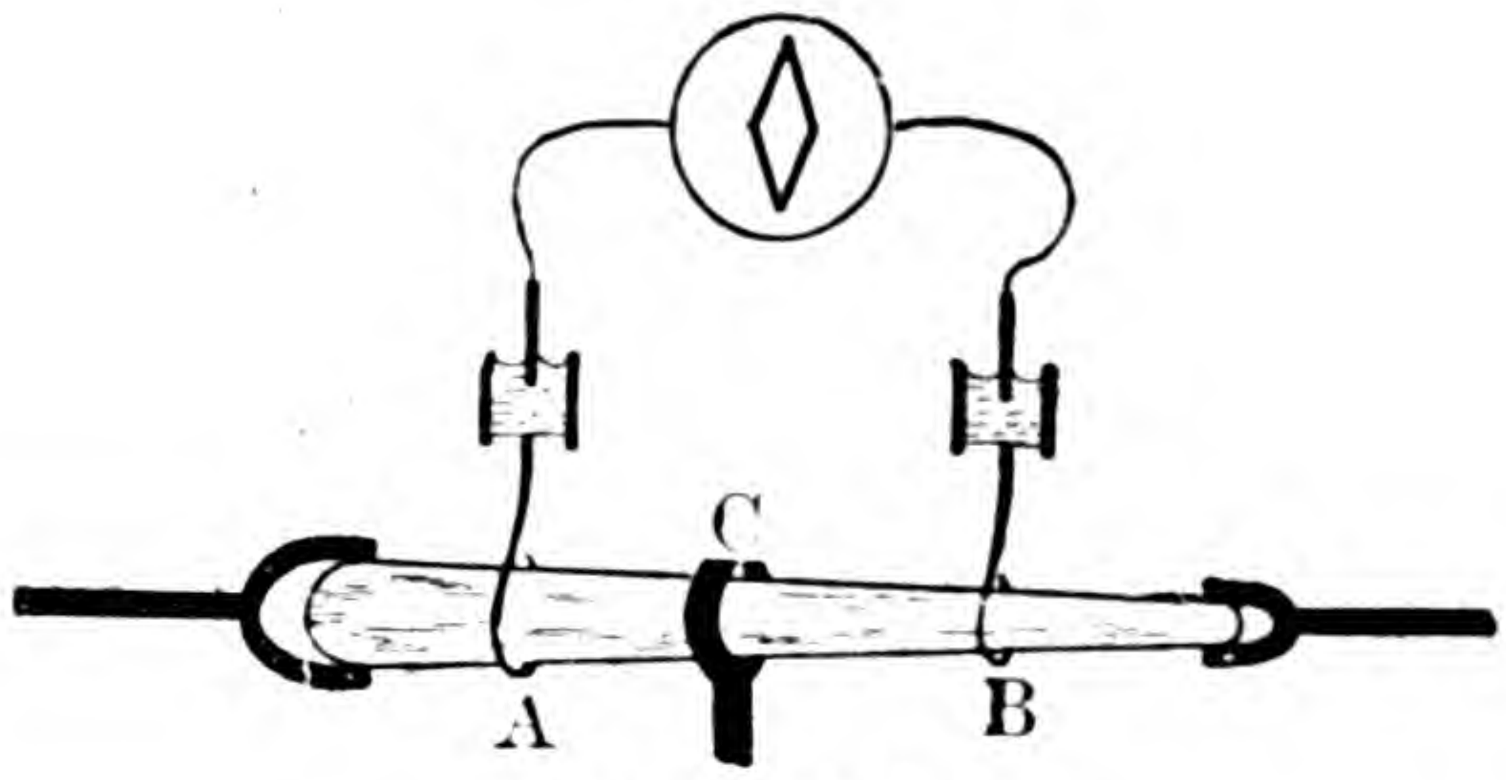
Block Method.

I shall now proceed to describe another and independent method devised by me for obtaining plant-response. It has the advantage of offering us a complementary means of verifying the results found by the method of negative variation. As it is also, in itself, for reasons which will be shown later, a far more perfect mode of inquiry, it also enables us to investigate problems which it would otherwise have been difficult to attempt.

We have seen that when the specimen of plant is excited throughout its whole length, the effect of A on the galvanometer is balanced by that of B. But if we produce a block, by clamping at C, between A and B, so that the disturbance made at A by tapping or torsion is prevented from reaching B, we shall then have A thrown into a relatively greater excitatory condition than B (fig. 7 *a*). It will now be found that a current of action flows in the stalk from A to B—that is to say, from the more excited to the less excited. When the B end is stimulated there will be a reverse current. The equal and opposite responses obtained by stimulating A and B are given in fig. 7 *b*.

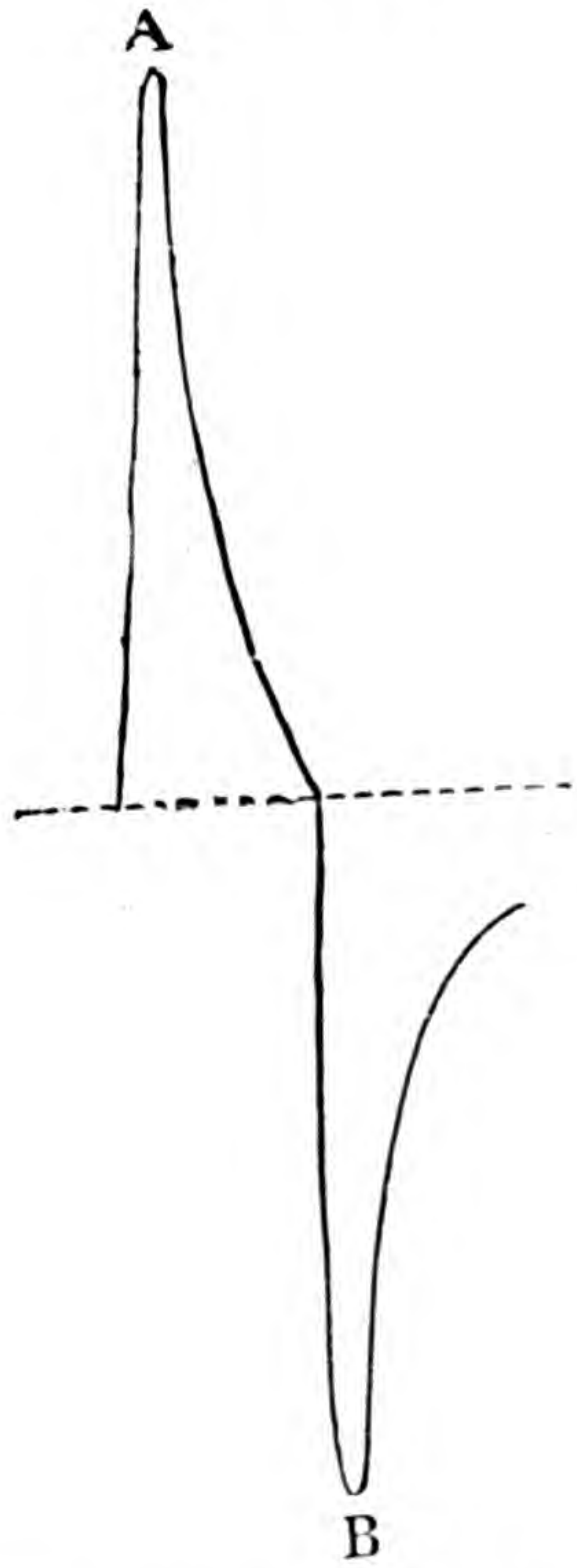
We have in this method a great advantage over that of

Fig. 7 *a*.



Method of block.

Fig. 7 *b*.



Equal and opposite responses obtained by stimulating the ends A and B.

negative variation, for we can always verify any set of results by making corroborative reversal experiments.

By the method of injury again, one end is made initially abnormal, *i. e.* different from the condition which it maintains when intact. Further, inevitable changes will proceed unequally at the injured and uninjured ends, and the conditions of the experiment may thus undergo unknown variations. But by the block method, which has just been described, there is no injury, the plant is normal throughout, and any physiological change (which in plants will be exceedingly small during the time of the experiment) will affect it as a whole.

Plant-Response a Physiological or Vital Response.

I now proceed to a demonstration of the fact that whatever be the mechanism by which they are brought about, these plant-responses are physiological in their character. As the investigations described below will show, they furnish an accurate index of physiological activity of the plant. For it will be found that, other things being equal, whatever tends to exalt or depress this activity tends also to increase or diminish the electric response.

I shall describe here a few crucial experiments only, in proof of the physiological character of electric response. The test applied by physiologists, in order to discriminate as to the physiological nature of the response, consists in experiments as to whether it is diminished or abolished by anæsthetics, poisons, and exceedingly high temperatures, all of which are known to depress or destroy vitality.

I shall therefore apply these same tests to plant-responses.

Effect of Anæsthetics and Poisons.—I took 30 leaf-stalks of horse-chestnut, and divided them into 3 batches of 10 each. One batch was kept in water, to serve as control experiment, another in chloroform water, and the third in 5 % solution of mercuric chloride.

Average response of stalks kept in water—23 divisions.
" " " chloroform—1 division.
" " " mercuric chloride—zero or very small.

Similar results were obtained with leaf-stalks of plane-tree.

I shall give later a continuous series of response-curves showing how, owing to progressive death from the action of poison, the responses undergo steady diminution till they are completely abolished.

Effect of High Temperature.—A leaf-stalk is taken, and using the block method strong responses are obtained at both ends A and B. The stalk is now immersed for a short time in water at 60° C. After this treatment the responses are completely abolished. As all the external conditions were the same in the first and second parts of the experiment, the only difference being that in one the stalk was alive, and in the other killed, we have here further and conclusive proof of the physiological character of electric response in plants.

The same facts may be demonstrated in a still more striking manner by first obtaining two similar but opposite responses in a fresh stalk at A and B, and then killing one half, say B, by immersing that half in hot water. The stalk is replaced in the apparatus, and it is now found that whereas the A half gives strong response, the end B gives none.

Responses to Single Stimuli.

In animal tissues three types of responses are observed:—

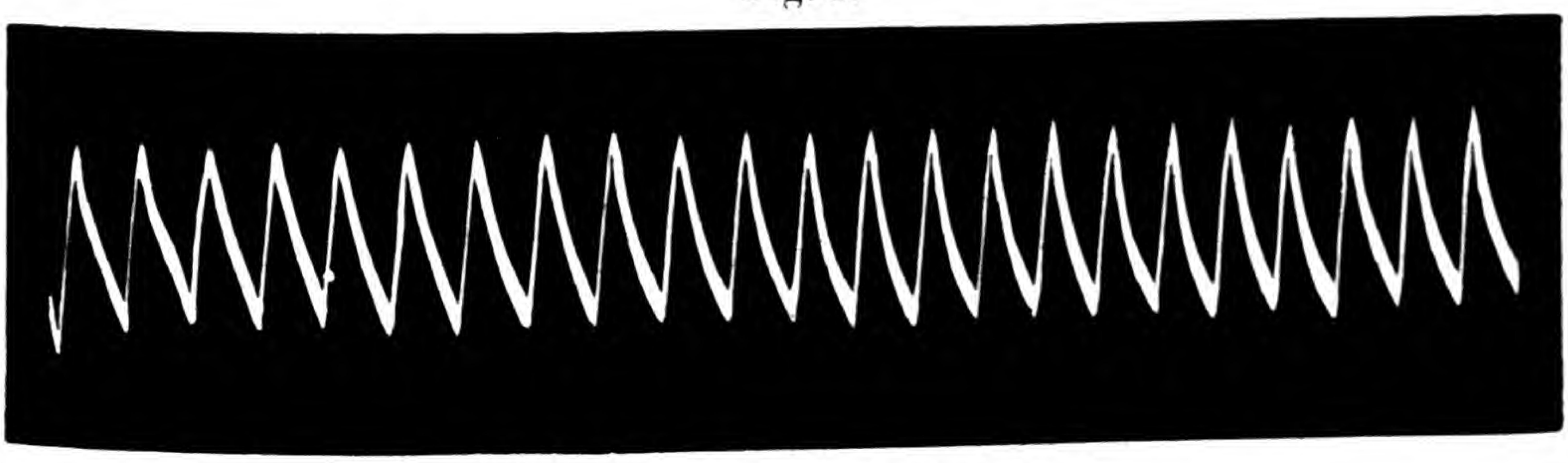
(1) Uniform responses, where succeeding stimuli of equal intensity give rise to equal responses.

(2) Staircase effect, where stimuli of equal intensity give rise to succeeding increased responses.

(3) Responses exhibiting fatigue, where equal stimuli give rise to diminishing responses.

Uniform responses.—Uniform responses may be obtained with some plants when in good condition. For studying the effect of various agencies in modifying response, it is essential to find specimens where the responses are regular. I have often met with such uniform responses from selected specimens of carrot and radish. The record given below shows how absolutely regular are such responses (fig. 8).

Fig. 8.



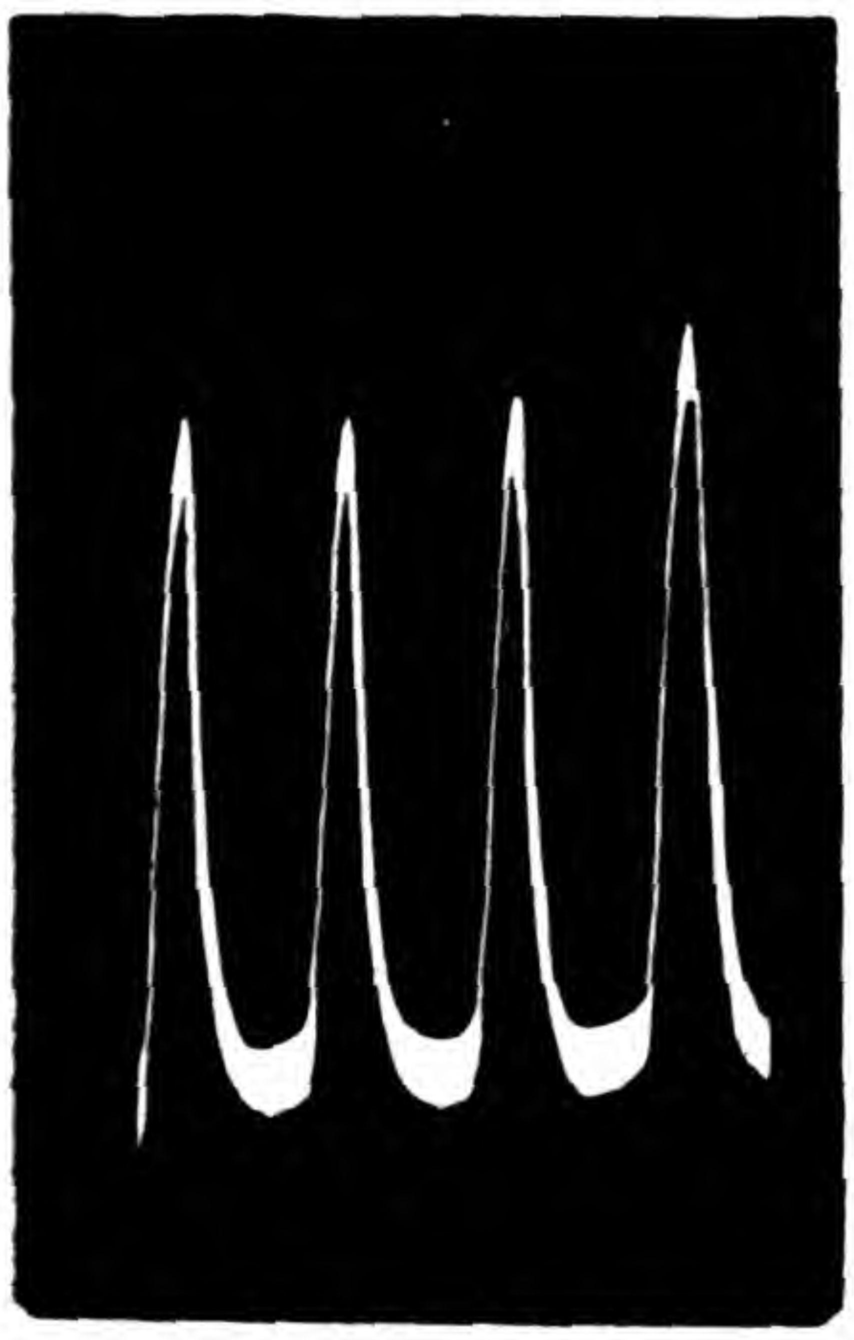
Uniform responses (Radish).

"*Staircase*" *effect.*—The following record (fig. 9) shows how in some cases increasing responses are obtained though the stimulus is kept constant. It appears as if the molecular sluggishness of the tissue was in these cases gradually removed by stimulation and the increased response resulted from increased molecular mobility.

Fatigue.—The E.M. variation caused by stimulus is the concomitant of a disturbance of the molecules of the responsive tissue from their normal equilibrium. The curves of recovery exhibit the gradual restoration of molecular equilibrium. Let us examine the record of an experiment given below, where successive stimuli were at first applied at intervals of one minute.

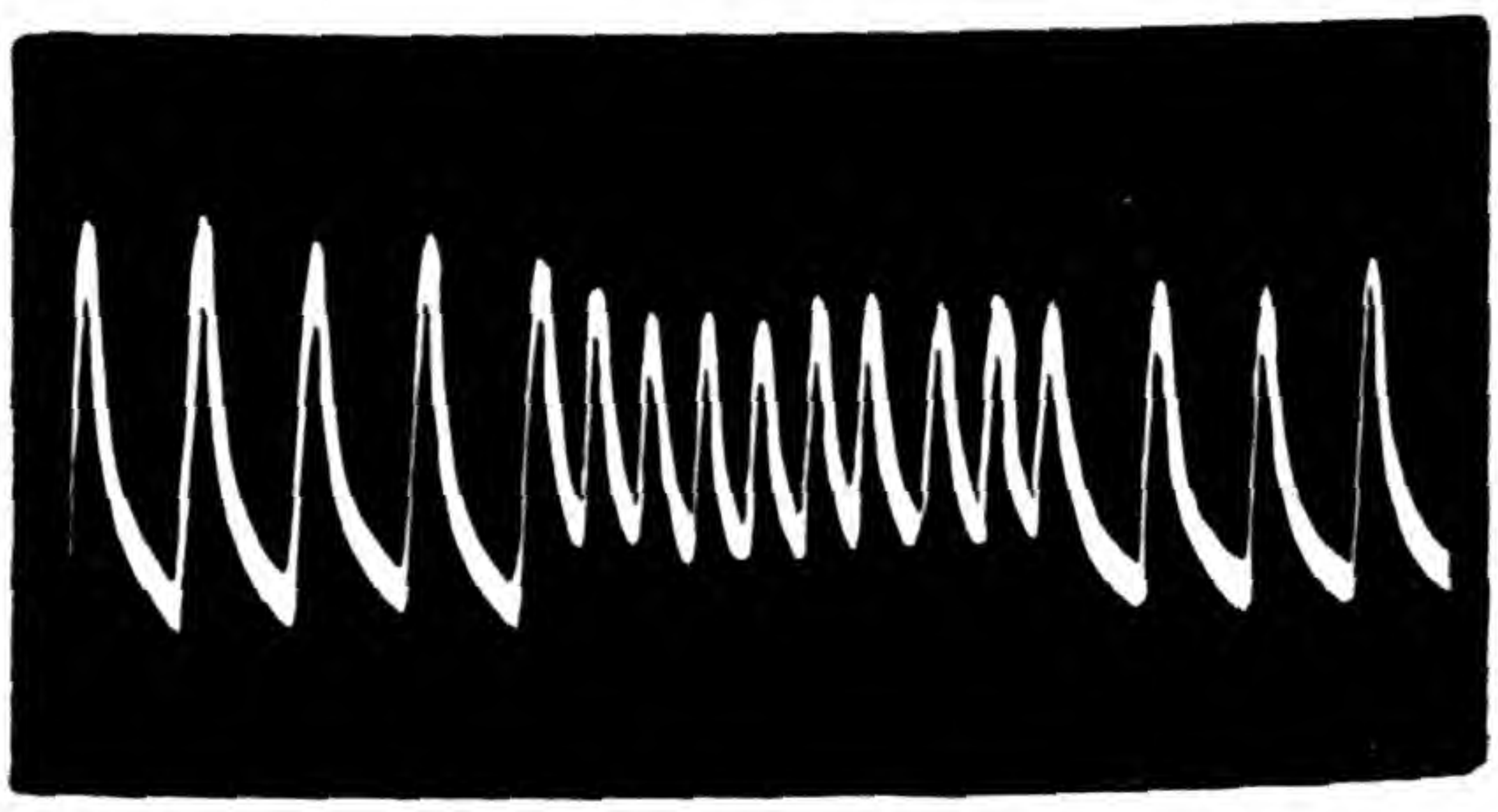
It will be seen from the four curves in the first part (fig. 10) that there is a complete recovery of the tissue one minute after the application of the stimulus. The molecular condition

Fig. 9.



"Staircase" response.

Fig. 10.

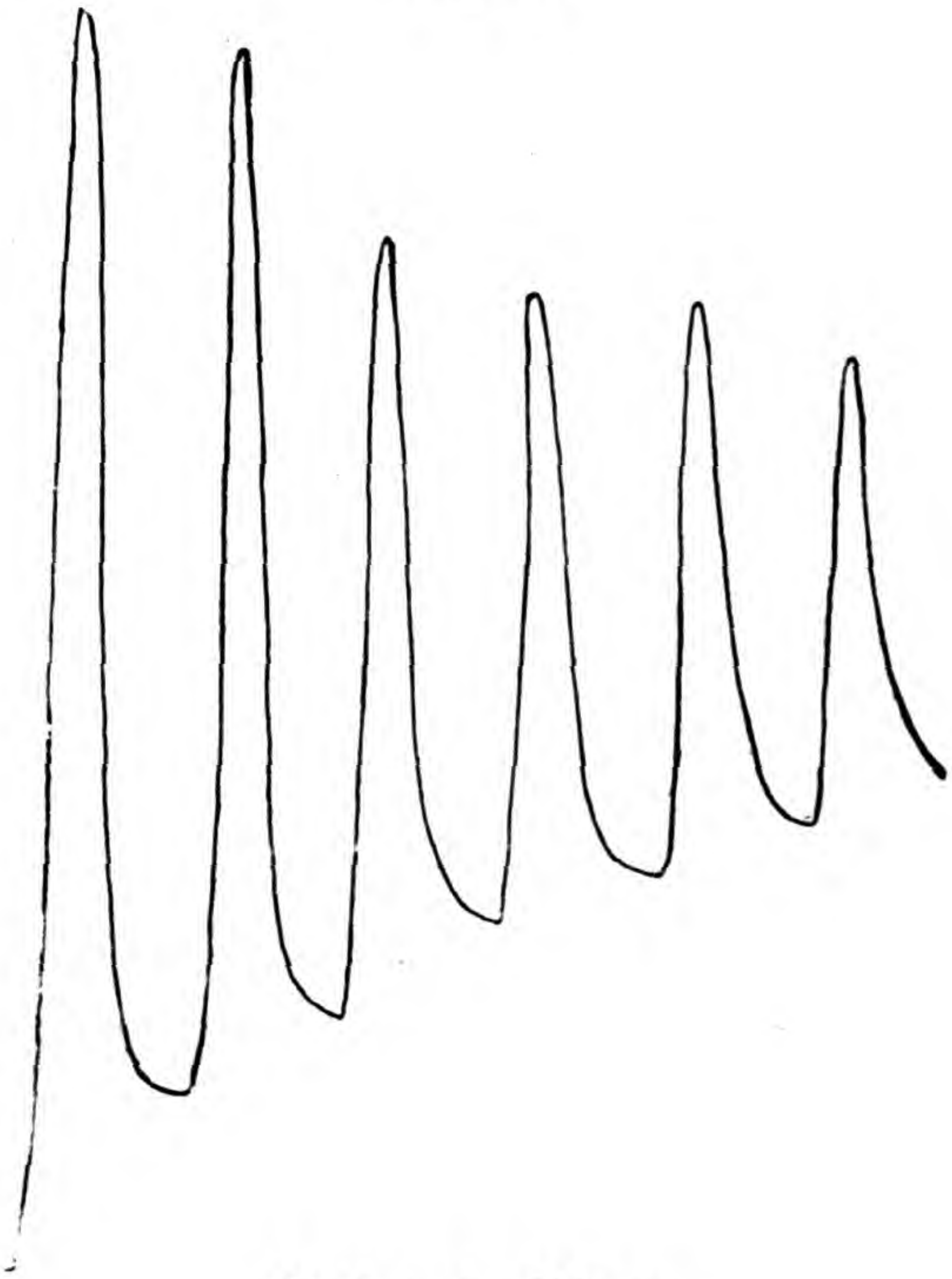


Appearance of fatigue in plant under shortened period of rest.

is exactly the same at the end of the recovery as at the beginning of stimulation; the second and succeeding response-curves therefore are exactly similar to the first, ***provided sufficient interval in each case has been allowed for complete recovery.***

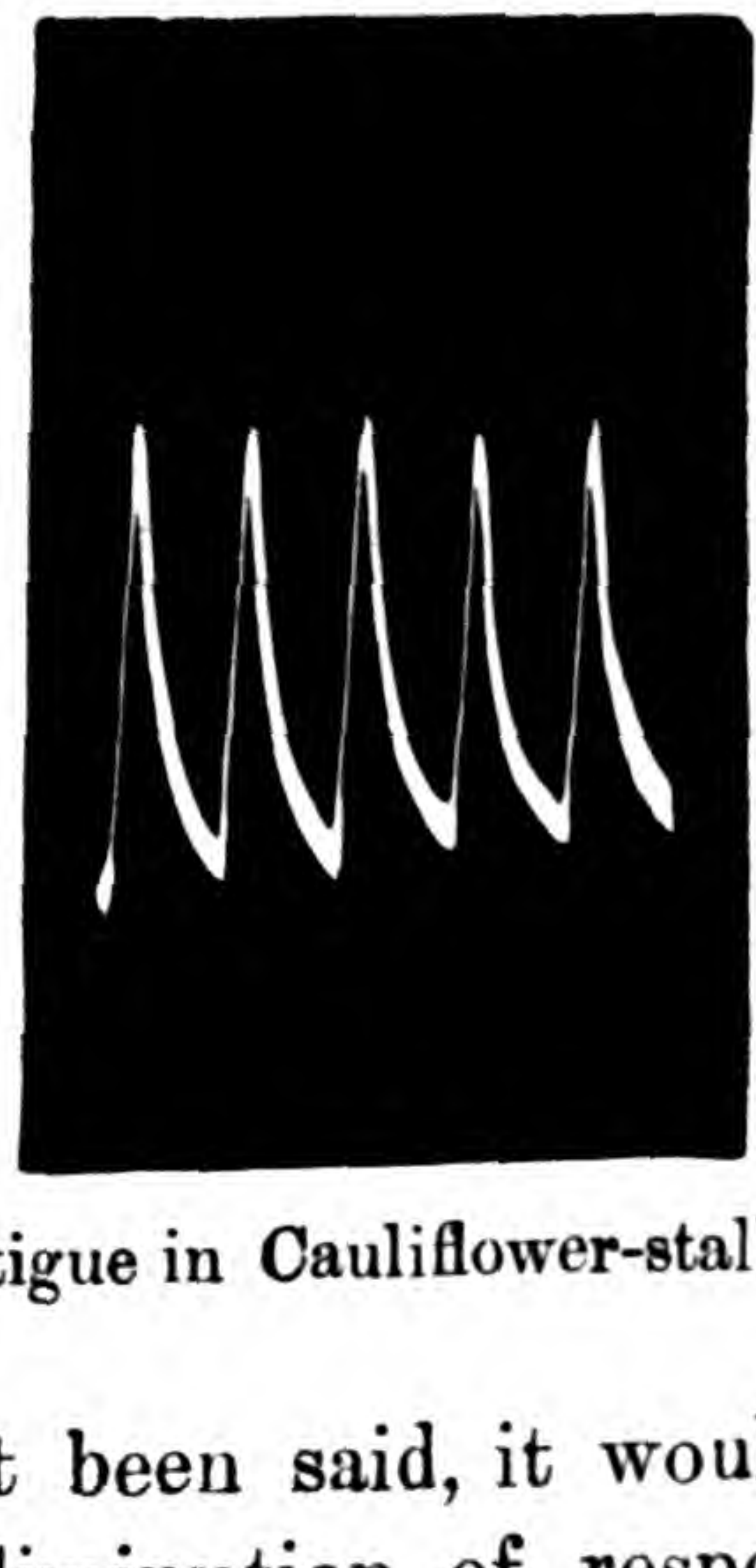
The rhythm was now changed and stimuli of the same intensity as before applied at intervals of half a minute, instead of one. It will be noticed that these responses in the second part appear much feebler than those in the first set, in spite of the equality of stimulus. An inspection of the figure will throw some light on the subject. It will be seen that when greater frequency was introduced, the tissue had not yet had time to effect complete recovery from previous strain; the molecular swing towards equilibrium had not yet abated when the next stimulus with its opposing impulse was received. There is thus a diminution of height in the resulting response. The original rhythm of one minute was now restored and the succeeding curves at once show increased response.

Fig. 11.



Fatigue in Celery.

Fig. 12.



Fatigue in Cauliflower-stalk.

From what has just been said, it would appear that one of the main causes for diminution of response or fatigue is the residual strain. This is clearly shown in figs. 11 and 12. It will be noticed that owing to imperfect molecular recovery during the time allowed, the succeeding heights of the responses have undergone a continuous diminution.

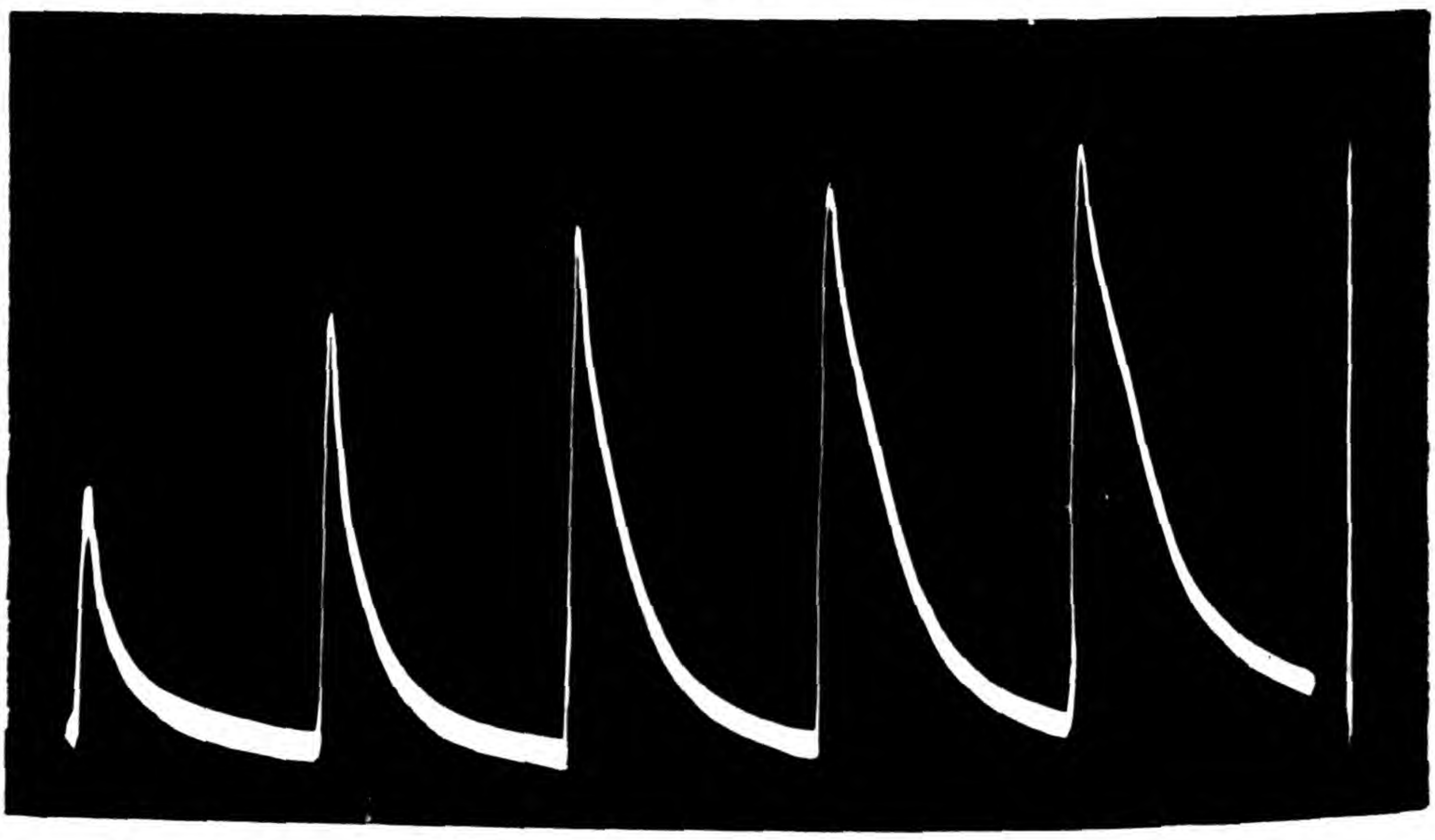
From considerations given above, we see how a period of rest is effective in the removal of all traces of fatigue.

Increased Response with increasing Stimulus.

I will now proceed to show that the electric variation produced is not merely a qualitative phenomenon, but the increased intensity of stimulus always gives rise to a definitely increasing response.

In order to obtain the simplest type of effects, not complicated by secondary phenomena, one has to choose specimens which exhibit little fatigue. Having obtained such a specimen I took records of responses for increasing stimuli caused by increasing amplitudes of vibration. In the record given (fig. 13) the

Fig. 13.



Increasing responses to increasing vibrational stimuli; the vertical line to the right represents ·1 volt.

amplitude of vibration was increased from 2°·5 to 12°·5 by steps of 2°·5 (cauliflower-stalk). It will be noticed the remarkably definite manner in which the response increases with the stimulus. The rise is at first rapid, but with high intensities of stimulus there is a tendency for the response to approach a limit.

Table showing the increased Electromotive Variation produced by increasing stimulus.

Amplitude of Vibration.	E.M. Variation.
2°·5	·044 volt
5°	·075 ,,
7°·5	·090 ,,
10°	·100 ,,
12°·5	·106 ,,

From numerous other records obtained, I find that if a curve be drawn with the electric responses as ordinates and the amplitudes of vibration as abscissæ, the first part of such a curve is slightly convex to the abscissa, then it is straight and ascending, and in the last part concave.

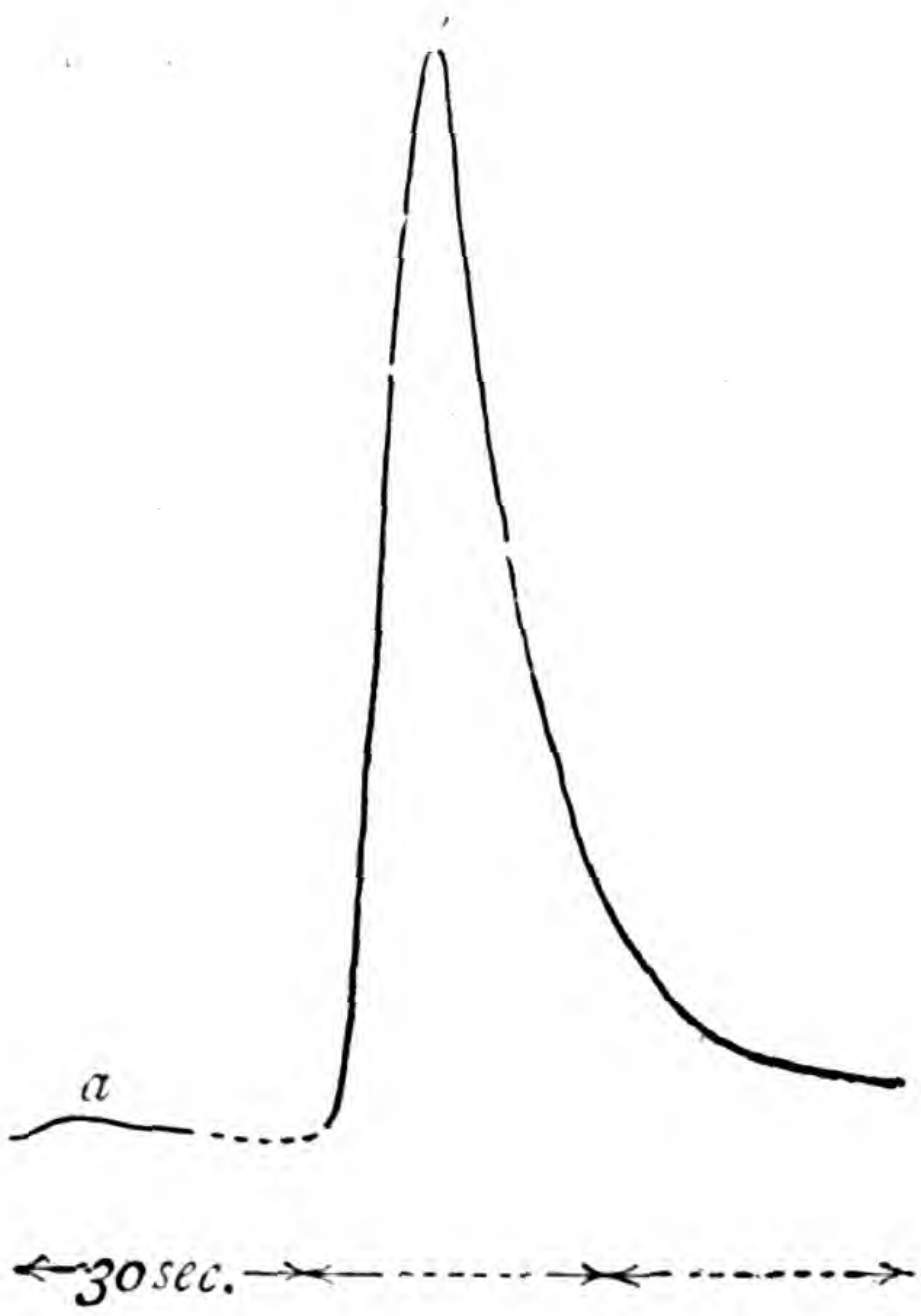
In some cases, as the intensity of stimulus is gradually increased from a low value, there would at first be apparently no response; but when a critical value is reached a maximum response would suddenly occur, which would be but little exceeded when the stimulus was further increased. All these remind us of the various types of response in animal tissue.

Effects of Superposition of Stimuli.

Additive effect.—There is apparently little or no response when the stimulus is feeble. But even a subminimal stimulus will, though singly ineffective, become effective by the summation of several. This is shown in fig. 14, where the first record *a* is the response to a feeble stimulus, and the second *b* is the response to the same stimulus repeated in quick succession, thirty times.

Fusion of partial effects.—Similar additive effects are seen with stimulus of ordinary intensity. If the frequency of stimulation is sufficiently rapid, the individual effects will become fused. A maximum effect is thus produced depending on the frequency and intensity of individual stimuli. Further continuation of stimulation adds nothing to the effect. If there is no fatigue, the top of the response-curve remains approximately horizontal. But there would be a decline if the specimen

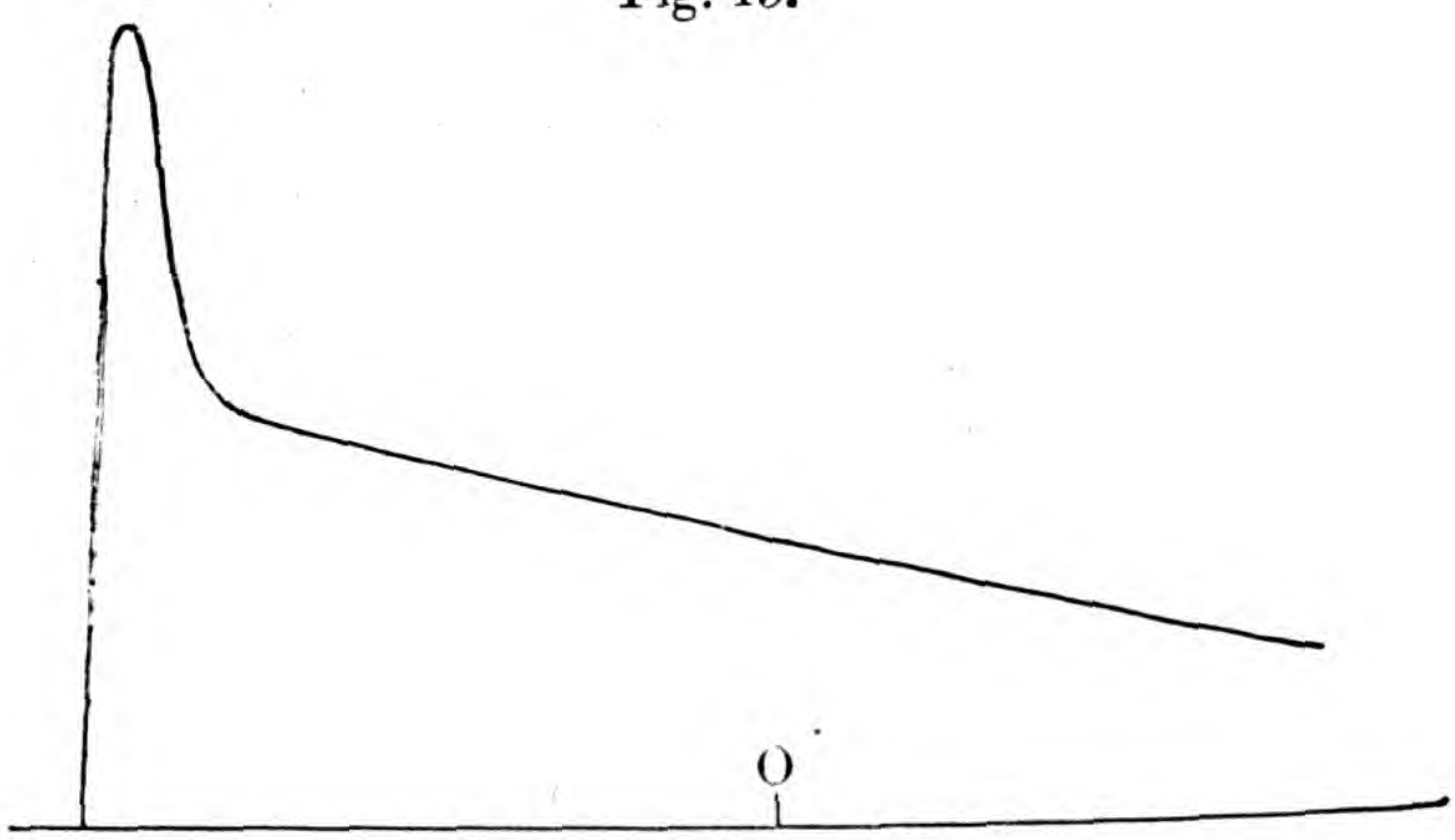
Fig. 14.



Additive effect of singly ineffective stimuli in plant.

exhibits fatigue. The following record (celery) exhibits rapid fatigue (fig. 15).

Fig. 15.



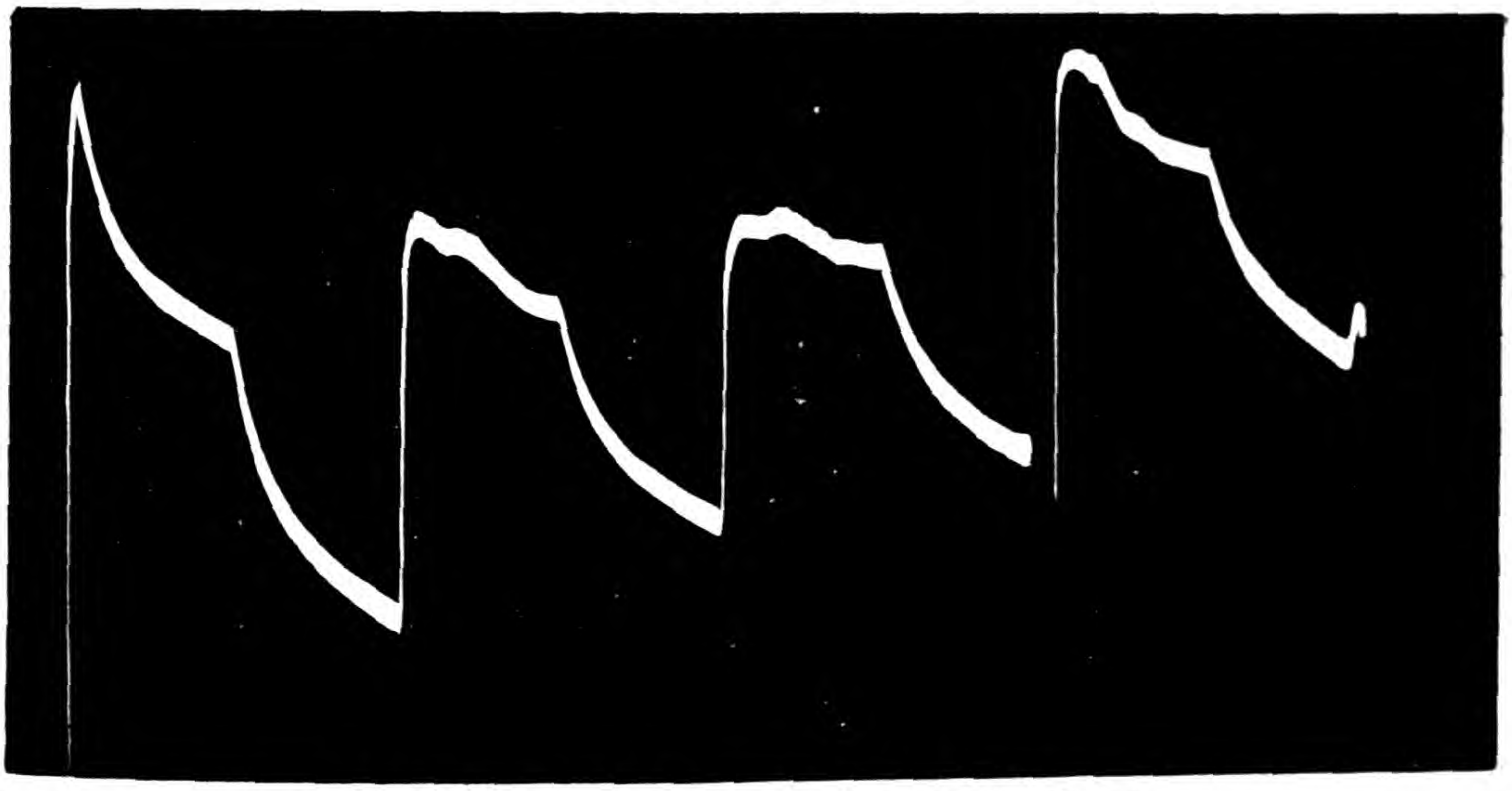
Fatigue under continuous stimulation (Celery).

The effect of rest in producing molecular recovery, and hence in the removal of fatigue, is well seen in the set of curves in fig. 16. The first shows the curve obtained with a fresh plant which had long previous rest. The effect is seen to be very large. Two minutes were allowed for recovery, and the stimulation was again repeated for two minutes. The response in this case is seen to be decidedly smaller. The third record is somewhat similar to the second. A period of rest of five minutes was now allowed, and the curve obtained subsequently, owing to partial removal of residual strain, is found to exhibit greater response.

Diphasic Variation.

When a plant is stimulated at any point, a wave of molecular disturbance is propagated outwards from the point of its initiation. This wave of molecular disturbance is attended by a wave of electrical disturbance. It takes some time for a disturbance to travel from one point to another, and its intensity may undergo a diminution as it recedes farther from its point of origin. This diminution is sometimes very rapid.

Fig. 16.



Series of records under continuous stimulation.

It will thus be seen that we might obtain responses even without injury or block in cases where disturbance is very much enfeebled on reaching a distant point. In such a case, on giving a tap near A, a responsive current would be produced in one direction, and a current in an opposite direction when the tap is given near B (fig. 17 *b*). Theoretically, then, we might find a neutral point between A and B, so that on originating the disturbance there the wave would reach A and B at the same instant, with the same intensity; the resulting electric disturbances at A and B will continuously balance each other and the galvanometer will show no current. On taking a cylindrical root of carrot, I have sometimes succeeded in finding a neutral point, which being disturbed did not give rise to any resultant current. But disturbing a point to the right or to the left gave rise to opposite currents. It is, however, difficult to obtain an absolutely cylindrical specimen, as it always tapers in one direction. The conductivity towards an ascending direction is not exactly the same as that in the opposite direction. It is therefore difficult to fix an absolutely neutral point, but a point may be found which approaches this very nearly (fig. 17 *a*), and on stimulating near this point a very interesting diphasic variation was observed, which was due to a slight difference in the rates of propagation of the disturbance in the two directions. From the record (fig. 17 *c*) it will be seen that the disturbance arrived earlier at A than at B. This produced an "up" response. But shortly after, the wave reached B. The effect of this was to produce a current in the opposite direction. This apparently hastened the recovery

Fig. 17 *c*.

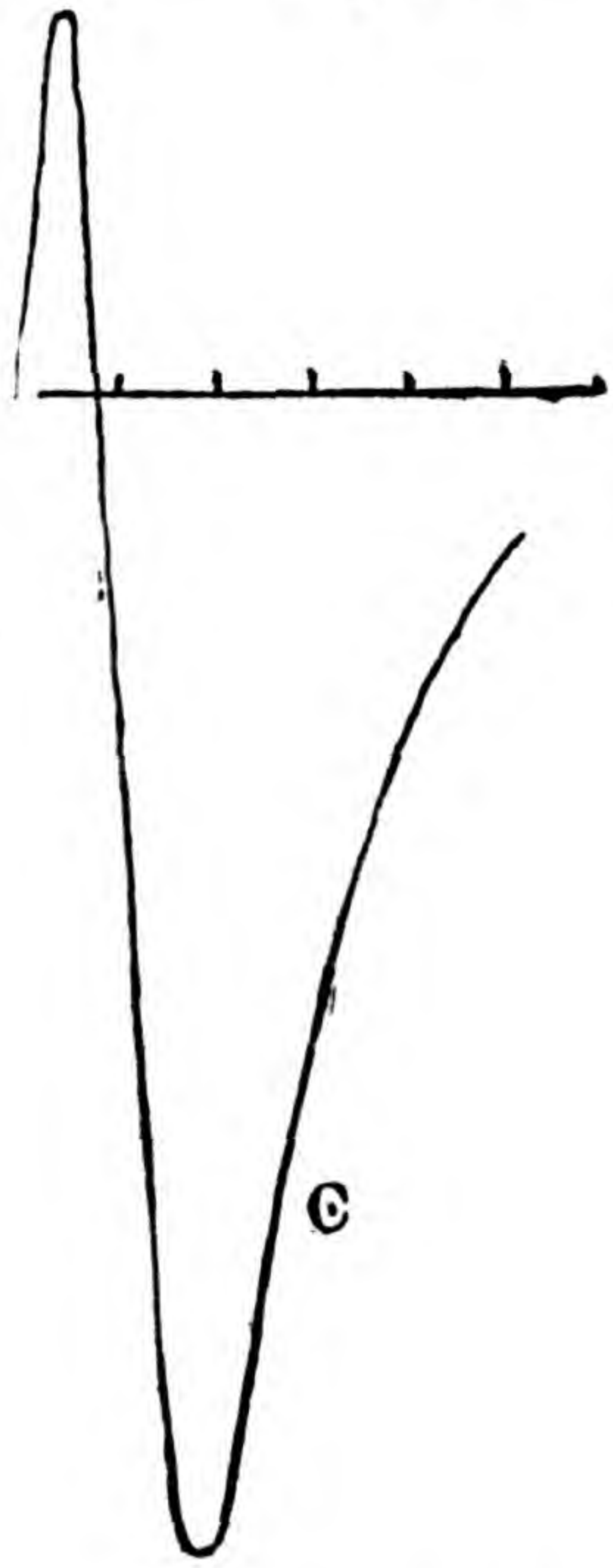


Fig. 17 *a*.

Diphasic variation.

of A (from the normal 60 seconds to 12 seconds), and then the second phase of response "down" due to excitation of B was fully displayed (fig. 17 *c*).

Radial Electromotive Force.

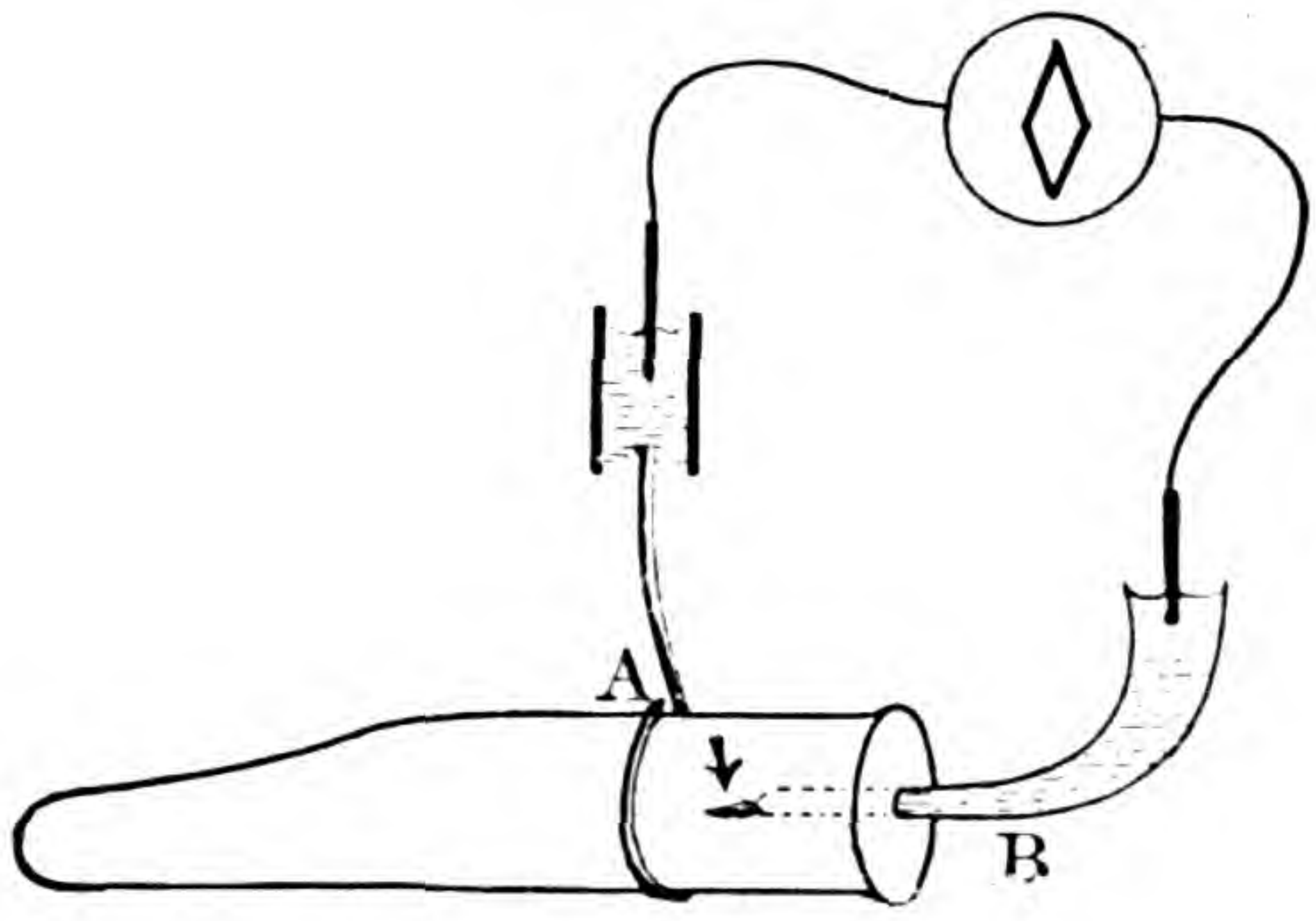
We have seen that a current of response in the plant flows from the relatively more to the relatively less excited. A theoretically important experiment is the following:—A thick plant-stalk is taken, and a hole bored so as to make one contact with the interior of the tissue, the other being on the surface. After a while the current of injury was found to disappear.

On exciting the tissue by taps or torsional vibration a responsive current was observed which flowed inwards, from the more disturbed outer surface to the shielded core inside (fig. 18).

Fig. 17 b.

Hence it is seen that when a wave of disturbance is propagated along the plant, there is a concomittant wave of radial

Fig. 18.



Radial E.M. variation.

E.M. variation. Swaying of a tree by the wind would thus appear to give rise to a radial E.M.F.

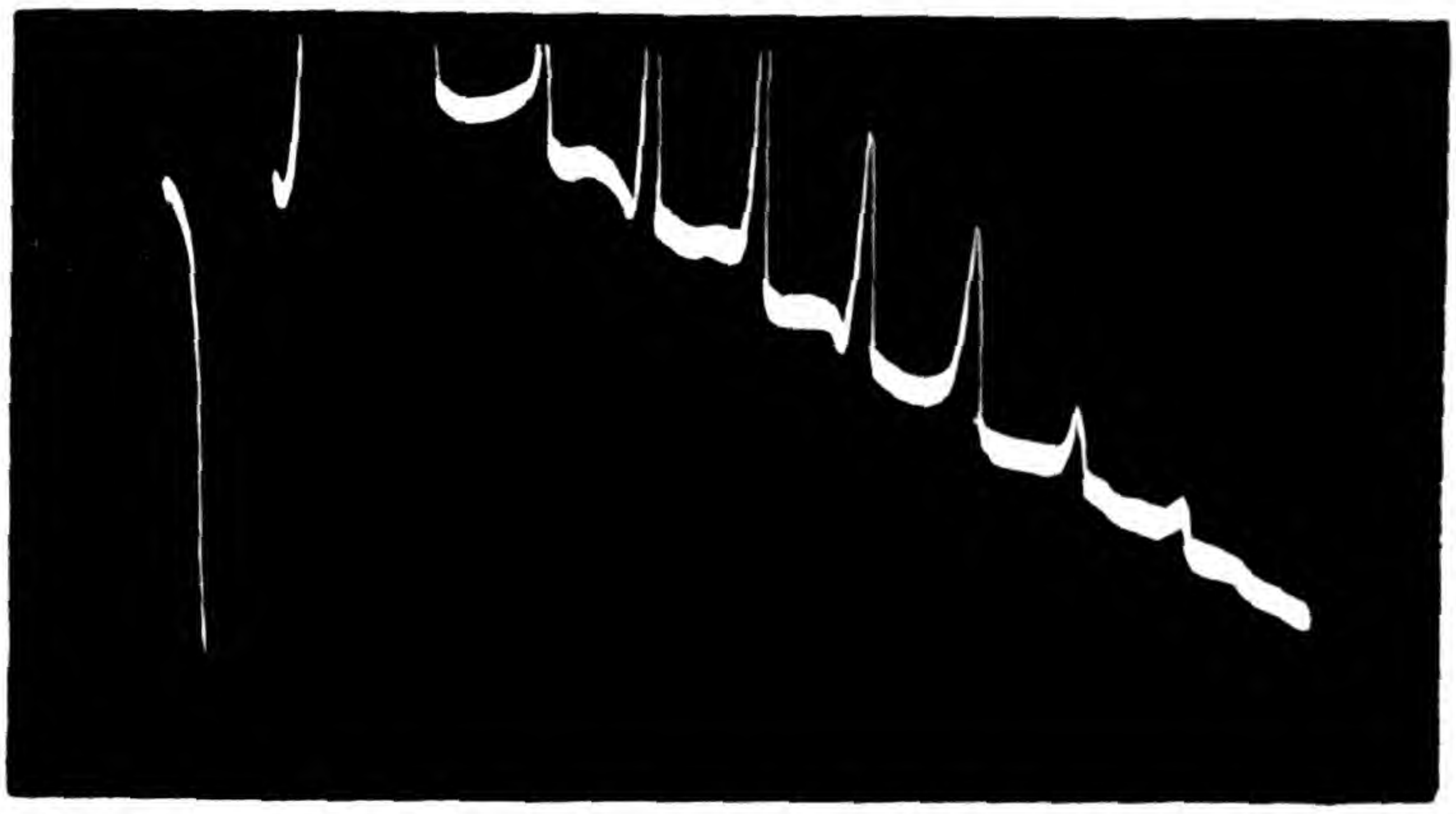
Abnormal Response.

The current of response in fresh nerves is from the more excitable to the less excitable, and the normal response is called "negative." The normal response in plants is similar in direction to the nerve-response. If we wish to keep in touch with the animal phraseology, we might also designate the plant-response as negative.

But stale nerve, owing to some peculiar molecular modification, gives rise, as Dr. Waller found, to the abnormal positive. This abnormal response is reversed to the normal negative after strong and long-continued stimulation. Curiously enough, I have on many occasions found exactly parallel instances of reversed response in stale plants, and, what is more interesting, the abnormal positive passed into normal negative when subjected to strong stimulation. I was able in some cases to trace the process of reversal, by continuously increasing the intensity of stimulus. It was found that as the stimulus was increased, at a certain point, the positive underwent a reversal into the normal negative. This is seen in fig. 19, in which the record should be read from right to left. The responses are at first abnormal positive (up); on increasing the stimulus, at a certain point there was produced (see the extreme left of the figure) a normal negative (down) response.

The plant thus gives reversed response under the abnormal condition of staleness. I have sometimes found similar reversal of response when the plant is subjected to the abnormal conditions of excessively high or low temperature and is near its death-point.

Fig. 19.



Abnormal positive response converted into normal negative.

Influence of Temperature on Plant-Response.

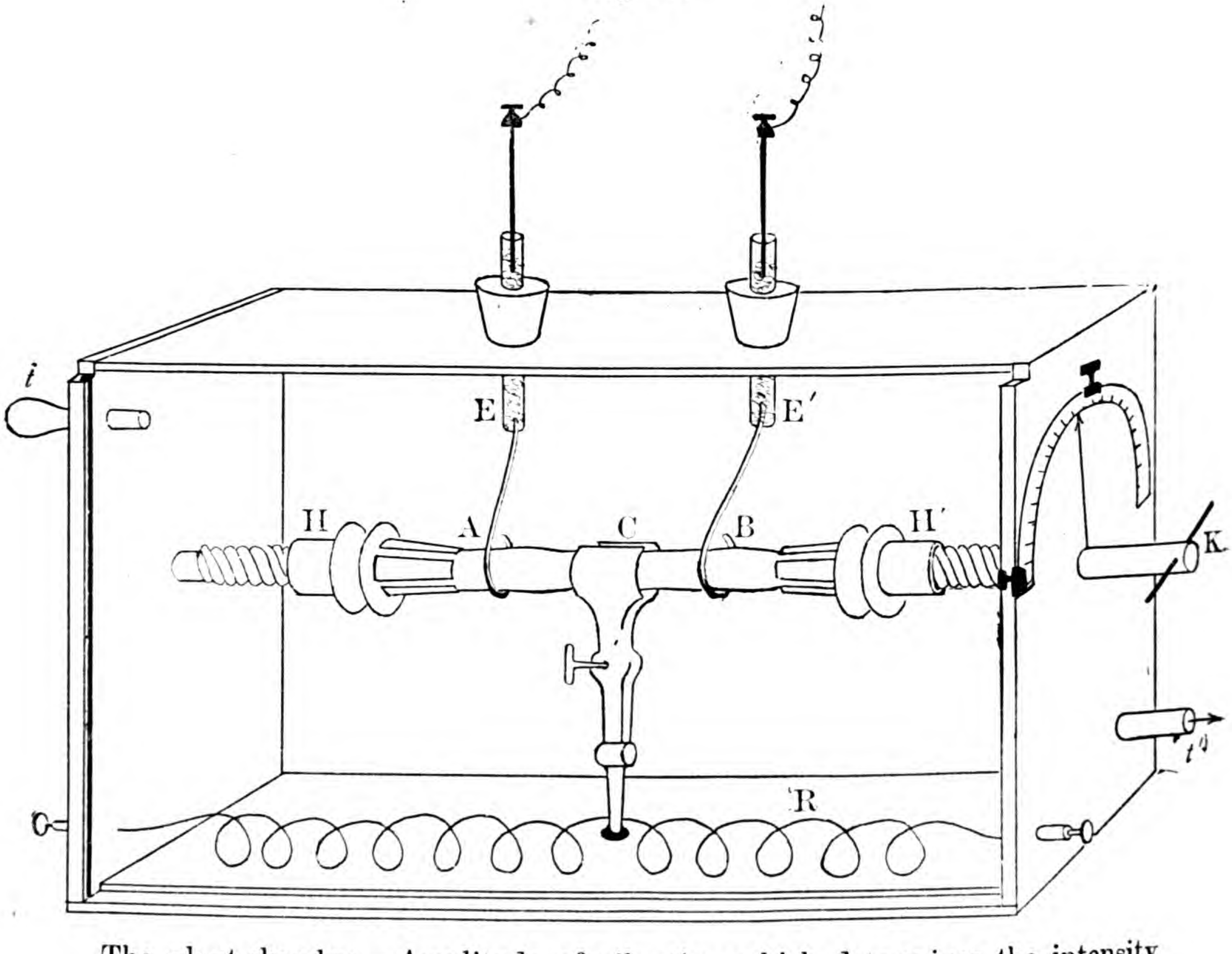
It is well known that for every plant there is an optimum temperature most favourable to its vital activity. Above and below, at the maximum and the minimum, the vital activity is arrested, and if the plant is kept for long time under these unfavourable conditions it is apt to be killed.

I tried to determine whether the undoubted changes induced by temperature in the vital activity of the plant affected the electrical response.

Effect of very Low Temperature.—After severe frost, I found specimens of plants, which usually give strong response, become irresponsive. I then tried the effect of artificial lowering of temperature. A plant which is easily affected by cold is the Eucharis lily. I first obtained strong responses of the leaf-stalk at ordinary temperature of the room (17° C.). After cooling the stalk to −2° C. for 15 minutes, the response practically disappeared. On warming it again, the response reappeared. But the action of too long-continued cold caused a permanent abolition of response. My next attempt was to find the comparative liability of different species of plants to the effect of low temperature. For experiment I chose (1) Eucharis lily (leaf-stalk), (2) ivy-stem, and (3) stems of holly. I obtained the record of their normal responses at 17° C. I then placed them in an ice-chamber for 24 hours, and took their records once more. I found the electric responsiveness of the Eucharis lily, known to be susceptible to the action of cold, had entirely disappeared, whereas the electric response of the hardier holly and ivy remained almost the same as before.

Influence of High Temperature.—I next tried to determine the high temperature at which the response disappeared altogether. I took six radishes, and put them in water whose temperature was gradually raised. I examined their responsiveness at different temperatures. In this way observations were made with each specimen till the death-point was reached, when there was a total abolition of response. With different specimens of

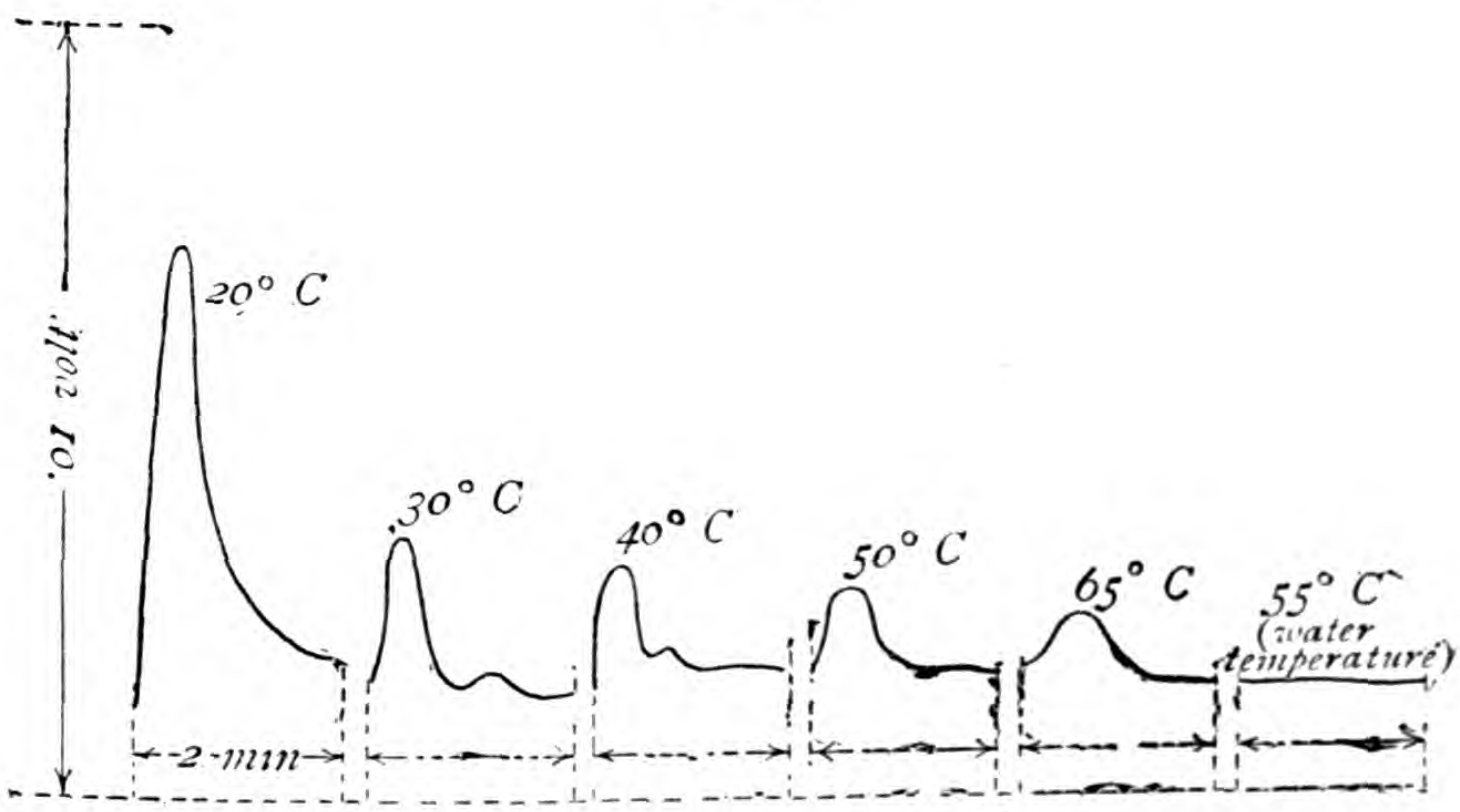
Fig. 20.



The plant chamber.—Amplitude of vibration which determines the intensity of stimulus is measured by the graduated circle seen to the right. The glass chamber is air-tight. Temperature is regulated by the electric heating-coil R. For experiments on anæsthetics, vapour of chloroform is blown in through the side tube *t*.

radish I found the death-point to lie between from 50° C. and 55° C. The experiment just described was rather troublesome, inasmuch as, in order to produce each variation of temperature, the specimens had to be taken out of the apparatus, warmed and remounted. I introduced an experimental modification which obviated this difficulty. The vibration apparatus containing the specimen was enclosed in a chamber, in which there was a spiral of german-silver wire, through which an electric current could be sent for heating (see fig. 20). The temperature could be regulated at will by varying the current. The specimen chosen for experiment was the leaf-stalk of celery. It was kept at a given temperature for 10 minutes, and record taken. This process was repeated. It will be seen how the response undergoes a continuous diminution as the temperature is raised. In radishes the response disappeared completely at 55° C., but with celery, treated in the manner described—by dry heating,—I could not obtain its entire abolition at 60° C. or even higher. But on taking the specimen out and putting it in water at 55° C. for five minutes, the response was entirely abolished (fig. 21). This shows that the plant can withstand dry heat much better than moist heat.

Fig. 21.



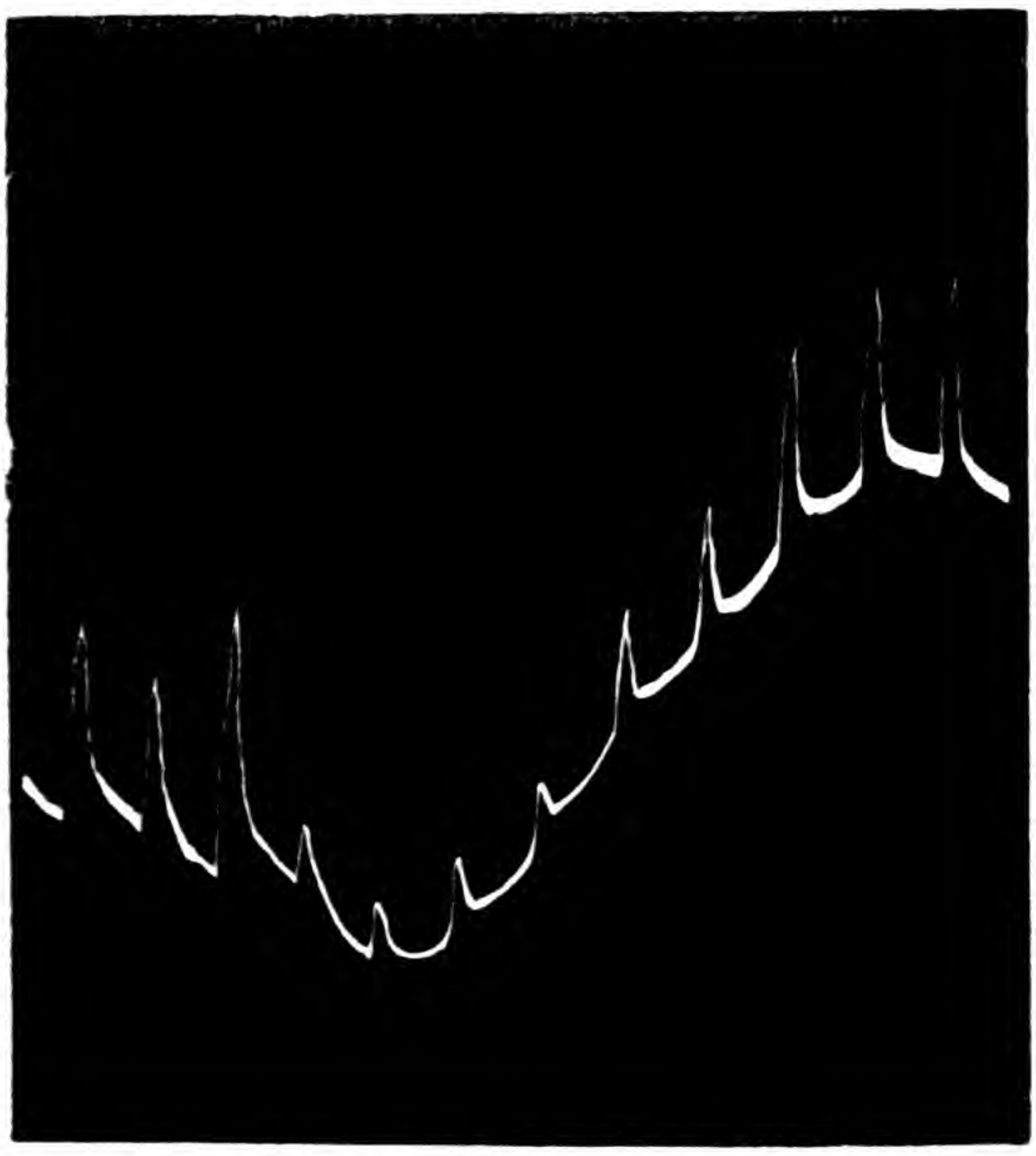
Effect of temperature on response.

A very curious effect of temperature variation is the marked increase of sensitiveness which is often seen as the after-effect. This is well exhibited when two series of records are taken, one during the rise of temperature, and the second during the fall. It is found that the responses are enhanced during cooling, as compared with responses given at the same temperature while warming. Previous temperature variation has, at least in some cases, a stimulating effect (fig. 22).

Effect of Steam.—The plant was mounted in a chamber into which steam could be introduced. I had chosen a specimen which gave regular responses. On the introduction of steam, with consequent rise of temperature, there was a transitory augmentation of excitability. But this quickly disappeared, and in five minutes the response disappeared with the death of the plant (fig. 23).

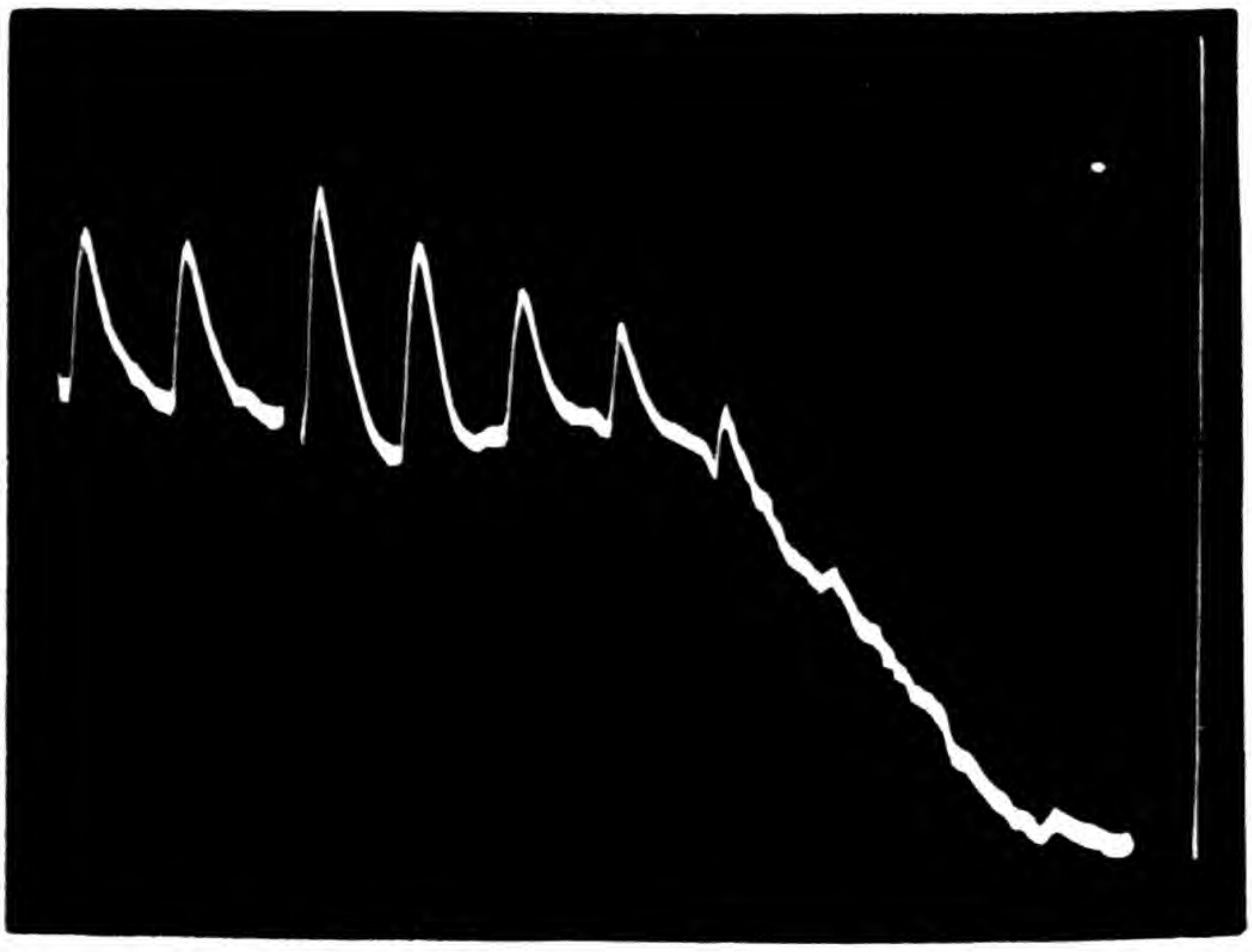
It will thus be seen that those modifications of vital activity which are produced in plants by temperature variation can

Fig. 22.



Responses to uniform stimuli under varying temperatures. Counting from the left, the responses are for temperatures (in Centigrade) 26°, 20°, 22°, 38°, 53°, 60°, 65°, 60°, 51°, 45°, 40°, 38°.

Fig. 23.



Effect of steam in abolishing response with death of plant. The two records to the left give responses at 20° C., after which steam was introduced.

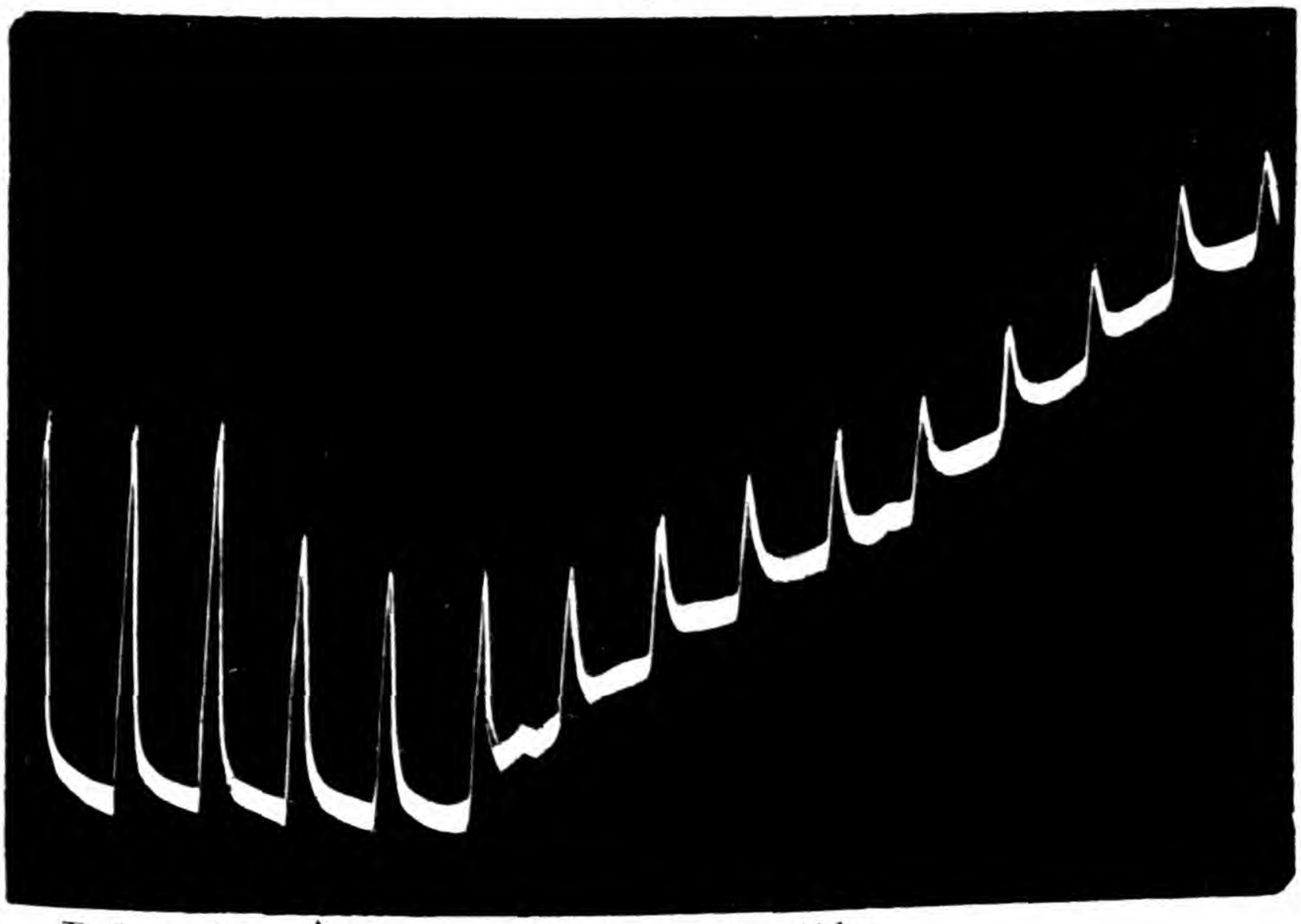
be very accurately gauged by the electric response. Indeed, it may be said that there is no other method by which the moment of arrest of vitality can be so satisfactorily distinguished. Ordinarily, we are able to judge that a plant has died only after various indirect signs have begun to appear. But in the electric response we have an *immediate* indication of the arrest of vitality, and are thereby enabled to determine the death-point, which it is impossible to do by any other means.

Effects of Anæsthetics and Poisons.

The most important test by which vital phenomena are differentiated is the influence on response of narcotics and poisons. I have already shown how plants which previously gave strong response, did not, after application of an anæsthetic or poison, give any response at all. In those cases it was the last stage only that could be observed. But it appeared important to be able to trace the growing effect of anæsthetisation or poisoning throughout the process.

Effect of Chloroform.—The mode of experiment was (1) to obtain a series of normal responses to uniform stimuli, applied at regular intervals of time, say one minute, the record being taken the while on a photographic plate. (2) Without interrupting this procedure, the anæsthetic agent, chloroform vapour, was blown into the closed chamber containing the plant. It will be seen how rapidly chloroform produces depression of response and how the effect grows with time (fig. 24).

Fig. 24.



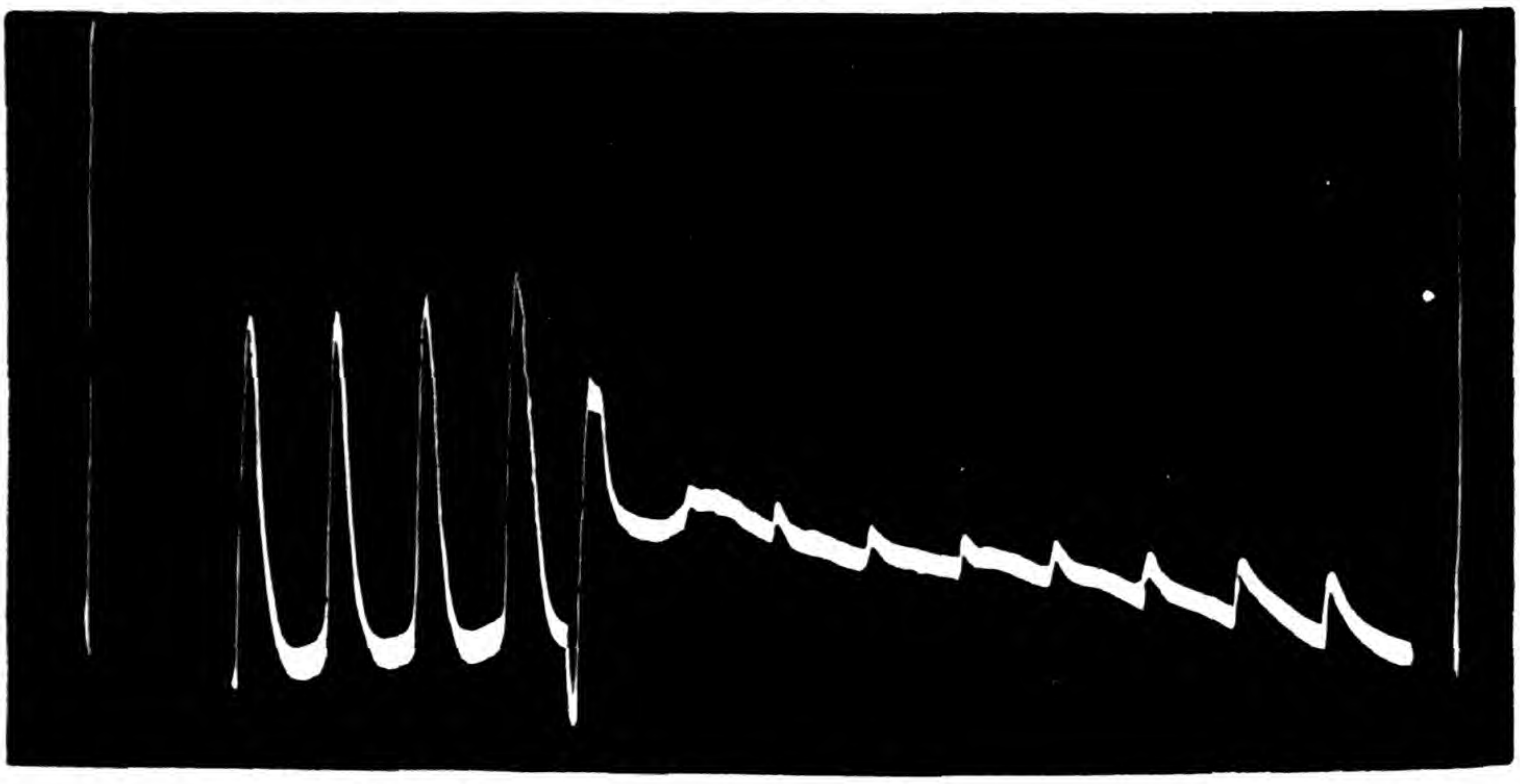
Before (3). ↑ After (11).

Effect of chloroform.

Exactly similar effects were obtained with chloral, also with formalin. These were applied in the form of solution on the tissue at the two leading contacts and the contiguous surface. In all these experiments an external resistance of one million ohms was always interposed, so that any slight variation of resistance that might be produced by the addition of a reagent would be quite negligible compared with the total resistance of the circuit. That the addition of a reagent did not produce any variation in the total resistance was independently verified by taking the deflection due to a definite small E.M.F. before and after (see the vertical lines to the left and right of fig. 25) the application of the reagent: the deflection showed no variation.

Effect of Potash.—The next record (fig. 25) shows the depression

Fig. 25.



Before. After.

of response by solution of potash. In connection with this I observed the curious opposite effects of poisonous reagents when given in small and in large doses, a peculiarity which is also sometimes exhibited by animal tissues. While large doses of potash produce abolition of response, a small dose was found to exhibit a stimulating action.

CONCLUSION.

The main object of my paper has been to show that the mode of investigation described, offers a very delicate and trustworthy means for the study of various intricate problems in plant-physiology. It has been shown how the electric record gives us an immediate and unfailing indication of the modification of the plant's vital activity under the influence of various external agencies.

It has been shown that the electric response is a faithful index of physiological action. It does not concern us at present to enter into the question as to the mechanism by which the response is brought about. On another occasion * I hope to bring forward certain facts which bear upon the subject. It may, however, be mentioned here, that the explanation offered by Kunkel of the response being due to movement of water in the plant is inadequate. For in that case we should expect a definite stimulation to be under all conditions followed by a definite electric response whose sign should remain invariable. But we find, instead, the response to be profoundly modified by any influence which affects the vitality of the plant. For instance, the response is at its maximum at an optimum temperature, a rise of a few degrees produces a profound depression, the response disappears at the maximum and minimum temperatures and is revived when brought back to the optimum. Anæsthetics and poisons abolish the response. Again, we have the response undergoing an actual reversal when the tissue is stale. All these facts show that mere movement of water could not be the effective cause of the plant-response.

Physiologists are now agreed that mechanical movement is not the only sign by which we may judge whether a tissue is or is not irritable. "We must be careful not to assume that irritability is restricted to motile organs. For all we know to the contrary, it is possessed by the protoplasm of all plant organs; and if in any case the action of a stimulus is not followed by a responsive movement, we must, before we assume the absence of irritability, assure ourselves that the structure of the organ is such that a movement is a mechanical possibility" †.

We have seen that a far more universal test of the responsiveness of a tissue is its electro-motility—that is to say, its power of exhibiting electromotive change. This is known to be possessed by all living animal tissue.

I have shown that these electric responses are given by all plants and by their different organs. It has also been shown that in the matters of response by negative variation, of fatigue,

* The subject of irritability and response will be found fully treated in my work on "Response in the Living and Non-Living," to be shortly published by Messrs. Longmans, Green & Co.

† Vines, Physiology of Plants, p. 372.

of modification of response by high and low temperatures, and even in matters of occasional abnormal variations, such as positive response in a modified tissue, they are strictly correspondent to similar phenomena in muscle and nerve. Judged by the final criterion of the effect produced by anæsthetics and poisons, these electric responses in plants fulfil with animal tissues the test of vital phenomenon.

How are we to account for these remarkable similarities? It may be that these resemblances are due to some chance coincidence. But do we know of any other instance where chance coincidence extended throughout the whole range of phenomena in all their details?

There thus remains one other alternative, namely, that the underlying life-phenomenon is the same in both animals and plants, and that both animal and plant responses are its common physiological expression.

The electro-physiological investigation on plants may thus be found to throw much light on the response phenomena in the animal. With animal tissues, experiments have to be carried on under many great and unavoidable difficulties. The isolated tissue, for example, is subject to unknown changes inseparable from the approach of death. Plants, however, offer a great advantage in this respect, for they maintain their vitality unimpaired during a very great length of time. In animal tissues, again, the vital conditions themselves are highly complex. Those essential factors which modify response can, therefore, be better determined under the simpler conditions which obtain in plant life.*

In concluding I wish to mention the efficient help rendered me by my assistant, Mr. J. Bull, in the course of this investigation.

* [The present work on Electric Response in Plants was undertaken to supply an important link between the responses observed in animal tissues and in inorganic substances. A short preliminary account of results obtained with plants was given in my paper, "On the Response of Inorganic Substances," communicated to the Royal Society on the 7th of May, read June 6th, 1901, and also in my Friday Evening Discourse, "On the Response of Inorganic Matter to Stimulus," at the Royal Institution, on May 10th, 1901.

I am glad to find that Dr. Waller has subsequently been able to confirm the results which he heard me describe on the occasions referred to above. (Waller: "Electric Response of Vegetable Protoplasm to Mechanical Excitation," Nov. 9, 1901, Proc. Physiological Society.)

June 11, 1902. J. C. B.]

A Contribution to the *Composite* Flora of Africa.

By SPENCER LE M. MOORE, B.Sc., F.L.S.

[Read 3rd April, 1902.]

(PLATE 8.)

THE plants forming the subject of this memoir are preserved in the British Museum herbarium. Of recent years that herbarium has been largely increased, no small factor in this increase relating to specimens brought home from North-eastern Tropical Africa by travellers in that part of the Dark Continent. One well-known resident, the Rev. W. E. Taylor, holds an honourable position as a contributor to the National Collection, this gentleman having, during the eighties of last century, forwarded many rare plants, chiefly from Mombasa and the country inland of that town. Among the travellers, the largest collection is Mr. Scott Elliot's, made in the course of his expedition to Mount Ruwenzori and thence south to Nyassaland. Mr. F. J. Jackson secured many valuable specimens during his journey through what is now British East Africa, as did Professor J. W. Gregory while making his well-known and adventurous visit to Mount Kenia. In 1899 Professor H. J. Mackinder also went to this mountain; and though his bundle was a small one, it was by no means without interest, and, indeed, included a few novelties. To these must be added the names of Dr. S. L. Hinde, who sent home plants from Machakos, and Lord Delamere, whose collection from the Lake Rudolf country is very valuable. The Museum also possesses a number of rare specimens from Somaliland, presented to the Trustees by Mrs. Lort Phillips and Dr. Donaldson Smith.

Irrespective of Scott Elliot's plants, the *Composite* Flora of Southern Tropical Africa is well represented at the Museum by *inter alia* the Nyassaland plants of the late Mr. John Buchanan (these including a valuable parcel sent in 1895), of Mr. A. Whyte, of Rev. Dr. Stewart, and of Mr. Richard Crawshay; and Dr. Rand has botanized with excellent result in Rhodesia. Lastly, from the South-western Tropics the Museum has Mr. J. G. Een's remarkable collection, which it acquired in 1879. So little was known of this part of Africa at the time of Mr. Een's visit, that his collection, one may say without exaggeration, contained an unusually high percentage of what were then novelties, and even now, in spite of the large amount of work since done in Germany upon the South-western Flora, one is continually finding undescribed plants gathered by Mr. Een.

Mr. Whyte's *Compositæ*, as also Mrs. Lort Phillips's, Dr. Donaldson Smith's, Professor Gregory's, Lord Delamere's, Mr. Een's, and Dr. Rand's, have been described or catalogued elsewhere, either wholly or in part. Mr. Scott Elliot's have, therefore, served as *pièce de résistance* in the present memoir; with them appear descriptions of some new species collected by one or other of the above. The present opportunity has also been taken of intercalating several determinations of *Composite* plants made by me while incorporating into the British Museum herbarium a large number of specimens belonging to this order.

Mr. Scott Elliot's plants are also at Kew, but, except very rarely indeed, I have failed in my search there for specimens referable to the other new species here described.

Bearing in mind the excellent botanical results which have accrued from the labours of travellers in British East Africa, it is to be hoped that this work will not for the future be relegated solely to official hands. Sportsmen and zoological collectors, too, while following their respective bents, might easily take a part in this pleasant and useful task, and so help in keeping the British Museum well supplied.

Tribe VERNONIACEÆ.

HÖHNELIA, *Schweinf.*

H. VERNONIOIDES, *Schweinf.* (Plate 8.)

British East Africa, Guaso Larok and Guaso Laschau; *Dr. J. W. Gregory.*

Professor Ascherson kindly compared a sketch I sent him with the type in Dr. Schweinfurth's herbarium, and was good enough to send me a leaf and a flower-head, at the same time indicating some slight discrepancies in the length of the corolla-lobes and of the style-arms of the two plants. On setting the moistened corollas side by side, I find these differences due to the more advanced state of Dr. Gregory's specimens. In his letter Professor Ascherson further observes that the *Sparganophorus*-like pappus (see Pl. 8. fig. H*e*) does not occur in the type-specimen.

GUTENBERGIA, *Sch. Bip.*

G. RÜPPELLII, *Sch. Bip.*

Machakos; *Dr. S. L. Hinde.*

GUTENBERGIA POLYCEPHALA, *Oliver & Hiern.*
British East Africa, Gopo lal Maru and Ndoro, Leikipia; *Dr. J. W. Gregory.*

ERLANGEA, *Sch. Bip.*

(*Bothriocline*, Oliver; *Stephanolepis*, S. Moore.)

E. SPISSA, sp. nov.; caule valido eximie striato arcte tomentoso deinde pubescente, foliis magnis stricte oppositis petiolatis ellipticis acutis basi cuneatis crenato- vel dentato-serratis supra pubescentibus mox puberulis subtus tomentellis, capitulis pro genere minimis pauciflosculosis ad apicem pedunculorum brevium axillarium vel terminalium arcte tomentosorum densissime aggregatis, involucri subcylindrici phyllis 3–4-seriatis exterioribus oblongo-ovatis obtusis erectis interioribus ovatis acuminatis apice patentibus intimis hæc æquantibus sed quam ea paullo angustioribus omnibus anguste scarioso-marginatis et (intimis exemptis) sursum atratis ibique hispidulis, pappi setis paucis debilibus scabriusculis achænia immatura minima compressa paullo excedentibus vel æquantibus.

Hab. Tropical Africa; *G. F. Scott Elliot,* without locality or number.

Caulis 0·35 cm. diam., angulatus. Foliorum lamina 8·0–10·0 cm. × 3·0–5·0 cm., subtus eminenter nervosa et microscopice glandulosa; petioli ultra 1·0 cm. long., arcte tomentosi. Capitulorum glomeruli fere usque ad 2·0 cm. diam. Capitula modo 0·25 cm. diam. Involucri phylla extima 0·25 cm., reliqua 0·3 cm. long. Achænia immatura 0·05 cm. long.

As far as the foliage is concerned this is much like *E. Schimperi*, var. *tomentosa*, but the inflorescence and capitula are quite different from those of any other known species.

E. SMITHII, sp. nov. Perennis, caule a basi ramoso, ramulis attenuatis patentibus subteretibus pubescentibus copiose foliatis, foliis alternis parvis lanceolatis acutis breviter amplexicaulibus margine undulatis puberulis passim pilosulis glandulis parvis immersis indutis, pedunculis paucis terminalibus vel axillaribus folia excedentibus sub capitulo pubescentibus, capitulis mediocribus multiflosculosis, involucri hemisphærici 5-seriatis phyllis arcte applicatis extimis minimis subulatis intermediis ovatis obtusis trinerviis phyllis seriei 4 comparative elongatis intimis reliqua excedentibus oblongis vel ovato-oblongis obtusis una cum intermediis lamina brevi scariosa onustis, flosculis exsertis, achæniis cylindricis sursum leviter ampliatis 5-costatis obscure puberulis, pappi setis pluribus achænium æquantibus vel paullo excedentibus scabridis.

Hab. North-east Tropical Africa, close to Lake Stéphanie, May 1895; *Dr. Donaldson Smith.*

Specimen unicum ante meos oculos fere semimetralis. Folia 2·5–5·0 cm. × 0·5–1·2 cm., firme membranacea. Pedunculi 6·0–7·0 cm. long., sub capitulo squamis minimis lineari-subulatis instructi. Capitula 1·2 cm. diam. Involucri phylla extima paullo ultra 0·1 cm. long.; intermedia 0·6 cm. et intima 0·8 cm. long. Corollæ 0·7 cm. long., basi attenuatæ, fere glabræ. Achænia vix 0·2 cm. long. Pappi setæ usque ad 0·3 cm. long., sæpe vero breviores.

The small amplexicaul leaves, the solitary medium-sized capitula on long stalks, and the peculiar involucral scales are the chief marks whereby this species can be distinguished from its congeners.

Erlangea brachycalyx, sp. nov.; caule erecto striato puberulo ramos foliatos erectos appresse pubescentes demum puberulos crebro emittente, foliis alternis parvis sessilibus vel subsessilibus lanceolato-oblongis obtusis integris supra scabriusculis subtus cinereo-tomentosis, cymis abbreviatis paucicapitulatis, capitulis parvis pauci-(circa 20-)flosculosis, involucri abbreviati 4-seriatis pubescentis phyllis extimis lanceolato-subulatis, phyllis intermediis ovato-lanceolatis, phyllis interioribus lanceolato-oblongis reliqua excedentibus, phyllis omnibus acutis insigniter uninerviis interioribus sursum pallide purpureis, achæniis minimis subsphæroideis circa 6-costatis costis sat latis intervallis pilis brevibus appressis hispidulis, pappi setis paucis barbellatis.

Hab. Ukamba, Wakilomi; *Dr. J. W. Gregory.*

Folia modice 1·5 cm. × 0·5–0·6 cm., subtus microscopice glandulosa. Capitula 0·6 cm. diam. Involucri phylla extima circa 0·13 cm. long.; intima 0·4 cm. long. Corolla vix 0·5 cm. long., sursum gradatim amplificata, puberula. Achænia 0·08 cm. diam. Pappi setæ 0·1 cm. long.

The small leaves, the short few-headed cymes, the very short involucre, and small hispidulous achenes are the main peculiarities of this plant.

ERLANGEA GREGORII, sp. nov.; caule verisimiliter procumbente subtereti striato ramulos ascendentes foliatos capituliferos hac atque illac emittente, foliis alternis parvis brevipetiolatis oblongo-lanceolatis obtusis vel obtuse acutis basi cuneatis (summis vero sessilibus) margine leviter undulatis supra puberulis subtus brevissime tomentosis et microscopice glandulosis, capitulis parvulis terminalibus brevipedunculatis cymam brevem paucicapitulatam efformantibus campanulatis multiflosculosis, involucri 4-seriatis phyllis lanceolatis acuminatis pubescentibus et ciliatis extimis abbreviatis intimis quam intermedia paullo longioribus, flosculis breviter exsertis, achæniis minimis turbinatis obscure costatis pilosulis, pappi setis paucis abbreviatis barbellatis caducissimis.

Hab. British East Africa, foothills of Kamasia; *Dr. J. W. Gregory.*

Ramuli capituliferi 9·0–12·0 cm. long., appresse pubescentes deinde puberuli. Foliorum lamina 1·5–2·0 cm. × 0·4–0·8 cm.; petioli 0·4–0·7 cm. long. Cymæ 3·0–4·0 cm. long. et circa 3·0 cm. diam. Capitula 0·6 cm. diam. Involucri phylla extima 0·3 cm. intima 0·5 cm. long., homochroma. Corolla 0·5 cm. long., deorsum gradatim attenuata, puberula. Achænia 0·075 cm. long. Pappi setæ inæquales, sæpe achænio breviores raro eo longiores.

Nearest *E. misera*, but different from it in respect of foliage, inflorescence, involucre, and achene.

E. RUWENZORIENSIS, sp. nov.; caule sat valido erecto subtereti manifeste striato puberulo crebro folioso, foliis amplis alternis brevipetiolatis ellipticis cuspidato-acuminatis deorsum in petiolum brevem sensim desinentibus dentato-serratis supra glabris subtus puberulis et glandulis microscopicis immersis instructis tenuiter membranceis in sicco læte viridibus, cymis terminalibus corymbosis multicapitulatis, capitulis parvis anguste campanulatis modice circa 20-flosculosis, involucri puberuli 4-seriatis phyllis ovatis vel ovato-lanceolatis acuminatis extimis paullo brevioribus intimis quam intermedia paullo longioribus membranaceis apice viridibus, flosculis longe exsertis, achæniis cylindricis sursum levissime amplificatis glabris 5-costatis costis prominulis attenuatis, pappi setis paucis attenuatis achænio subæquilongis scabridis.

Hab. Ruwenzori Mountain, 7000–8000 feet; *G. F. Scott Elliot*, no. 7892.

Folia modica 8·0–12·0 cm. × 3·0–4·0 cm.; costæ supra planæ subtus eminentes; petioli 0·5–0·7 cm. long., ima basi amplificati, pubescentes. Capitula 0·5–0·6 cm. diam. Involucri phylla extima 0·2 cm. intima 0·3 cm. long. Corolla circa 0·4 cm. long., inferne paullo angustatæ ibique pilosulæ. Achænia 0·1 cm. long.

A species with much the general appearance of *Erlangea longipes*, but the strictly alternate leaves, the small heads, the narrower and acuminate involucral leaves, &c. render confusion of the two impossible.

Erlangea boranensis, sp. nov.; caule verisimiliter ascendente ramos elongatos se ipsos ramuligeros copiose emittente glabro, ramulis crebro foliosis tenuibus puberulis, foliis alternis parvis brevipetiolatis anguste oblongis obtusis supra fere omnino glabris subtus minute sericeo-tomentosis, capitulis parvis subsphæroideis multiflosculosis solitariis ex axillis superioribus oriundis vel in cymam terminalem perpaucicapitulatam digestis, pedunculis tenuibus folia subæquantibus, involucri phyllis 5–6-seriatis ovato-oblongis obtusis extimis parvulis acutis vel acuminatis reliquis gradatim majoribus viridibus trinerviis margine lamina scariosa lacerata onustis obscure puberulis, achæniis minutis turbinato-subsphæroideis 5-costatis et inter costas rugulosis, pappi setis paucis achænium excedentibus barbellatis caducissimis.

Hab. North-east Tropical Africa, Boran, April 1895; *Dr. Donaldson Smith.*

Folia modica 1·5–3·0 cm. × 0·5–0·7 cm., præsertim ex ramulis abbreviatis orta. Pedunculi circa 1·5 cm. long. Capitula 0·7 cm. diam. Involucri phylla extima 0·2 cm. long.; phylla ser. III. vix 0·35 cm. et intima 0·5 cm. long. Achænia 0·1 cm. long., vix totidem lat. Pappi setæ 0·2–0·3 cm. long.

The affinity of this species is with *E. marginata* and *E. cordifolia*; the habit, the small leaves, the few very effuse capitula, the lacerate involucral scales, and rugulose achenes are its chief characteristics.

E. marginata (*Vernonia marginata*, Oliver & Hiern; *Bothriocline marginata*, O. Hoffm.), var. depauperata (var. nov.). Folia parva, nempe 2·0 cm. × 0·6–0·8 cm. Capitula pauca. Involucri 5-seriatis phylla quam ea typi paullo angustiora necnon acutiora.

Ukamba, 5000–6000 feet; *G. F. Scott Elliot*, no. 6473.

Erlangea calycina, sp. nov.; caule erecto angulato sursum folioso piloso-pubescente, foliis alternis sessilibus lanceolato-oblongis acutis vel obtusis serrulatis undulatisve sericeo-villosis demum pubescentibus, pedunculis quam folia brevioribus monocephalis pubescentibus, capitulis pro genere magnis multiflosculosis flosculis involucrum haud excedentibus, involucri sericei 3–4-seriatis phyllis magnis foliaceis lanceolatis vel oblanceolatis acutis acuminatisve, achæniis turbinato-cylindricis 5-costatis glabris, pappi setis paucis inter se subæquilongis achænio brevioribus barbellatis.

Hab. British East Africa, Malewa River, 1893; *Dr. J. W. Gregory*. Machakos; *G. F. Scott Elliot*, nos. 6381, 6418, 6538.

Caulis usque ad 25·0 cm. alt., ramulos paucos erectos sericeos emittens. Folia modica 4·5–5·0 cm. × 1·0–1·2 cm., approximata, firme membranacea. Pedunculi 3·0–3·5 cm. long., sat validi. Involucri phylla omnia 1·5–2·0 cm. long. et 0·3–0·5 cm. lat. Corolla 0·7 cm. long., tubo dimidio inferiore attenuato, juxta medium subito dilatato, pilis brevissimis glandulosis obsito. Achænia paullo ultra 0·2 cm. long., pallida. Pappi setæ circa 0·13 cm. long.

The silky leaves, large solitary capitula, and foliaceous involucre are the chief peculiarities of this remarkable species.

The genus *Erlangea* was proposed in 1853 by Schultz Bipontinus for the reception of a plant (*E. plumosa*, Sch. Bip.) collected by E. Jardin in the Gaboon region. The type was examined by Mr. Bentham when working at the *Compositæ* for the 'Genera Plantarum,' and by Professor Oliver and Mr. Hiern in the course of their joint study of African *Compositæ* for the 'Flora of Tropical Africa.' A short time before this, Professor Oliver had described in the 'Icones Plantarum' (tab. 1133) the remarkable plant called by him *Bothriocline Schimperi*, the chief points about which were its possession of opposite leaves and extremely small achenes crowned with a caducous pappus consisting of a very few short scabrous setæ. The same achenes and pappus were known to be possessed by three other plants referred in the 'Flora of Tropical Africa' to *Vernonia*, viz., *V. misera*, Oliver & Hiern, *V. Moramballæ*, Oliver & Hiern, and *V. marginata*, Oliver & Hiern. Later on, Dr. Hoffmann, disregarding the opposition of the leaves as a valid generic character for *Bothriocline*—and, I think correctly, remembering that *V. oppositifolia*, Less., is considered by everyone to be a true *Vernonia*—removed these three species to *Bothriocline.* That this step was justified is proved by the subsequent discovery of an undoubted *Bothriocline* (*B. laxa*, N. E. Br.) with leaves both opposite and alternate. Moreover, Mr. Hiern himself (Cat. Welw. Plants, iii. p. 516) has assented to Dr. Hoffmann's proposal.

This leaves as the only point of distinction between *Bothriocline* and *Erlangea* the scabrous, or at most shortly barbellate, setæ of the former and the latter's alleged "shortly plumose" setæ. As it had become advisable to ascertain the value of this alleged difference, I, on the friendly hint of M. Jules Poisson, applied to M. Barratte, conservator of the Cosson herbarium in Paris, for a flowering head, or at least a few setæ from the pappus of *Erlangea plumosa.* The type of this consisting of but a single specimen with only one capitulum, M. Barratte was, of course, unable to comply with my larger request; but he very kindly sent me four setæ from the pappus. These I have carefully examined, and I find that instead of being "shortly plumose," the said setæ are only barbellate; and the same remark applies to a second species of *Erlangea* (*E. Schinzii*, O. Hoffm.), of which there is a fine example at the British Museum. In fact one finds in the pappus of *Bothriocline* and *Erlangea* a complete series ranging between scabrid setæ on the one hand and barbellate setæ on the other, just as one finds in *Vernonia* itself, although there are species of *Vernonia* with pappus-setæ even more strongly barbellate than are those of *E. plumosa* and *E. Schinzii.* Under these circumstances, it is clear that the two genera can no longer be kept apart, and, as *Erlangea* has the priority, that *Bothriocline* must disappear.

My own genus *Stephanolepis* (Journ. Bot. xxxviii. 1900, p. 153) must also be suppressed. At the time of proposing it, I held the original view about *Bothriocline*, which I was disposed to restrict to species having numerous smallish cymose capitula, and opposite or opposite and alternate leaves, while the other species referred to the genus by Dr. Hoffmann should either, I thought, be removed back to *Vernonia* or constitute a genus by themselves. But on reflection this was seen to involve the creation of too many genera.

I may add that Dr. Kunze, while pointing out (Rev. Gen. Pl. pars ii. p. 348) that *Erlangea plumosa* was first called by Schultz

Jardinia plumosa, which name became valid when Steudel's similar name was sunk, has overlooked the important fact that *Jardinia plumosa*, Sch. Bip., was only a *nomen nudum* until it was printed as a synonym at the end of Schultz's description of *Erlangea plumosa*. *Erlangea* is therefore the proper name to use here.

Consolidated as above suggested, the genus may be arranged in the following way:—

Erlangearum Clavis.

§ *Bothriocline*. Folia opposita vel et opposita et alterna. (*E. laxa, longipes, Schimperi, spissa.*)

§ *Stephanolepis*. Folia alterna. Involucri phylla omnia vel saltem aliqua appendice terminali coronata. (*E. centauroides, Smithii.*)

§ *Eu-Erlangea*. Folia alterna. Involucri phylla acuta, haud vel summum brevissime scarioso-marginata. (*E. alternifolia, brachycalyx, Gregorii, misera, Moramballæ, pauciseta, plumosa, ruwenzoriensis, Schinzii.*)

§ *Platylepis*. Folia alterna. Involucri phylla obtusa vel apiculata, omnia vel saltem interiora late scarioso-marginata. (*E. boranensis, cordifolia, marginata.*)

§ *Phyllocalyx*. Folia alterna. Involucri phylla foliacea. (*E. calycina.*)

The synonyms are as follow:—

E. laxa=*Bothriocline laxa*, N. E. Br.

E. longipes=*Bothriocline longipes*, N. E. Br.

E. Schimperi=*Bothriocline Schimperi*, Oliver & Hiern.

E. centauroides=*Stephanolepis centauroides*, S. Moore.

E. alternifolia=*Bothriocline alternifolia*, O. Hoffm.

E. misera=*Vernonia misera*, Oliver & Hiern. *Bothriocline misera*, O. Hoffm.

E. Moramballæ=*Vernonia Moramballæ*, Oliver & Hiern. *Bothriocline Moramballæ*, O. Hoffm.

E. pauciseta=*Bothriocline pauciseta*, O. Hoffm.

E. cordifolia=*Gutenbergia cordifolia* *, Oliver & Hiern. *Bothriocline diversifolia*, O. Hoffm.

E. marginata=*Vernonia marginata*, Oliver & Hiern. *Bothriocline marginata*, O. Hoffm.

* A note of Mr. N. E. Brown's in the Kew Herbarium drew my attention to this. Dr. Hoffmann's plant is certainly the same as the one called *Gutenbergia cordifolia* in Oliver's 'Flora of Tropical Africa.'

VERNONIA, *Schreb.*

§ *Lepidella.*

V. CISTIFOLIA, *O. Hoffm.*, var. ROSEA, *O. Hoffm.*
Nyassaland; *Buchanan*, no. 219 of 1895 collection.

V. HOLSTII, *O. Hoffm.*
Nyassaland; *Buchanan*, no. 104 of 1895 collection.

V. HOFFMANNIANA, *S. Moore.*
Neighbourhood of the Albert Edward Nyanza; *G. F. Scott Elliot*, no. 8030.

V. POSKEANA, *Vatke & Hildebr.*
Shiré; *G. F. Scott Elliot*, no. 8452.
Var. CHLOROLEPIS.
Hab. Damaraland; *T. G. Een.*

V. AMPLEXICAULIS, *Baker.*
Somaliland, Laskarato; *Dr. Donaldson Smith.*

V. PETERSII, *Oliver & Hiern.*
Lukoma (Likoma?), Lake Nyassa; *Wm. Bellingham.*

V. STAHELINOIDES, *Harv.*
Transvaal, Pretoria and Houtbosch; *Dr. A. Rehmann*, nos. 4057 & 6159.
Heads in a very young state, but identification certain.

V. DEMULANS, *Vatke.*
Rabai Hills, Mombasa; *Rev. W. E. Taylor.*

V. UGANDENSIS, sp. nov.; caule erecto sursum ramoso pubescente, foliis sessilibus lanceolato-oblongis obtusis acutisve basi leviter angustatis radicalibus deorsum cuneatim angustatis integris adpresse puberulis deinde glabris, capitulis mediocribus plurifloscuIosis ramulos sæpissime solitatim binatimve coronantibus brevipedunculatis, involucri late campanulati pubescentis 5-seriatis phyllis anguste lineari-lanceolatis exterioribus subæquilongis intimis quam reliqua paullo longioribus omnibus longe acuminatis sursum viridibus, achæniis cylindricis 4-costatis appresse (præsertim basi) setulosis costis glabris intervallis latis glandulis sessilibus dense obsitis, pappi albidi squamis lineari-lanceolatis breviter acuminatis setis scabridis achænia bene excedentibus.

Hab. Uganda; *G. F. Scott Elliot* no. 7396.

Folia 1·5–3·0 cm. long., 0·5–0·8 cm. lat., sparsa, membranacea, Involucri phylla exteriora 0·7–0·8 cm. intima vix 1·0 cm. long. Corollæ circa 0·7 cm. long., obscure puberula; harum limbi lobi apice setulosi. Achænia fusca, 0·2 cm. long. Pappi squamæ usque ad 0·15 cm. setæ 0·4–0·7 cm. long.

Near *Vernonia demulans*, Vatke, which has decidedly smaller heads, much shorter and less acuminate involucral leaves (the outermost of which are reduced in size and subulate), &c.

Vernonia Elliotii, sp. nov. Fruticosa, caule verisimiliter erecto tereti in longitudinem striato minute pubescente deinde glabrescente, foliis subsessilibus oblongo-ovatis acutis vel obtusis margine undulatis subcoriaceis supra scabridulis subtus nervis eminentibus reticulatim percursis ibique crasse pubescentibus, capitulis dense corymbosis subparvis breviter pedunculatis campanulatis pluri-(circa 18-)flosculosis puberulis, involucri circa 6-seriatis phyllis extimis parvis subulatis acutis sursum patentibus reliquis oblongo-lanceolatis acutis intimis intermedia excedentibus sursum purpureis, achæniis cylindricis basi paullulum angustatis 5-costatis puberulis necnon minute nitenti-glandulosis, pappi sordide albi squamis lineari-lanceolatis abbreviatis setis scabridis squamas multoties excedentibus.

Hab. British East Africa, Mau at 8000 feet; *G. F. Scott Elliot*, no. 6920.

Caulis 0·2–0·3 cm. diam., intervallis 1·0–3·0 cm. long. foliiferus. Folia 4·0–5·5 cm. long., plerumque 1·5–2·0 cm. lat.; petioli 0·2 cm. long., pubescentes. Corymbi usque ad 12·0 cm. diam. Pedunculi usque ad 1·0 cm. long., plurimi vero minores, minute pubescentes. Capitula 0·8 cm. long., juxta medium 0·5 cm. lat. Involucri phylla extima circa 0·15 cm., intermedia 0·45 cm., intima 0·7 cm. long. Flosculi 0·65 cm. long. Achænia vix 0·3 cm. long., pallida. Pappi squamæ 0·04 cm. setæ circa 1·0 cm. long.

To be compared with *V. Hochstetteri*, Sch. Bip., from which the differently shaped subcoriaceous subsessile leaves with their short coarse crowded hairs, the puberulous involucre, and the different achenes serve as admirable points of distinction.

V. viatorum, sp. nov. Herba humilis, caule attenuato ascendente puberulo sparsim ramoso, foliis sparsis parvis sessilibus lineari-spathulatis obtusissimis puberulis, capitulis subparvis ovoideis pluri-(circa 20-)flosculosis pedunculis tenuibus elongatis terminalibus vel ex axillis superioribus oriundis fultis, involucri 4-seriatis pubescentis a flosculis bene superati phyllis lanceolato-oblongis obtuse acutis extimis brevibus intimis elongatis pallidis sursum fuscescentibus, achæniis nondum maturis parvis turbinatis 5-costatis inter costas papillis parvis albis dense obsitis, pappi sordide albi sursum pallide purpurascentis squamis linearibus setis barbellatis squamas plus quam duplo excedentibus.

Hab. Nyassaland, Stevenson Road; *G. F. Scott Elliot*, no. 8271.

Planta ex specimine unico meos ante oculos 12·0 cm. alt. Rami vix 0·1 cm. diam., angulati. Folia 1·0–1·5 cm. long. Pedunculi 3·0 cm. attingentes, puberuli. Capitula circa 0·7 cm. long., 0·6 cm. lat. Involucri phylla extima 0·2 cm. intermedia circa 0·4 cm. intima 0·55 cm. long. Flosculi circa 0·7 cm. long., puberuli; limbi lobi infra apicem hirsutuli. Achænia paullo ultra 0·1 cm. long. Pappi squamæ 0·13 cm. et setæ 0·3 cm. long.

The chief peculiarities of this species are the lowly habit, slender branches, small scattered narrowly spathulate leaves, ovoid heads, and barbellate pappus.

§ *Tephrodes.*

VERNONIA NATALENSIS, *Sch. Bip.*

Ukambane; *G. F. Scott Elliot*, no. 6465. Pilgrim's Rest Goldfields; *Rev. W. Greenstock.* Pretoria; *Dr. A. Rehmann*, no. 4064.

V. CALYCULATA, sp. nov. Elata, caule erecto striato minute pubescente vel puberulo, ramulis crebro foliosis gracilibus, foliis sessilibus linearibus vel anguste lineari-lanceolatis apice mucronulatis integerrimis supra puberulis mox glabris subtus albide sericeo-tomentosis, capitulis parvis ad apicem ramulorum laxe corymbosis campanulatis pauci- (circa 10-) flosculosis, involucri insigniter abbreviati 4-seriatis pubescentis phyllis perpaucis inter se subæquilongis extimis lanceolato-subulatis intermediis ovatis una cum intimis oblongis breviter apiculatis sub apice minute serrulatis ibique purpurascentibus ceteroquin viridibus, achæniis cylindrico-turbinatis obscure costatis dense pubescentibus, pappi setis exterioribus paucis quam interiores albo-sericeas multo brevioribus.—*V. natalensis*, Sch. Bip., *var.*, Britten, in Trans. Linn. Soc. ser. 2, Bot. iv. (1894) p. 18.

Hab. Nyassaland, Mount Milangi; *A. Whyte.* Shiré; *G. F. Scott Elliot*, no. 8471.

Folia 6·0 cm. × 0·6 cm. attingentia, modica vero 2·0–3·0 long., 0·1–0·2 cm. lat., marginibus revolutis. Involucra vix 0·3 cm. long., et totidem diam.; phylla extima 0·18 cm. reliqua 0·25 cm. long., uninervia. Flosculi 0·5 cm. long., extus puberuli. Achænia fere 0·2 cm. long., 0·05 cm. lat. Pappi setæ exteriores 0·1–0·15 cm. interiores 0·4 cm. long.

Distinguished from *Vernonia natalensis*, Sch. Bip., by *inter alia* the narrower leaves, the remarkably short involucre, and the achenes with a shorter pappus.

VERNONIA KRAUSSII, *Sch. Bip.*

Transvaal, Pretoria; *Dr. A. Rehmann*, no. 4450. Orange River Colony, Reitfontein; *Id.* no. 3692.

V. HIRSUTA, *Sch. Bip.*

Transvaal, Pilgrim's Rest; *Rev. W. Greenstock.* Pretoria; *Dr. A. Rehmann*, no. 4457.

§ *Cyanopis.*

V. LEOPOLDI, *Vatke.*

Somaliland, Sheik Mahomet; *Dr. Donaldson Smith.*

V. ASTERIFOLIA, *Baker.*

Nandi, 6-7000 feet; *G. F. Scott Elliot*, no. 6695.

V. NESTOR, sp. nov. Fruticosa, erecta, rigida, sursum ramosa, ramis rigidis una cum caule crebro foliosis, caule valido subtereti striato dense sericeo-hirsuto deinde pubescente, foliis approximatis oblongo-lanceolatis acutis sessilibus basibus leviter amplexicaulibus supra necnon subtus dense sericeo-hirsutis demum pagina superiore pilorum delapsu scabridulis, capitulis dense corymbosis mediocribus obovoideis multiflosculosis, involucri pubescentis 6-seriatis phyllis extimis anguste lineari-lanceolatis acuminatis reliquis lineari-lanceolatis apiculato-acuminatis viridescentibus apice sæpe leviter purpurascentibus, achæniis subcylindricis obscure 5-costatis pubescentibus, pappi albidi setis exterioribus brevibus interioribus scabridis exteriores longe excedentibus.

Hab. Nyassaland; *Buchanan*, 1891, no. 44; 1895, no. 129.

Caulis 0·4–0·5 cm. diam. Folia modica 3·5–4·0 cm. long., 0·9–1·2 cm. lat., juniora vero multo minora sc. 1·0–1·5 cm. long., 0·5–0·6 cm. lat. Capitula fere 1·5 cm. long., sursum 1·0 cm. lat.

Involucri phylla extima 0·4 cm. intermedia 0·8 cm. intima 1·0 cm. long. Flosculi 0·8 cm. long., extus puberuli. Achænia 0·25 cm. long., pallida. Pappi setæ exteriores 0·12 cm. interiores 0·65–0·7 cm. long.

A plant of very distinct appearance. The rigid habit, indumentum, amplexicaul leaves, narrow hairy involucral leaves, and pubescent achenes are its chief characteristics among its fellows of the section.

Vernonia milanjiana, sp. nov.; caulibus brevissimis e rhizomate sat crasso ortis, foliis congestis sessilibus vel subsessilibus obovatis vel obovato-oblongis nonnunquam oblongo-oblanceolatis nunc acutis nunc obtusis nunc obtusissimis deorsum sæpissime longe attenuatis raro obtusis dimidiorum superiorum marginibus dentatis vel denticulatis vel solummodo undulatis ceteroquin integris utrinque puberulis tenuiter membranaceis in sicco viridibus, scapo folia excedente rarissime bracteato ascendente sursum arcte et breviter pubescente capitulas paucas vel paupercas minusculas corymbosas brevipedunculatas circa 25-flosculosas gerente, involucri campanulati puberuli phyllis 3-seriatis extimis lineari-lanceolatis quam reliqua oblonga brevioribus omnibus brevissime acuminatis, flosculis involucrum bene superantibus, achæniis nondum maturis cylindricis 5-costatis setulosis, pappi sordide albi setis 2-seriatis scabridis exterioribus quam interiores multo longioribus.

Hab. Mount Milanji, 1891; *A. Whyte*, no. 194.

Rhizoma circa 0·5 cm. diam., sparsim fibrosum. Caulis modo 0·3–0·4 cm. alt. Folia 5·0–9·0 cm. long., juxta medium 1·2–4·0 cm. lat.; costa centralis supra plana subtus eminens; petiolus summum 0·2–0·4 cm. long. Scapus 10·0–20·0 cm. alt., bracteis 1–2 anguste linearibus vel setaceis 0·5–2·0 cm. long., et 0·1 cm. lat. (rarissime fere 3·0 cm. long. et 0·25 cm. lat.) onustis. Pedunculi sæpissime 0·3–1·0 cm. long., pubescentes, 1–2-bracteati vel nudi. Capitula expansa 1·2 cm. long., 1·0 cm. diam. Involucri 0·6 cm. long. phylla extima 0·35 cm. long., 0·08 cm. lat.; phylla reliqua 0·4–0·45 cm. long. (intima quam intermedia paullulum longiora) et 0·13 cm. lat. Corollæ purpureæ, obscure puberulæ, 0·6 cm. long. Achænia vix 0·2 cm. long. Pappi setæ exteriores 0·03 cm. interiores circa 0·5 cm. long.

Easily distinguished by means of the usually broad, thin, almost rosulate leaves, the scapes with few smallish heads, and the relatively short involucre of few leaves.

VERNONIA MIGEODI, sp. nov. Herbacea, elata, caule subtereti ramoso eleganter striato mox fere omnino glabro, foliis sparsis sessilibus ovatis obtusis basi amplexicaulibus integris glabris, capitulis subparvis ad apicem ramulorum laxe corymbosis late campanulatis circa 18-flosculosis, involucri puberuli 5-seriatis phyllis extimis minimis late subulatis acutis reliquis oblongis mucronulatis trinervibus sursum atro-purpureis intimis elongatis, achæniis parvis late turbinatis 5-costatis costis latis et valleculis angustissimis sejunctis griseis glabris, pappi setis exterioribus interioribus scabridulis manifeste brevioribus.

Hab. Nigeria, Lokoja or Abbeokuta; *J. H. Migeod.*

Folia 2·0–3·5 cm. long., usque ad 1·5 cm. lat., tenuiter membranacea. Capitula 0·7 cm. long., vix totidem lat. Involucri phylla extima 0·15 cm. intermedia 0·3 cm. intima 0·6 cm. long. Achænia 0·12 cm. long. Pappi setæ exteriores 0·3 cm. interiores 0·6 cm. long.

A species of familiar appearance, which, however, I have been unable to match at the British Museum or at Kew or from published descriptions of *Vernonias* not in this country. At a first glance it reminds one of *V. plumbaginifolia*, Fenzl, but the nearly glabrous condition, the differently shaped amplexicaul leaves, the broadly turbinate glabrous achenes, and the longer outer setæ of the pappus are characters by which the two can be easily distinguished.

§ *Xipholepis.*

V. FASTIGIATA, *Oliver & Hiern.* (*V. Schinzii*, O. Hoffm.)

Damaraland; *T. G. Een.* Transvaal, Makapansberg; *Dr. A. Rehmann*, no. 5452.

§ *Decaneuron.*

V. AMYGDALINA, *Delile.*

Kavirondo, 4–5000 feet; *G. F. Scott Elliot*, no. 7020. Ruwenzori Mountain, 5–6000 feet; *Id.* no. 7840.

V. GLABRA, *Vatke.*

Shiré; *G. F. Scott Elliot*, no. 8963. Tanganyika; *Id.* no. 8320. Zambesiland in sandy soil; *R. Webb.* British Central Africa; *A. Blayney Perceval.* Between Zanzibar and Uyui; *Rev. W. E. Taylor.*

§ *Stengelia.*

VERNONIA MASAIENSIS, sp. nov. Elata, caule folioso striato-pubescente, foliis majusculis brevipetiolatis ellipticis acutis vel cuspidulato-acuminatis basi obliquis necnon cuneatim angustatis margine dentatis supra scabriusculis subtus pallidioribus et præsertim in nervos eleganter reticulatos pubescentibus, capitulis submediocribus corymbosis campanulatis brevipedunculatis, involucri glabri 5–6-seriatis phyllis exterioribus abbreviatis puberulis (reliquis glabris) extimis lanceolatis serr. II. & III. ovatis acutis interioribus oblongis vel lineari-oblongis et appendice parva brunnea acuta coronatis omnibus pallide virescentibus et uninervibus, achæniis immaturis anguste cylindricis 5-costatis puberulis, pappi straminei setis exterioribus abbreviatis aliquantulo ampliatis interioribus scabriusculis.

Hab. Masailand, 7–8000 feet; *G. F. Scott Elliot*, no. 6780.

Folia 7·0–12·0 cm. long., 3·5–6·0 cm. lat.; petioli circa 0·6–0·9 cm. long., pubescentes. Involucrum 0·6 cm. long., 0·7 cm. lat.; phylla exteriora 0·2–0·3 cm. interiora 0·5–0·6 cm. long. Achænia 0·23 cm. long., 0·04 cm. lat. Pappi setæ exteriores vix 0·1 cm. interiores 0·6 cm. long.

A plant with much superficial resemblance to *V. Holstii*, O. Hoffm., which, however, is a member of another section. Its nearest congener is undoubtedly *V. abyssinica*, Sch. Bip., from which it differs entirely in leaf and in many other details.

V. ABYSSINICA, *Sch. Bip.*
Somaliland, near Lake Marsabit; *Lord Delamere.*

V. KOTSCHYANA, *Sch. Bip.*
Somaliland, Sheik Mahomet; *Dr. Donaldson Smith.*

V. OXYURA, *O. Hoffm.*
East Equatorial Africa; *Rev. W. E. Taylor.*

V. CIRRIFERA, sp. nov. Erecta, elata, caule lignoso valido dense ac minute fulvo-velutino sat crebro folioso, foliis anguste ellipticis apice pungentibus basi parum attenuatis margine crispe undulatis et distanter calloso-denticulatis supra scabridis subtus præsertim in nervos eminentes fulvo-pubescentibus petiolis brevibus robustis pubescentibus fultis, capitulis mediocribus laxe corymbosis late campanulatis multiflosculosis, involucri abbreviati a flosculis bene superati 5-seriatis puberuli phyllis ovatis apice in cuspidem lanceolatam longe acuminatam viridem desinentibus marginibus integerrimis intimis obtusissimis (sc. cuspide orbis) et margine angustissimo scarioso onustis, achæniis anguste cylindrico-turbinatis inconspicue 5-costatis glandulosis, pappi saturate straminei setis achænia longe excedentibus scabridis.

Hab. Nyassaland; *J. Buchanan*, no. 370 of 1895 collection.

Caulis circa 0·6 cm. diam., obscure striatus, deinde eminenter lenticellifer. Folia usque ad 15·0 cm. long. et 7·0 cm. lat.; summa 8·0 cm. long., in sicco subtus pallidiora. Corymbus circa 18·0 cm. diam. Pedunculi fulvo-velutini, modici 1·5–2·0 cm. long., bracteolis paucis parvis angustissimis onusti. Involucri 0·7 cm. long. et 1·0 cm. diam. phylla extima vix 0·4 cm. intermedia 0·5 cm. long., hæc summum fere 0·3 cm. lat., phyllorum ext. et intermed. cuspides patentes, phylla intima 0·5 cm. long. Corollæ 0·8 cm. long., extus puberuli. Achænia 0·3 cm. pappi setæ 0·8 cm. long.

Apparently near *Vernonia oxyura*, O. Hoffm., but very different from it in many respects.

VERNONIA RUWENZORIENSIS, sp. nov.; caule valido crasse fulvo-pubescente demum glabrescente, foliis ovato-oblongis obtusis margine denticulatis deorsum in petiolum anguste alatum sensim coarctatis supra pubescentibus mox scabriusculo-puberulis subtus præsertim in nervos eminentes pubescentibus, capitulis mediocribus dense corymbosis subsphæroideis multiflosculosis, involucri glabri 5-seriatis phyllis extimis lineari-subulatis seriei II. lineari-lanceolatis reliquis oblongis et præsertim seriei III. appendice oblonga obtusa vel acuminata scariosa pallide brunnea onustis, achæniis anguste cylindricis 10-costatis puberulis fuscis basi callosis, pappi straminei setis exterioribus paucis quam interiores scabriusculas apice leviter dilatatas multo brevioribus.

Hab. Ruwenzori Mountain, 6–8000 feet; *G. F. Scott Elliot*, no. 7673.

Folia 6·0–10·0 cm. longa, 2·5–4·0 cm. lat., firme membranacea, subtus pallidiora; petioli circa 1·0–2·0 cm. long., pubescentes, horum alæ undulatæ. Involucri 1·2 cm. long. et lat. phylla extima 0·6 cm. seriei II. 0·7 cm. seriei III. 0·5 cm. cum appendice 1·0 cm. long., hæc 0·2–0·3 cm. lat., phylla interiora (appendice brevi inclusa) 1·0–1·2 cm. long. Corolla 1·5 cm. long.; tubus angustissimus, minute glandulosus. Achænia 0·3 cm. long., 0·08 cm. lat. Pappi setæ exteriores circa 0·3–0·5 cm. interiores fere 1·0 cm. long.

Var. GLABRA. Caulis glaber vel summum puberulus. Folia omnino glabra.

Hab. Ruwenzori Mountain; *G. F. Scott Elliot*, no. 7679.

The comparatively small densely clustered heads, the small achenes, and long setæ of the pappus are the chief characteristics of this plant.

VERNONIA PROLIXA, sp. nov.; caule ascendente fere a basi ramoso tereti sulcato minute fulvo-tomentoso deinde pubescente, foliis paucis sparsis sessilibus anguste oblongo-linearibus utrobique obtusis distanter denticulatis integrisve coriaceis supra glabris in sicco fuscis nec nitidis subtus fulvo-tomentosis, capitulis mediocribus in paniculis laxis paucicapitulatis caulem vel ramulos terminantibus dispositis, involucri subglobosi phyllis 4-seriatis exterioribus ovatis quam interiora (sc. serr. III. et IV.) oblonga manifeste brevioribus omnibus appendice brevissima griseo-pubescente coronatis ceterum glabris et chartaceis et brunneis, corollis involucrum bene excedentibus, achæniis cylindricis 8-striatis fulvo-pubescentibus, pappi involucrum superantis straminei setis subsquamiformibus 2-seriatis exterioribus quam interiores apice anguste lineari-spathulatæ scabridæ multo brevioribus.

Hab. Urundi; *G. F. Scott Elliot*, no. 8383.

Planta circa semimetralis. Folia fere usque ad 10·0 cm. long., 0·8–1·0 cm. lat., subtus eminenter reticulata. Pedunculi 1·5–6·0 cm. long., nudi, ipso sub capitulo aliquantulum dilatati, fulvo-tomentosi. Involucrum 1·0 cm. long., tantundem vel paullo ultra diam.; phylla extima 0·4 cm. intima 0·8 cm. long. Corollæ purpureæ. Achænia 0·4 cm., pappi setæ exteriores 0·2 cm. interiores 0·7 cm. long.

Not very like any of its fellow-members of § *Stengelia*; this may be distinguished by its prolix habit, narrow leaves tomentose below, and the long-stalked short involucres.

I have seen the lower part of a corolla of this plant at Kew (there is not even that in the case of the Museum specimen), but there can be no doubt as to the genus.

V. HOMILOCEPHALA, sp. nov.; caule crebro folioso minute ac elegantissime fusco-velutino deinde puberulo, foliis oblanceolato-oblongis acutis margine denticulatis deorsum sensim angustatis supra fere glabris subtus dense pubescentibus necnon in nervum medianum minute rufido-velutinis petiolis velutinis fultis, capitulis submediocribus multiflosculosis dense aggregatis subsphæroideis, involucri puberuli circa 7-seriatis phyllis subscariosis pallide viridibus exterioribus anguste linearibus appendice lineari elongata onustis phyllis interioribus oblongis et appendice lanceolata vel lanceolato-oblonga papyracea pallida coronatis, achæniis subcylindricis eleganter multicostatis nigerrimis nitentibus fere omnino glabris, pappi straminei setis scabriusculis.

Hab. Mau, 7000 feet; *G. F. Scott Elliot*, no. 7058.

Folia 4·5–6·0 cm. long., 1·5–2·0 cm. lat., firme membranacea; petioli 0·5–1·0 cm. long., supra canaliculati. Capitulorum glomeruli 4·0–5·0 cm. diam. Involucra 1·2 cm. long. et lat.; phylla exteriora 0·5–0·6 cm. intermedia usque ad 1·1 cm. intima 0·9 cm. long. Corollæ circa 1·0 cm. long. Achænia vix 0·3 cm. long. Pappi setæ 0·8 cm. long., apice parum amplificatæ, adjectis paucis parvis exterioribus brevioribus.

Allied to *Vernonia ruwenzoriensis*, S. Moore, but differing in the clothing of the stem, the shape and indumentum of the leaf, the shape of the appendages to the involucral leaves, and the broader very dark and shining many-ribbed achenes.

VERNONIA PUMILA, *Kotschy & Peyr.*

Nandi; *G. F. Scott Elliot*, no. 7037.

V. NANDENSIS, sp. nov. Humilis acaulis foliis radicalibus sessilibus oblanceolatis obtusis margine undulato-denticulatis glabris e rhizomate crasso fusco-lanato oriundis, pedunculis folia excedentibus vel subæquantibus monocephalis striatis juxta apicem minute pubescentibus ceterum glabris, capitulis magnis late campanulatis multiflosculosis, involucri glabri 4-seriatis phyllis oblongo-lanceolatis acuminatis margine minute ciliatis intimis abbreviatis et appendice lanceolata acuminata scariosa coronatis (reliquorum appendice viridi), achæniis subcylindricis basi aliquantulo angustatis 10-costatis setulosis, pappi straminei setis scabriusculis apice nequaquam dilatatis adjectis paucis exterioribus brevioribus.

Hab. Nandi, 7000 feet; *G. F. Scott Elliot*, no. 7032.

Rhizoma 1·5 cm. crassum. Folia 6·0–8·0 cm. long., 1·0 cm. lat., firme membranacea, nervus centralis latus, subtus prominens. Pedunculus 4·5–15·0 cm. long., erectus. Capitula 2·0 cm. long., 3·0 cm. diam. Involucri phylla extima 0·8–1·0 cm. intermedia 1·2 cm. intima (cum appendice) 1·6 cm. long. Achænia usque ad 0·8 cm. long., sursum 0·2 cm. diam. Pappi setæ usque 1·3 cm. long., exteriores circa 0·7 cm. long.

Allied to *Vernonia pumila*, Kotschy & Peyr., but well distinguished by reason of the leaves being contemporaneous with the flowers, the one-headed peduncles, larger heads, longer involucral scales, longer and broader achenes, and pappus-setæ without an apical dilatation. *V. macrocyanus*, O.Hoffm., has much larger heads, more lengthily acuminate involucral leaves, and quite different achenes.

VERNONIA PERPARVA, sp. nov. Acaulis, aphylla ?, capitulis majusculis sessilibus e rhizomate dense fusco-lanato solitatim oriundis campanulatis multiflosculosis, involucri 4-seriatis phyllis lanceolato-oblongis appendice scariosa atro-purpurea dorso pilosula onustis, achæniis stricte cylindricis 8-costatis setulosis pallidis, pappi straminei setis scabriusculis sursum haud dilatatis.

Hab. Dry hills at Karagwe, 4–5000 feet; *G. F. Scott Elliot*, no. 8123.

Capitula 1·5 cm. long., 2·2 cm. diam. Involucri phylla extima circa 0·5 cm. intermedia 0·8 cm. intima 1·1 cm. long. Corollæ 1·0 cm. long., extus minute glandulosæ. Achænia 0·4 cm. long., 0·12 cm. lat. Pappi setæ 1·0 cm. long.

Allied to the species just described, which has leaves at the time of flowering, larger stalked heads, different appendages to the involucral leaves, and larger achenes narrowed below. It is also very close to *V. chthonocephala*, O. Hoffm., differing from it chiefly in the markedly narrower heads, the fewer and broader involucral leaves, and the longer achenes.

This species and the one preceding it would be referred to § *Lachnorhiza* by those who follow Dr. Hoffmann's classification of the genus.

V. TENOREANA, *Oliver*.

Hab. Neighbourhood of Albert Edward Nyanza; *G. F. Scott Elliot*, no. 8028.

§ *Strobocalyx*.

V. GLABERRIMA, *Vatke*.

Hab. Nyassaland; *Buchanan*, no. 27 of 1895 collection. Ruwenzori Mountain, 5–6000 feet; *G. F. Scott Elliot*, no. 8277.

VERNONIA SUBULIGERA, *O. Hoffm.* (ex descript.).

East Equatorial Africa; *Rev. W. E. Taylor.* Masai Highlands, 6000 feet; *G. F. Scott Elliot*, no. 6762.

These specimens agree excellently with Dr. Hoffmann's description.

V. PODOCOMA, *Sch. Bip. ex Oliver & Hiern, in Fl. Trop. Afr.* iii. p. 296.

Ruwenzori Mountain, 8000 feet; *G. F. Scott Elliot*, no. 7633.

Tribe ASTEROIDEÆ.

PTERONIA, *Linn.*

P. FLEXICAULIS, *Linn. fil.*, var. MINOR, var. nov. Folia nec ultra 1·0 cm. long., plerumque vero breviora. Capitula modo 1·2 cm. long., 12-flosculosa. Pappi setæ 0·5 cm. long.

Cape Colony; *Dr. A. Rehmann*, no. 2843.

P. EENII, sp. nov. Verisimiliter fruticulosa, ramosa, tenuiramea, ramis minute albo-tomentosis mox glabrescentibus, foliis oppositis anguste linearibus obtusis subcarnosis triquetris vel fere planis senioribus patentibus vel etiam recurvis, capitulis mediocribus circa 15-flosculosis turbinato-obovoideis ex apices ramorum solitatim oriundis sessilibus, involucri phyllis circa 7-seriatis lanceolatis spinoso-acuminatis membranaceo-scariosis uninerviis araneosis interioribus satis elongatis necnon fere glabris, corollis involucro brevioribus, styli ramis elongatis, achæniis compressiusculis apice truncatis glandulosis dense albido-villosis, pappi setis multis achænio longioribus rigidis scabridis purpureis.

Hab. Damaraland, 1879; *T. G. Een.*

Rami 0·15 cm. diam., cortice cinereo obducti. Folia 1·0–1·3 cm. × 0·1 cm., juniora vero breviora, hæc itaque magna pro parte secus ramulos abbreviatos imbricata. Capitula in toto 1·3–1·5 cm. long., circa 1·0 cm. diam. Involucri phylla extima 0·35 cm., intermedia circa 0·6 cm. intima 1·1 cm. long., plurima sursum purpurascentia. Receptaculum planum. Flosculi 0·7 cm. long., flavi sursum purpurascentes. Styli rami 0·2 cm. long., horum appendices 0·07 cm. long. Achænia 0·22 cm. long. Pappi setæ circa 1·1 cm. long.

The affinity of this pretty plant is undoubtedly with *P. incana*, DC., from which it differs in indumentum, in the form and araneose clothing of the involucral leaves, in the broader capitula with a greater number of florets, in the purple pappus, &c.

Detris, *Adans.* (Felicia, *Cass.*).

D. ericifolia, *Hiern.* (*Felicia abyssinica*, Sch. Bip.)

Kikuyu Escarpment, *Dr. J. W. Gregory.* Nandi, 6–7000 feet; *G. F. Scott Elliot*, no. 6985. Kidung, 7000 feet; *Id.* no. 6537.

Var. ? anthemoides, *Hiern.*

Damaraland; *T. G. Een.* Karagwe, 4–5000 feet; *G. F. Scott Eliot*, no. 8136.

Nidorella, *Cass.*

N. microcephala, *Steetz.*

Between Zanzibar and Uyui; *Rev. W. E. Taylor.* Nyassaland; *J. Buchanan*, 1895, no. 232; *G. F. Scott Elliot*, nos. 8294 & 8401.

N. resedifolia, *DC.*

Damaraland, *T. G. Een.*

N. Welwitschii, sp. n. Pubescens vel subglabra, caule erecto copiose folioso, foliis linearibus raro anguste lineari-lanceolatis acutis obtusisve vel etiam brevissime uncinulatis 3·0–5·0 cm. long., 0·1–0·7 cm. lat., involucri phyllis lineari-lanceolatis breviter acuminatis, ligulis involucrum bene superantibus nempe in toto 0·5 cm. long.—*N. solidaginea*, Hiern, Cat. Welw. Pl. iii. p. 550, nec DC. *Microglossa angolensis*, var. *linearifolia*, O. Hoffm. in Bol. Soc. Brot. xiii. (1896) p. 22, saltem quoad specc. Welwitschiana.

Hab. Huilla; *Welwitsch*, nos. 3418, 3419. South-west Africa, on the Kubango beyond Kabindere, at 1150 metres; *H. Baum*, no. 342.

To be distinguished from *N. solidaginea* by its acuminate involucral leaves and relatively long ligules, in which latter character it much resembles *N. pedunculata*, Oliver.

Microglossa, *DC.*

M. volubilis, *DC.*

Ukambane, 4000 feet; *G. F. Scott Elliot*, no. 6336.

M. densiflora, *Hook. fil.*

Ruwenzori Mt., 7–8000 feet; *G. F. Scott Elliot*, no. 7690.

Microglossa Hildebrandtii, *O. Hoffm.* (ex descript.).

Giryama and Tsimba Mountains; *Rev. W. E. Taylor.*

The specimen answers fairly well to the description, but the leaves are smaller (2·0 cm. long and at most 1·5 cm. broad). The same plant is at Kew, collected by Rev. T. Wakefield at Ribe.

M. Elliotii, sp. nov. Fruticosa, caule erecto robusto dense albo-tomentoso sursum sparsim ramoso, foliis lanceolatis breviter acuminatis in petiolum brevem desinentibus supra glabrescentibus subtus in nervis arcte reticulatis minute albo-tomentosis ceterum pubescentibus, capitulis parvis dense corymbosis corymbis pedunculis albo-tomentosis quam folia brevioribus suffultis, involucri tomentosi phyllis 3-seriatis lanceolatis aliquantulum erosulo-serrulatis uninervibus interioribus quam exteriora paullo majoribus, receptaculo nudo, radii flosculis circa 25 disci circa 6 illorum ligula oblonga stylum paullulum superante, achæniis compressiusculis pubescentibus, pappi setis uniseriatis scabridis.

Hab. Masailand, Kidung, Lake Naivasha, 6000 feet; *G. F. Scott Elliot*, no. 7034.

Caulis usque ad 0·4 cm. diam. Folia modice 8·0–10·0 cm. long. (summa vero breviora) et 1·6–1·8 cm. lat.; petioli circa 0·5 cm. long. Corymbi usque ad 7·0 cm. diam. Involucra 0·23 cm. long.; phylla extima 0·2 cm. interiora 0·22 cm. long. Flosculorum fem. corollæ tubus 0·15 cm. long.; horum ligula 0·1 cm. long. Achænia 0·1 cm. pappus 0·23 cm. long.

A very distinct species easily recognized by its close white tomentose indumentum.

Marsea, *Adans.* (Conyza, *Less.*).

M. pyrrhopappa, *Hiern.*

Uganda, *G. F. Scott Elliot*, no. 7438. North-east Tropical Africa, between Cantalla and Hadda; *Lord Delamere.*

M. ruwenzoriensis, sp. nov.; caule valido erecto folioso hirsuto-pubescente, foliis confertis sessilibus anguste lineari-lanceolatis basi leviter amplexicaulibus apice pungentibus integris vel rare denticulatis supra scaberrimis subtus pubescentibus, capitulis parvis in corymbis terminalibus sat longe pedunculatis hispidulo-pubescentibus dispositis multiflosculosis, pedunculis propriis capitula excedentibus, involucri subcylindrici pubescentis phyllis 5-seriatis serr. I. et II. brevioribus lanceolato-oblongis reliquis lineari-lanceolatis omnibus acutis, receptaculo subplano foveolato foveolorum angulis sæpe productis, flosculorum fem. corollis breviter ligulatis, achæniis angustis utrinque uninervibus pilosulis, pappi setis sordide albis uniseriatis.

Hab. Ruwenzori Mountain, 5300 feet; *G. F. Scott Elliot*, no. 7614.

Folia modice 4·0–5·0 cm. long., sæpissime 0·4–0·6 cm. lat., firme membranacea, uninervia. Pedunculi circa 8·0 cm. long. Involucri 0·4 cm. long. phylla exteriora 0·3 cm. interiora 0·4 cm. long. Corollarum fem. tubus 0·15 cm. et ligula 0·4 cm. long., hæc integer vel bifida. Achænia 0·12–0·14 cm. long. Pappus 0·4 cm. long.

Allied to *Marsea pyrrhopappa*, Hiern, from which it differs in the shape of the amplexicaul leaves, in the broader involucral leaves, the somewhat different female florets, &c.

Marsea variegata (*Conyza variegata*, Sch. Bip.).
Mt. Ruwenzori, 7–8000 feet; *G. F. Scott Elliot*, no. 7576.

M. subscaposa (*Conyza subscaposa*, O. Hoffm.).
Nandi, 7–8000 feet; *G. F. Scott Elliot*, no. 6862.

M. spartioides, *Hiern.*

Karagwe, 4–5000 feet, *G. F. Scott Elliot*, no. 8113. Stevenson Road, 4–5000 feet, *Id.* no. 8368.

M. boranensis, sp. nov.; caule ascendente attenuato herbaceo e rhizomate sat crasso oriundo una cum ramis tenuibus abundanter foliosis araneoso-pubescente demum glabrescente, foliis sessilibus oblanceolatis vel oblanceolato-linearibus apice nigro-mucronatis integerrimis præsertim facie inferiore araneoso-tomentosis, capitulis parvis corymbum pauci-(2–5-)capitulatum terminalem longipedunculatum efformantibus, pedunculis propriis capitula excedentibus vel subæquantibus, involucri phyllis 4-seriatis lanceolatis acutis acuminatisve extimis quam reliqua paullo brevioribus exterioribus deorsum araneosis, receptaculo convexiusculo foveolato foveolorum marginibus breviter productis, flosculorum fem. corollis breviter ligulatis, achæniis minimis setulosis utrinque uninervibus, pappi setis sordide albis vel pallide rubescenti-stramineis stricte uniseriatis.

Hab. British East Africa, Boran, April 1895; *Dr. Donaldson Smith.*

Planta usque ad 30·0 cm. alt. Folia 2·0–3·0 cm. long., 0·35–

0·5 cm. lat., basi aliquantulum amplexicaulia. Pedunculi 10·0–12·0 cm. long., dense araneosi; pedunculi proprii usque ad 1·0 cm. long. Corymbus 2·0 cm. diam. attingens, sæpe vero angustior. Involucri paullo ultra 0·4 cm. long. phylla extima 0·3 cm. interiora 0·4 cm. long. Corollæ florum fem. pilosæ; harum tubus 0·25 cm. et ligula vix 0·1 cm. long. Achænia 0·12 cm. et pappus 0·4 cm. long.

A very distinct species recognized by the indumentum and shape of the leaves, the small corymbs supported on their long peduncles, &c. In habit, and especially in the form and clothing of the leaves, it closely resembles *Nidorella pedunculata*, Oliver.

Marsea celebris, sp. nov.; caule ascendente sparsim ramoso hispidulo, foliis parvis sessilibus oblongis obtusis pinnatifidim lobatis piloso-pubescentibus, capitulis parvis in corymbis terminalibus densis multicapitulatis dispositis multiflosculis flosculis perpaucis hermaphroditis, pedunculis propriis capitulis subæquilongis pubescentibus, involucri campanulati puberuli phyllis 3-seriatis extimis brevioribus lanceolatis reliquis lanceolato-oblongis omnibus acutis et margine hyalinis, receptaculo crassiusculo alveolato alveolorum marginibus breviter productis, flosculorum fem. corollis omnino tubulosis glabris, achæniis glabris marginibus induratis faciebus uninervibus vel nervo orbis, pappi albi setis paucis uniseriatis.

Hab. Mau, 8000 feet; *G. F. Scott Elliot*, no. 6907.

Folia fere usque ad 3·0 cm. long. et circa 1·0 cm. lat. Involucri 0·42 cm. long. circa 0·4 cm. diam. phylla extima 0·3 cm. reliqua 0·4 cm. long. Flosculi hermaph. circa 5. Flosculorum fem. corollæ 0·15 cm. et stylus vix 0·4 cm. long. Achænia immatura 0·075 cm. long. Pappi setæ circa 14, 0·3 cm. long.

To be compared with *M. abyssinica* (*Conyza abyssinica*, Sch. Bip.), from which it differs in respect of the slightly broader eglandular involucral leaves, female florets with slenderer glabrous corollas and longer styles, the different shape of the hermaphrodite florets, and, judging from their immature condition, the smaller glabrous achenes.

Psiadia, *Jacq.*

P. incana, *Oliver & Hiern.*

British East Africa, Dadáro, 3700 feet; *Lord Delamere.*

Psiadia arabica, *Jaub. & Spach.*

Tropical East Africa; *Rev. W. E. Taylor*; *Dr. J. W. Gregory.* Kidung, 6–7000 feet, *G. F. Scott Elliot*, no. 6645. Somaliland, Wagga Mountain, *Mrs. Lort Phillips.*

Pluchea, *Cass.*

P. sordida, *Oliver & Hiern.*

Samburu; *G. F. Scott Elliot*, no. 6136.

Sphæranthus, *Linn.*

S. hirtus, *Willd.*

Machakos, 5–6000 feet; *G. F. Scott Elliot*, no. 6594. Ruwenzori Mt., 6000 feet; *Id.* no. 7585.

S. suaveolens, *DC.*

Leikipia, Guaso Larok; *Dr. J. W. Gregory.*

S. ukambensis, *Vatke & O. Hoffm.*

British East Africa, Lé, 3700 feet; *Lord Delamere.*

S. Kirkii, *Oliver & Hiern.*

Ngomeni; *G. F. Scott Elliot*, no. 6262.

S. Taylorii, sp. nov. Herbaceus, verisimiliter annuus, obscure puberulus, caule attenuato ramoso anguste alato, foliis parvis sessilibus oblongo-lanceolatis breviter apiculatis margine undulatis minutissime glanduloso-punctatis, capitulorum glomerulis parvis subsphæroideis sat longe pedunculatis, bracteis exterioribus 7 subæquilongis extimis lanceolatis interioribus late oblongis omnibus longiuscule spinulosis, bracteis capitula suffulcientibus late oblongis longe cuspidato-spinulosis utrinque puberulis margine scariosis sursum ciliolatis, involucri phyllis 3 oblanceolatis obtusissimis apice ciliolatis dorso carinatis ibique sursum cristulatis, flosculis fem. 3–4, hermaph. 1–2, horum corollis prope basin maxime constrictis superne late dilatatis.

Hab. German East Africa, between Zanzibar and Uyui, 1886; *Rev. W. E. Taylor.*

Folia 1·0–1·5 cm. long., 0·2–0·3 cm. lat. Pedunculi modici circa 1·0 cm. long. Capitulorum glomeruli 0·7 cm. long., 0·8 cm. lat. Bracteæ exteriores circa 0·2 cm. long., harum appendix spinulosa totidem long. Bracteæ suffulcientes 0·3 cm. long., appendix 0·2 cm. long. Involucri phylla 0·3 cm. long. Flosculorum hermaph. corollæ ima basi 0·03 cm. lat., mox usque ad 00·2 cm. coarctatæ inde usque ad 0·05 cm. subito dilatatæ. Flosculi fem. deorsum aliquantulo ampliati. Antheræ basi breviter sagittatæ. Flosculorum hermaph. stylus indivisus. Achænia immatura pilosa.

Apparently nearest to *Sphæranthus cristatus*, O. Hoffm., but differing from that species in leaf, size and shape of glomerules, shape of bracts, number and form of involucral leaves, &c.

TRIPLOCEPHALUM, *O. Hoffm.*

T. HOLSTII, *O. Hoffm.* (ex ic. et descript.).

Tropical East Africa, Plains of Arusha, Tini and Kahé, 3000 feet; *Rev. W. E. Taylor.*

Tribe INULOIDEÆ.

ARTEMISIOPSIS, gen. nov. (Plate **8**.)

Capitula heterogama, disciformia, multiflosculosa, flosculis exterioribus femineis, pluriseriatis, interioribus 3–4 hermaphroditis, omnibus fertilibus; involucri subglobosi subscariosi phyllis paucis, 2-seriatis, inappendiculatis. Receptaculum parvum convexum, nudum. Corollæ femineæ filiformes, apice 5-dentatæ; hermaphroditæ regulares, tubulosæ, limbo amplificato, 5-lobo. Antheræ basi caudatæ. Flosculorum fem. styli rami oblongi, obtusi; flosculorum hermaph. truncati, papillosi. Achænia oblonga, compressiuscula. Flosculorum fem. pappus brevis, cupularis; flosculorum hermaph. itaque sed conspicuus cupularis, adjectis setis brevibus tenuibus inter se æquilongis vel inæquilongis 3–5. Herba erecta, copiose ramosa, facie odoreque *Artemisiæ*. Folia alterna, angusta, integra. Capitula parvula, solitaria, ramulos terminantes vel ex axillis foliorum approximantium oriunda.

ARTEMISIOPSIS LINEARIS, sp. unica; caule tereti una cum ramulis breviter glanduloso-puberulis mox glabris, foliis sessilibus anguste linearibus obtusis uninervibus membranaceis puberulis cito glabris, involucri phyllis oblongis acutis margine scariosis necnon erosulo-ciliatis una cum pedunculis lana araneosa tenui obtectis, capitulis circa 40-flosculosis, flosculis involucrum haud excedentibus, flosculorum fem. stylis tandem exsertis hermaph. inclusis, achæniis minimis hispidulis brunneis quam cupula coronans longioribus.

Hab. Nyassaland; *John Buchanan*, 1895, no. 405.

Planta saltem 35·0 cm. alt. Caulis basi 0·25 cm. diam., ibique fibrillas paucas simplices emittens. Ramuli rigidi, gracillimi, modo 0·6 cm. diam. Folia modice 1·5–2·0 cm. long., 0·13–0·2 cm. lat. Pedunculi 0·1–0·4 cm. long. Capitula 0·22 cm. long., 0·3 cm. diam. Involucri phylla circa 0·7 cm. lat. Receptaculum 0·1 cm. diam. Flosculorum fem. corollæ 0·06 cm. long.; hermaph. paullulum longiores; hæc 0·03 cm. diam. Antheræ oblongæ, apice tenuiter cuspidatæ. Achænia 0·07 cm. long. Pappi setæ 0·03–0·09 cm. long., scabriusculæ.

Under the compound microscope the pappus-cupule is seen to be composed of a number of thin rods closely united side by side except at the very tips, which are free.

I find some difficulty in determining the exact position of this plant. There can be no doubt that it should be referred to the series *Eugnaphalieæ* of the subtribe *Gnaphalieæ*, and among the genera comprised in this series it perhaps comes nearest *Amphidoxa*. But, irrespective of other details, the curious pappus of *Artemisiopsis* affords a weighty reason for assuming that we have here a new and distinct generic type.

ACHYROCLINE, *DC.*

A. HOCHSTETTERI, *Sch. Bip.*

Machakos; *G. F. Scott Elliot*, no. 6596. Urundi; *Id.* no. 8253. Ukamba; *Id.* no. 6449.

A. LUZULOIDES, *Vatke.*

Somaliland, Wagga Mountain; *Mrs. Lort Phillips.* British East Africa; *Dr. J. W. Gregory.*

A. SCHIMPERI, *Sch. Bip.*

Masailand, 5600 feet; Mau, 7–8000 feet; *G. F. Scott Elliot*, nos. 6599, 6956.

HELICHRYSUM, *Vaill.*

H. (*Argyreia* § *Declinatæ*) ACHYROCLINOIDES, sp. nov.; ramulis erectis gracilibus foliosis dense araneoso-tomentosis, foliis parvis sessilibus ovato-lanceolatis obtuse acutis dense araneoso-tomentosis supra mox glabratis ibique leviter bullulatis, capitulis parvis campanulato-cylindricis 5–7-flosculosis in cymas parvas, multicapitulatas densas a foliis ultimis bracteatas digestis, involucri 3-seriati phyllis serr. I. et II. late oblongis obtusissimis basi ipsa araneosis phyllis intimis spathulatis omnibus fere omnino scariosis argyreis haud radiantibus, receptaculo plano, flosculis 1–3 exterioribus angustis femineis reliquis hermaphroditis, achæniis compressis glabris, pappi setis caducissimis scabriusculis sordide albis.

Hab. Mount Milanji, 6000 feet; *A. Whyte.*

Ramuli circa 0·1 cm. diam. Folia modice 1·0–1·5 cm. long., 0·35–0·6 cm. lat.; nervi supra impressi, subtus eminentes. Cymæ 1·5–3·0 cm. lat. Involucra 0·45 cm. long., 0·25 cm. lat.; phylla exteriora parum ultra 0·4 cm. long., summum 0·12 cm. lat.; phylla intima vix 0·4 cm. long., 0·08 cm. lat. Corollæ 0·25 cm. long. Achænia 0·07 cm. et pappus 0·3 cm. long.

A very distinct species not likely to be mistaken for any other of § *Declinatæ*, and which, but for the fact of most of its florets being hermaphrodite, would unhesitatingly be referred to *Achyrocline*.

HELICHRYSUM LEPTOLEPIS, *DC.*
Damaraland; *T. G. Een.*

H. ARGYROSPHÆRUM, *DC.*
Damaraland; *T. G. Een.*

H. STUHLMANNI, *O. Hoffm.*
Mt. Ruwenzori, 12,000 feet; *G. F. Scott Elliot*, no. 8106.

H. ELEGANTISSIMUM, *DC.*
Mt. Ruwenzori, 9–10,000 feet; *G. F. Scott Elliot*, no. 8010.

H. (*Argyreia* § *Elegantissima*) NANDENSE, sp. nov. Elatum, fruticosum ?, ramis teretibus sulcatis pubescentibus demum glabris, foliis sessilibus leviter amplexicaulibus lineari-lanceolatis apice breviter pungenti-acuminatis supra puberulis subtus aliquantulum araneosis firme membranaceis senioribus maxime revolutis, capitulis mediocribus late campanulatis pedunculatis multiflosculosis in corymbum pluricapitulatum digestis, involucri glabri phyllis circa 10-seriatis fere a basi scariosis deinde radiantibus lanceolatis acutis nitentibus albis interdum juxta basin dilute roseis, flosculis extimis femineis reliquis hermaphroditis, receptaculo nudo convexo alveolato, achæniis subteretibus glabris, pappi setis scabriusculis prorsus attenuatis albis

Hab. Nandi, 7–8000 feet; *G. F. Scott Elliot*, no. 6949.

Planta sesquimetralis ex scheda cl. detectoris. Folia 3·0–4·0 cm. long., 0·3–0·5 cm. raro usque ad 0·7 cm. lat. Corymbi circiter 8·0 cm. diam. Pedunculi modice 0·5–1·5 cm. long., araneosi. Involucra 1·0 cm. long.; phylla extima 0·4–0·6 cm. interiora fere 1·0 cm. long., intima imminuta, lineari-oblonga, 0·4 cm. long., vix 0·1 cm. lat. Corollæ 0·3 cm. long. Antherarum caudæ simplices. Achænia adhuc valde cruda 0·05 cm. long. Pappus vix 0·4 cm. long.

Near *Helichrysum elegantissimum*, DC., which has broader leaves, larger heads arranged only a few together on longer peduncles, all the florets hermaphrodite, pubescent achenes, &c.

HELICHRYSUM MEYERI-JOHANNIS, *Engl.*
Tropical East Africa; *Rev. W. E. Taylor.*

H. ARGYRANTHUM, *O. Hoffm.*
Mt. Kenia, 10,000 feet; *H. J. Mackinder*, 1899.

H. (*Argyreia* § *Sphærocephala*) ALBO-BRUNNEUM, sp. nov. Ascendens, parvum, caule abundanter folioso una cum foliis dense araneoso-tomentosis, foliis sessilibus oblongis obtusis membranaceis inferioribus imbricatis summis sparsis necnon angustioribus, capitulis mediocribus ad apicem caulis sæpius ad 6–10 arcte congestis circa 70-flosculosis flosculis omnibus hermaphroditis, involucri subglobosi circa 8-seriatis phyllis appendicibus haud radiantibus ovato-oblongis sursum brunneis deorsum albis exterioribus obtuse acutis quam interiora late obtusa paullo brevioribus intimis spathulato-oblongis necnon omnino albis, receptaculo plano foveolato, achæniis glabris, pappi setis corollas paullo excedentibus scabriusculis sursum paullulum incrassatis albis.

Hab. Cape Colony, Kondveld Mountain near Murraysburg; *W. Tyson*, 1879, no. 98.

Planta fere 20·0 cm. attingens, sæpius vero circa 10·0 cm. vel minus. Folia 1·5–2·0 cm. long., 0·6–0·8 cm. lat., summa revera usque ad 0·3 cm. angustata. Capitulorum glomerulus nec ultra 2·0 cm. diam. Involucri 0·8 cm. long. phylla exteriora 0·5 cm. long. vix 0·2 cm. lat.; interiora 0·6 cm. long. 0·22 cm. lat.; intima 0·13 cm. lat. Corolla 0·33 cm. long. Antherarum caudæ attenuatæ, simplices. Achænia adhuc cruda 0·06 cm. long.; pappi setæ 0·4 cm. long.

The narrower firmer brown-tipped involucral leaves, the glabrous achenes, and the longer pappus are the chief points by which this can be distinguished from *H. felinum*, Less.

HELICHRYSUM KIRKII, *Oliver & Hiern.*
Masailand, 5–6000 feet; *G. F. Scott Elliot*, no. 6458.

H. KILIMANJARI, *Oliver.*
Kilimanjaro; *Rev. W. E. Taylor.*

H. (*Chrysolepidea* § *Xerochlæna*) GREGORII, sp. nov. Verisimiliter suffrutex elatum, caulibus robustis subteretibus striatis piloso-pubescentibus deinde glabris, ramulis gracilibus piloso-pubescentibus, foliis sparsis parvis ovatis vel ovato-lanceolatis obtusis amplexicaulibus margine undulatis pilosis supra scabriusculis membranaceis, capitulis mediocribus late campanulatis ad apicem ramulorum corymbosis pedunculatis multiflosculosis, pedunculis gracilibus araneosis, involucri circa 7-seriati glabri phyllis obovato-oblongis obtusis integris vel rarius erosis intimis oblongis quam reliqua brevioribus omnibus appendice scariosa radiante lutea coronatis, flosculis minimis extimis femineis, receptaculo plano, achæniis minimis glabris, pappi setis corollas sæpe excedentibus barbellatis luteis.

Hab. Rangatan Ndaro, Leikipia; *Dr. J. W. Gregory.*

Folia modice 1·5–2·0 cm. long., alia vero extant paullo longiora vel breviora. Pedunculi usque ad 3·5 cm. long., sæpe vero breviores. Involucri 0·6 cm. long. demum 1·2 cm. diam. phylla extima 0·4 cm. interiora 0·5 cm. intima 0·3 cm. long. Corollæ modo 0·06 cm. long. Achænia 0·03 cm. long. Pappus sub flore 0·12 cm., tandem 0·3 cm. long.

Very near *H. fœtidum*, Cass., which has a different clothing and different leaves, larger flower-heads and florets, &c.

H. SETOSUM, *Harv.*
Nandi, 7–8000 feet, and Ruwenzori Mt., 9500 feet; *G. F. Scott Elliot.*

H. (*Chrysolepidea* § *Xerochlæna*) ELLIOTII, sp. nov. Humile, subacaule, dense foliosum, foliis radicalibus comparate elongatis oblongis sessilibus 5-nervibus una cum foliis caulinis brevioribus tomento dense coarcto cutem mentiente obsitis, capitulis mediocribus paucis (2–3 ?) ad apicem caulis arcte approximatis late ovoideis multiflosculosis, involucri multiseriati phyllis oblongis obtusis acutisve scariosis basi sæpe araneosis in exemplariis duobus mihi obviis nondum radiantibus pallide brunneis deorsum sordide albis phyllis intimis quam reliqua angustioribus necnon luteis, flosculis externis femineis, receptaculo plano, achæniis glabris, pappi setis albis sursum paullulum latioribus scabriusculis apice ipsa sæpe barbellatis.

Hab. Sotchi, Shiré Highlands; *G. F. Scott Elliot*, no. 8609.

Planta 3·0–4·0 cm. alt. Folio radicalia circa 8·0 cm. long., 1·5 cm. (raro usque ad 2·0 cm.) lat. Folia caulina caulem omnino occludentia, circa 3·5 cm. long., 1·0 cm. lat. Involucrum 1·2 cm. long., vix 2·0 cm. lat.; phylla extima 0·5–0·6 cm. long.; intermedia 1·0 cm. long., 0·3 cm. lat.; intima vix 1·0 cm. long. et 0·1–0·2 cm. lat. Corollæ 0·3 cm. long. Achænia immatura 0·06 cm. et pappus 0·45 cm. long.

To be inserted in the genus next to *Helichrysum fulgidum*, Willd., and greatly resembling in habit the var. *nanum*, DC., of that species. Its chief peculiarities are the curious epidermis-like tomentum, the somewhat narrower capitula, the more numerous and brown involucral leaves, the longer florets, and the white (not yellow) pappus.

HELICHRYSUM (*Chrysolepidea* §*Xerochlæna*) TAYLORII, sp. nov. Verisimiliter suffruticosum, caule sursum ramoso, ramulis erectis dense foliosis, foliis imbricatis ramos omnino obtegentibus sessilibus lineari-lanceolatis superioribus linearibus majoribus leviter amplexicaulibus omnibus nigro-mucronatis margine revolutis dense araneoso-tomentosis, capitulis mediocribus circa 50-flosculosis ramulos breves solitatim coronantibus, flosculis fere omnibus hermaphroditis, involucri campanulati multiseriati aliquantulum araneosi phyllis deorsum cartilagineis sursum scariosis erectis exterioribus brevioribus obovatis obtusissimis superne erosis et ciliato-serrulatis interioribus oblongis obtusissimis intimis oblongo-linearibus una cum interioribus luteo-stramineis exterioribus paullulum pallidioribus, receptaculo plano, achæniis cylindricis abbreviatis glabris, pappi setis lutescentibus breviter barbellatis.

Hab. German East Africa, between Zanzibar and Uyui; *Rea. W. E. Taylor*.

Folia 1·0–2·5 cm. long., majora sc. seniora basi 0·4 cm., sub apice 0·15 cm. lat., juniora angustiora. Involucra 1·0 cm. long. et lat.; phylla exteriora 0·4–0·45 cm. long. (seriei extimæ vero 0·35 cm.), sursum 0·2–0·25 cm. lat.; phylla interiora 0·7 cm. long., 0·15 cm. lat.; intima vix 0·1 cm. lat. Corollæ 0·3 cm. long., 0·03 cm. diam. Achænia adhuc cruda 0·06 cm. long., angulata; pappi setæ 0·35 cm. long.

A plant with considerable resemblance to several others, especially *Helichrysum Höhnelii*, Schweinf., *H. Kilimanjari*, Oliver, and *H. argyranthum*, O. Hoffm. Its chief points are the narrow araneose leaves, the comparatively narrow straw-coloured involucre (the outer rows of whose leaves are short and pass without transition into the longer and narrower inner ones), and the extremely short angled achenes.

HELICHRYSUM (*Chrysolepidea* § *Stœchadina*) CERES, sp. nov.; folio inferiore unico mihi solummodo obvio (an radicali?) magno anguste elliptico apice incurvo-mucronato deorsum longe gradatimque attenuato araneoso-tomentoso, caulibus gracilibus angulatis araneosis sparsissime foliosis, foliis caulinis parvis lanceolatis acuminatis pagina inferiore araneosis, capitulis submediocribus anguste ovoideis circiter 10-flosculosis in paniculas parvas densiusculas pluricapitulatas digestis, involucri 4-seriati phyllis oblongis exterioribus basi araneosis omnibus acutis scariosis pallide brunneis appendice lutea erecta coronatis, receptaculo plano, flosculis omnibus hermaphroditis, achæniis breviter setulosis, pappi setis ima basi connatis pallidissime lutescentibus deorsum breviter barbellatis sursum scabriusculis.

Hab. Hill-sides at Urundi, 4–5000 feet; *G. F. Scott Elliot*, no. 8170.

Planta circa 25·0 cm. alt. Folium inferius in toto 22·0 cm. long., summum 5·3 cm. lat., nervo centrali lato, maxime eminente, nervis lateralibus deorsum subparallelis sursum divergentibus. Folia caulina circa 1·0 cm. long. Capitula 0·8 cm. long., demum (phyllis tunc aliquantulum divergentibus) 0·6 cm. lat. Involucri phylla extima 0·5 cm. intima 0·7 cm. long., hæc 0·15 cm. lat. Corollæ 0·5 cm. long. Achænia vix usque ad 0·2 cm. et pappus 0·5 cm. long.

To be inserted in the genus near *H. floccosum*, Klatt, and *H. Danaë*, S. Moore, but differing from both in leaf and in many details of the capitula.

H. HEBELEPIS, *DC.*
Namaqualand; *W. C. Scully*, no. 102.

H. LUCILIOIDES, *DC.*
Cape Colony; *Francis Masson*. Namaqualand; *W. C. Scully*, no. 235.

HELICHRYSUM UNDATUM, *Less.*
Uganda and Shiré Country; *G. F. Scott Elliot*, nos. 7232, 8640.

H. LEIOPODIUM, *DC.*
Nandi, 6–7000 feet, and Ukamba, 5–6000 feet; *G. F. Scott Elliot*, nos. 6445, 6447, 6912.

H. NUDIFOLIUM, *Less.*
Urundi and Shiré Country; *G. F. Scott Elliot*, nos. 8169, 8575.

H. MARAGUENSE, *O. Hoffm.*
Mau, 8000 feet; *G. F. Scott Elliot*, no. 6871.

H. TILLANDSIÆFOLIUM, *O. Hoffm.* (ex descript.).
Nyassaland, Nyika Country, 6500–7890 feet; *Richard Crawshay.*

The specimens are small with very short stems; the leaves 1·5–2·0 cm. long., 0·2–0·3 cm. lat. Inflorescence (not exceeding the leaves) of about 10 stalked capitula. Paleæ of the receptacle 0·1 cm. long. Floscules and pappus 0·3 cm. long. Female floscules very few, in one of the heads I examined there was but a single one. Apparently a small form of Dr. Hoffmann's recently described species.

There is an unnamed *Helichrysum* at Kew collected by Rev. W. P. Johnson in the mountainous country east of Lake Nyassa, which is most probably to be referred to this species, though, as the flowering heads are very immature, the identification must remain somewhat doubtful.

H. GLOBOSUM, *Sch. Bip.*
Mau, 8000 feet, Nandi, 7–8000 feet, and Mt. Ruwenzori, 6–9000 feet; *G. F. Scott Elliot*, nos. 6863, 7011, 7529, 7619.

H. GERBERÆFOLIUM, *Sch. Bip.*
Mau, 7–8000 feet; *G. F. Scott Elliot*, no. 6774.

H. (*Lepicline* § *Plantaginea*) RUWENZORIENSE, sp. nov.; caule ascendente gracili sparsim folioso araneoso, folio radicali unico viso oblanceolato-oblongo obtuso basin versus gradatim attenuato et in petiolum elongatum desinente margine raro et minute denticulato trinervi piloso, foliis caulinis radicali subsimilibus sed petiolo orbis summis vero valde abbreviatis, capitulis parvis campanulatis circa 25-flosculosis pedicellatis in paniculum subcorymbosum sublaxum pluricapitulatum digestis, flosculis omnibus hermaphroditis, involucri circa 6-seriati glabri phyllis extimis anguste oblongis phyllis serr. II. et III. oblongo-ovatis phyllis interioribus quam hæc paullo angustioribus sed gradatim longioribus omnibus obtusissimis scariosis erectis sursum aureis, receptaculo paleis oblongis dorso alato-carinatis onusto, achæniis glabris, pappi setis albis scabriusculis penitus attenuatis.

Hab. Ruwenzori Mountain, 6000 feet; *G. F. Scott Elliot*, no. 7864.

Folium radicale (petiolo basi amplificato incluso) 10·0 cm. long., 1·5 cm. lat.; costæ laterales subtus conspicuæ; folia caulina usque ad 6·5 cm. long. Capitula 0·4 cm. long. et lat. Involucri phylla extima 0·2 cm. long., 0·08 cm. lat.; serr. II. et III. totidem long. et 0·15 cm. lat.; intima 0·32 cm. long., 0·12 cm. lat. Flosculi 0·3 cm. long., horum limbus 0·1 cm. diam. Achænia adhuc immatura vix 0·1 cm. long. Pappus 0·3 cm. long.

Allied to *Helichrysum gerberæfolium*, Sch. Bip., but different from it in leaf, shape of capitula, form of involucral leaves, &c.

HELICHRYSUM CYMOSUM, *Less.*

Teita Mountains and Leikipia Plateau; *Dr. J. W. Gregory.* Masailand, Urundi, and Mt. Ruwenzori, 6000 feet; *G. F. Scott Elliot*, nos. 6843, 7721, 8306.

Var. COMPACTUM, *Vatke.*

Guaso Mairi, Ndoro, and terminal moraine of sheet glaciation, Mt. Kenia; *Dr. J. W. Gregory.* Mt. Kenia, 10,000 feet; *H. J. Mackinder*, 1899.

H. AURICULATUM, *Less.*

Mt. Ruwenzori, 5–6000 feet; *G. F. Scott Elliot*, no. 7542.

H. LASTII, *Engl.*

Mt. Milanji; *A. Whyte*, no. 32.

ROSENIA, *Thunb.*

R. GLANDULOSA, *Thunb.*

Cape Colony; *Francis Masson.*

ATHRIXIA, *Ker.*

A. NYASSANA, sp. nov.; caule attenuato debili arcuato-ascendente araneoso sub apice solummodo breviter ramuloso copiose folioso, foliis elongatis patentibus acicularibus margine valde revolutis supra glabris et nitentibus subtus araneoso-tomentosis, capitulis mediocribus turbinatis deorsum attenuatis (sc. in caulem decurrentibus) ramulos (numero 3–7 approximatis) terminantibus, involucri multiseriati aliquantulum araneosi phyllis lineari-lanceolatis longissime caudatis sursum recurvis exterioribus insigniter brevioribus, radii flosculis circa 20 involucrum vix superantibus albis, achæniis basi plumosis, pappi setis scabridis adjectis totidem paleis lanceolatis brevibus.

Hab. Nyika Country, Lake Nyassa, 6500–7890 feet; *Richard Crawshay.*

Caulis 0·1 cm. diam., subteres, demum glaber. Folia 2·5–3·5 cm. long., summa vero gradatim paullo breviora, 0·1 cm. lat. Capitula circa 1·5 cm. long., summum 1·2 cm. lat. Involucri phylla extima paullo ultra 1·0 cm. long.; intermedia 1·4 cm., intima quam reliqua minus caudata 1·5 cm. long. Flosculorum fem. corollæ tubus 0·4 cm., ligula 0·6 cm. long., hæc summum 0·2 cm. lat. Flosculorum hermaph. corollæ fere 0·4 cm. long. Achænia nondum matura 0·1 cm. long.; pappi setæ 0·5 cm., paleæ 0·04 cm. long.

The singular habit, the relatively narrow involucres, the elongated tails to the involucral leaves, and the white florets are the main distinctive features of this plant.

INULA, *Linn.*

I. MACROPHYLLA, *Sch. Bip.*

Mau, 7–8000 feet; *G. F. Scott Elliot.* Somaliland, Sheik Mahomet; *Dr. Donaldson Smith.*

I. SHIRENSIS, *Oliver.* (*Bojeria vestita*, Baker; *Inula Bakeriana*, O. Hoffm.)

Nyassaland; *J. Buchanan*, no. 123.

I. ACERVATA, sp. nov.; caule herbaceo elato robusto superne ramoso sparsim folioso fulvo-pubescente, folio radicali unico viso magno elliptico deorsum cuneatim angustato margine dentato petiolo brevi anguste alato fulto supra scabriusculo subtus pubescente, foliis caulinis parvis oblongis obtusis breviter amplexicaulibus nequaquam decurrentibus supra pubescentibus subtus dense tomentosis, capitulis homogamis parvis cylindrico-turbinatis fere 50-flosculosis in glomerulas densas a foliis summis imminutis bracteatas digestis, involucri villosuli 6-seriati phyllis exterioribus (sc. serr. I.–III.) oblongis obtusis herbaceis sursum scariosis interioribus linearibus obtuse acutis omnino scariosis, corollis superne amplificatis, achæniis oblongis compressiusculis minutissime pluricostatis glabris, pappi setis uniseriatis stramineis circa 17.

Hab. Mpororo, 5000 feet; *G. F. Scott Elliot*, no. 8034.

Folium radicale 40·0 cm. long., cujus petiolus 7·0 cm. exigit, nervus centralis subtus maxime eminens; folia caulina 5·0–6·0 cm. long., superiora vero breviora. Capitulorum glomeruli usque ad 3·5 cm. diam. Capitula 1·0 cm. long., 0·5 cm. diam. Involucri phylla exteriora 0·5–0·6 cm. long., summum 0·15 cm. lat.; phylla interiora 0·6 cm. long., modo 0·06 cm. lat. Corollæ 0·5 cm. long., sursum 0·08 cm. diam. Styli rami 0·075 cm. long. Achænia pallida, vix 0·2 cm. pappi setæ 0·3–0·35 cm. long.

To be inserted between *Inula glomerata*, Oliver & Hiern, and *I. Welwitschii*, O. Hoffm., having the non-decurrent leaves of the former, and in its flower-heads greatly resembling the latter species. The heads of *I. glomerata* are larger and more campanulate, and its involucre is different; moreover, its florets are considerably larger, and its achenes narrower and longer. Besides its decurrent leaves, *I. Welwitschii* has its heads somewhat smaller and less cylindrical, and with only about half as many florets; its involucral leaves are decidedly smaller, the florets less broad, &c.

Inula subscaposa, sp. nov. Herbacea, erecta, elata, caule sat gracili puberulo rare folioso, foliis pluribus radicalibus longipetiolatis oblanceolato-oblongis obtusis calloso-dentatis tenuiter membranaceis puberulis, foliis caulinis sparsis lanceolatis sessilibus haud decurrentibus calloso-denticulatis puberulis, capitulis radiatis parvis campanulatis circa 20-flosculosis in cymas pluricapitulatas densiuscule dispositis, involucri puberuli 4-seriati phyllis herbaceis oblongo-lanceolatis exterioribus comparate abbreviatis, flosculorum hermaph. corollis abbreviatis latis, achæniis oblongis aliquantulum compressis pubescentibus, pappi setis uniseriatis sordide albis corollis subæquilongis divergentibus circa 30 barbellatis.

Hab. Nyassaland; *J. Buchanan*, nos. 148, 1477.

Folia radicalia in toto ultra 20·0 cm. long., sursum modice circa 2·5 cm. lat. (raro usque ad 3·5 cm.); nervus centralis et nervi laterales subtus eminentes. Cymæ 3·0–4·0 cm. diam. Capitula 0·7 diam. Involucri paullo ultra 0·5 cm. long. phylla exteriora 0·25 cm. interiora 0·4–0·5 cm. long. Ligulæ anguste oblongæ, circa 0·5 cm. long. Corollæ 0·3 cm. long., 0·1 cm. lat.

Styli rami 0·05 cm. long. Achænia vix 0·2 cm. long., 0·08 cm. lat. Pappus 0·33 cm. long.

Near *Inula confertiflora*, A. Rich., and *I. Stuhlmanni*, O. Hoffm. The habit, the small heads, short broad corollas, and relatively broad pubescent achenes are the chief peculiarities of the species.

PEGOLETTIA, *Cass.*

P. SENEGALENSIS, *Cass.*

Damaraland; *T. G. Een.*

CALOSTEPHANE, *Benth.*

C. DIVARICATA, Benth.

Damaraland; *T. G. Een.*

ONDETIA, *Benth.*

O. LINEARIS, *Benth.*

Damaraland; *T. G. Een.*

ANISOPAPPUS, *Hook. & Arn.*

A. AFRICANUS, *Oliver & Hiern.*

Ukamba, Kavirondo, and Ruwenzori district; *G. F. Scott Elliot*, nos. 6448, 7075, 8104.

GEIGERIA, *Griessel.*

G. ODONTOPERA, *O. Hoffm.*

Damaraland; *T. G. Een.*

Tribe HELIANTHOIDEÆ.

SIEGESBECKIA, *Linn.*

S. SOMALENSIS, sp. nov. Herbacea, erecta, elata, caule robusto leviter angulato abundanter striato piloso-hirsutulo, foliis lanceolato-oblongis obtusis sessilibus amplexicaulibus præsertim subtus piloso-pubescentibus, capitulis pro genere majusculis, in cymas paucicapitulatas digestis, involucri phyllis 5 (quorum 3 exterioribus) late ovatis cuspidatis obtusis 5-nervibus puberulis et minutissime glandulosis subscariosis cuspide herbacea, ligulis 3-dentatis, flosculorum hermaph. corollarum limbo 5-lobo, horum styli ramis acuminatis recurvis hispidulis, achæniis oblongo-obovoideis aliquantulum tetragonis rectis parum turgidulis.

Hab. Somaliland, Sheik Mahomet; *Dr. Donaldson Smith.*

Planta circa semimetralis. Caulis deorsum fere 1·0 cm. diam.

Folia 8·0 cm. attingentia, sæpius vero breviora, sc. 3·0–4·0 cm. long. Involucrum 0·6–0·8 cm. long.; phylla 0·35–0·4 cm. lat. Receptaculi paleæ sursum ciliatæ, 0·5 cm. long. Flosculorum hermaph. corollæ 0·4 cm. long., infra medium subito constrictæ, deorsum pubescentes. Andrœcium exsertum, 0·25 cm. long. Styli rami 0·15 cm. long. Achænia circa 0·2 cm. long., nigra.

Nearest *Siegesbeckia abyssinica*, Oliver & Hiern, but different in respect of the leaves, involucre, hermaphrodite florets, &c.

The thickness of the stem of Dr. Donaldson Smith's only specimen has apparently prevented the proper drying of the leaves; it is, therefore, quite possible that those organs have not been described with accuracy.

WEDELIA, *Jacq.*

W. ABYSSINICA, *Vatke.*

Masailand, 6000 feet; *G. F. Scott Elliot*, no. 6644.

W. INSTAR, sp. nov. Erecta, sparsim ramosa, ramis erectis rare foliosis piloso-hispidis, foliis lanceolatis brevipetiolatis acutis vel obtusis basi rotundatis margine distanter denticulatis appresse piloso-hispidis, capitulis majusculis longipedunculatis ex axillis superioribus oriundis, involucri phyllis exterioribus anguste obovato-oblongis obtuse acutis hispido-pilosis deorsum decoloribus, receptaculi paleis late oblongis cuspidulatis carinatis, ligulis circa 8 oblongis bifidis vel trifidis involucrum bene excedentibus, achæniis (adhuc crudis) compressis oblongis pubescentibus, pappi squamis deorsum connatis ciliolatis aristis 0.

Hab. Nyassaland; *John Buchanan*, 1895, no. 67.

Folia modice 7·0–8·5 cm. long. (summa breviora), 1·5–2·0 cm. lat., obscure 3-nervia. Petioli 0·2 cm. long. Pedunculi 4·0–6·0 cm. long., graciles, piloso-hispidi. Involucrum fere 1·5 cm. long., basi 0·6 sursum 1·1 cm. diam. Receptaculi paleæ 1·0 cm. long. Flosculorum fem. corollæ 1·8 cm. long., cujus 1·4 cm. ad ligulam pertinet; hæc 0·4 cm. lat., plurinervis. Flosculorum hermaph. corollæ tubus basi subito constrictus, vix 0·7 cm. long., sub limbo fere 0·25 cm. lat.; lobi 0·15 cm. long. Achænia 0·45 cm. long., circa 0·1 cm. lat. Pappus 0·05 cm. long.

Allied to *W. natalensis*, Sond., but different from it in the leaves, involucre, long and narrow ligules, &c. It is remarkably like *Aspilia monocephala*, Baker, which is, however, a true *Aspilia*.

MELANTHERA, *Rohr.*

M. ACUMINATA, sp. nov. Erecta, elata, crebro foliosa, scabrida, foliis lanceolatis obtusis margine grosse serratis e basi leviter coarctata in petiolum abbreviatum desinentibus subtus eminenter et delicatule reticulatis, corymbis paucicapitulatis apertis folia excedentibus, capitulis mediocribus longipedunculatis, involucri scabridi 3-seriatis phyllis lanceolatis acutis et basibis dilatatis insertis interioribus quam illa paullo angustioribus necnon acuminatis, receptaculi paleis ovato-oblongis apice cuspidato-acuminatis ibique scabridis, achæniis parvis ovoideis subquadrangularibus nitidis glabris setis 1–3 caducissimis levibus coronatis.

Hab. British East Africa, Kavirondo; *G. F. Scott Elliot*, no. 7052.

Ramuli albidi, in longitudinem canaliculati et striati, circa 0·25 cm. diam. Folia 7·0–10·0 cm. long., 1·3–2·5 cm. lat., firme membranacea; petioli vix 0·5 cm. long., ima basi dilatati. Corymbi circa 11·0 cm. long. Pedunculi 2·5–4·5 cm. long. Capitula sicca fructescentia 0·8 cm. diam. Involucri phylla 0·6 cm. long., exteriora 0·22 cm. interiora 0·18 cm. lat. Receptaculi paleæ 0·65 cm. long. Disci flosculorum corollæ a basi sensim amplificatæ, 0·4 cm. long. Achænia 0·2 cm. long., 0·16 cm. lat., nigra, horum setæ 0·13–0·2 cm. long.

Nearest *M. pungens*, Oliver & Hiern, which has broadly ovate, almost smooth, thinly membranous leaves, broader involucral leaves, achenes half as large again, &c. I have not seen the ligules.

GUIZOTIA, *Cass.*

G. SCHULTZII, *Hochst.*

Nyassaland, 1895; *J. Buchanan*, no. 69. Near Lake Marsabit; *Lord Delamere.*

Var. SOTIKENSIS, var. nov. A typo discrepat ob involucri phylla brevia, flosculos abbreviatos, achæniaque quam ea typi minora.

British East Africa, Sotik; *F. J. Jackson.*

This should perhaps be regarded as a distinct species.

ASPILIA, *Thouars.*

A. KOTSCHYI, *Benth. & Hook. fil.*

Nyanza (not stated whether Victoria or Albert Edward Nyanza); *G. F. Scott Elliot*, no. 7136.

Aspilia Eenii, sp. nov.; caule erecto angulato una cum ramulis strictis sparsim foliosis scabriusculo, foliis breviter et late petiolatis lanceolatis vel lanceolato-linearibus obtusis acutisve basi acutis scaberrimis margine rarissime et brevissime denticulatis firme membranaceis, capitulis mediocribus longipedunculatis (sc. pedunculis folia magnopere superantibus), involucri 3-seriati phyllis herbaceis lanceolatis vel ovato-lanceolatis acutis exterioribus scabriusculis ciliolatis intimis glabris, receptaculi paleis oblongis inæqualiter 2–3-fidis, ligulis circa 8 late oblongis bifidis deorsum coarctatis, achæniis hispidulis flosculorum exteriorum triquetris 2–3-aristatis interiorum 2-aristatis adjectis squamellis parvis lanceolatis.

Hab. Damaraland; *T. G. Een.*

Folia 4·0–6·0 cm. long., summa vero usque ad 2·0 cm. imminuta, 0·5–1·0 cm. lat.; petioli 0·2–0·4 cm. long. Pedunculi circa 10·0 cm. long., scabridi. Involucra 1·0 cm. long., vix totidem lat.; phylla exteriora 0·8–1·0 cm. long., 0·2–0·4 cm. lat., striato-nervosa, sursum majus viridia; intima 0·7 cm. long. Receptaculi paleæ 0·7 cm. long. Ligulæ 1·2–1·4 cm. long., 0·5 cm. lat. Achænia 0·3 cm. long., horum aristæ 0·3–0·5 cm. long., basi leviter incrassatæ, scabriusculæ; squamellæ 0·05 cm. long.

Apparently nearest *A. Welwitschii*, O. Hoffm., but differing from it in shape of leaf, elongated peduncles, shape of receptacular paleæ, achenes, &c.

A. zombensis, *Baker*, var. longifolia, var. nov. Folia modice 7·0–12·0 cm. long.

Nyassaland, 1895; *J. Buchanan*, no. 24. Shiré country; *G. F. Scott Elliot*, no. 8555.

Coreopsis, *Linn.*

C. ruwenzoriensis, sp. nov. Glaberrima, verisimiliter elata, ramulis validis ascendentibus perspicue striatis, foliis sessilibus per paria connatis oblongis vel oblongo-oblanceolatis margine subgrosse simpliciterque serratis firme membranaceis, capitulis majusculis ramulos abbreviatos singillatim coronantibus, involucri 3-seriatis phyllis lanceolato-oblongis obtusis intimis quam reliqua manifeste brevioribus necnon margine decoloribus, ligulis circa 12 luteis, achæniis maxime compressis oblongis basi levissime angustatis margine apiceque ciliatis faciebus striolatis et scabridis, pappi aristis 2 brevibus nudis debilibus.

Hab. Ruwenzori Mountain; *G. F. Scott Elliot*, no. 7410.

Ramuli ultimi 0·2–0·3 cm. diam. Folia fere usque ad 3·0 cm. long. et 0·8 cm. lat., superiora vero 1·0–1·5 cm. long., 0·4–0·5 cm. lat. Capitula pansa circa 3·5 cm. diam. Involucri phylla extima usque ad 2·0 cm. long., 0·5 cm. lat.; intima 1·2 cm. long. Ligulæ anguste ovato-oblongæ, plurinervosæ, apice undulatæ, 2·3–2·5 cm. long., summum 1·0 cm. lat. Receptaculi paleæ lineari-lanceolatæ, obtusæ acutæve, 1·2 cm. long. Achænia grisea, 0·6 cm. long., 0·2 cm. lat.; pappi setæ 0·2 cm. long.

To be compared with *Coreopsis coriacea*, O. Hoffm., a plant known to me by description only, which indicates its possession of larger capitula (6 cm. in diameter), ovate involucral leaves the innermost of which are longer than the rest, just the reverse of what is seen when one examines the involucre of *C. ruwenzoriensis*, &c.

Coreopsis Elliotii, sp. nov. Ascendens, fere omnino glabra, verisimiliter parva, ramosa, ramulis gracilibus striolatis crebro foliosis, foliis sessilibus pinnatisectis segmentis anguste linearibus pinnatifidis vel (foliorum superiorum) simplicibus foliis summis simplicibus anguste linearibus, capitulis mediocribus laxe corymbosis pedunculatis, pedunculis mox puberulis, involucri 3-seriatis phyllis exterioribus linearibus comparate elongatis necnon foliis summis similibus intermediis ovato-oblongis obtusis lutescenti-marginatis dorso pubescentibus intimis his similibus nisi paullo minoribus et glabris, ligulis circa 8 verisimiliter aurantiacis, achæniis compressis lineari-oblongis margine apiceque ciliatis faciebus unicostatis scabridis, pappi aristis 2 scabridis quam achænia admodum brevioribus.

Hab. Ruwenzori Mountain at 9600 feet; *G. F. Scott Elliot*, no. 7724.

Planta saltem 25·0 cm. alt. Caulis fistulosus, ad nodos aliquantulo tumidus. Folia modica circa 4·0 cm. long.; horum lobi 1·0–2·0 cm. long. et 0·1–0·15 cm. lat.; folia summa circa 1·5 cm. long. Pedunculi paullo post anthesin usque ad 5·5 cm. elongati, sæpius vero parum breviores. Capitula florescentia 2·0 cm. diam. Involucri phylla extima 1·0 cm. long.; intermedia 0·7 cm. long., 0·35 cm. lat.; intima 0·5 cm. long. Receptaculi paleæ lanceolato-oblongæ, obtusissimæ, medio pauci-purpureo-nervosæ. Ligula obovato-oblonga, apice integra, 1·2 cm. long., 0·5 cm. lat. Achænia subpallide grisea, 0·8 cm. long., 0·1–0·13 cm. lat. Pappi setæ vix omnino æquilongæ, 0·3 cm. long.

This has much the look of *Coreopsis Prestinaria*, Sch. Bip., but with leaves more deeply divided and linear-lobed, longer outer involucral leaves and pubescent middle ones, broader ligules, shorter and narrower setæ to the achenes, &c.

Coreopsis ugandensis, sp. nov. Verisimiliter elata, molliter pubescens, ramulis teretibus striatis solidis, foliis sessilibus basi connatis usque ad medium trilobatis lobis anguste linearibus lobo intermedio laterales plerumque superante, capitulis mediocribus solitariis pedunculatis, pedunculis modicis folia excedentibus, involucri 2-seriatis phyllis exterioribus oblongo-linearibus obtusis quam interiora ovato-oblonga obtusissima margine scariosa dorso hispidula brevioribus, ligulis circa 8 late oblongis apice tridentatis, achæniis oblongis compressis margine apiceque ciliatis faciebus unicostatis ibique sursum puberulis, pappi aristis 2 brevibus tenuibus nudis.

Hab. Uganda; *G. F. Scott Elliot*, no. 7520.

Folia 3·0–5·0 cm. long.; lobi laterales 1·2–2·0 cm. long., intermedius 4·0 cm. attingens (sæpissime vero brevior), et 0·1 cm. lat. Pedunculi modici 5·0–8·0 cm. long. Capitula pansa circa 2·5 cm. diam. Involucri phylla exteriora 0·55 cm. long., 0·1 cm. lat.; interiora 0·85 cm. long., 0·4 cm. lat. Receptaculi paleæ oblongo-lineares, obtusissimæ, 0·6 cm. long. Ligulæ 1·5 cm. long., summum 0·6 cm. lat. Achænia 0·6–0·7 cm. long., 0·1 cm. lat., brunnea; aristæ 0·13 cm. long.

The pubescence, narrowly lobed leaves, solitary heads on long peduncles, and the narrower outer and much broader and hispidulous inner leaves of the involucre are the chief distinctive points of this species.

C. Jacksoni, sp. nov. Glabra, caule valido crebro folioso striato, foliis parvis sessilibus connatis ovatis vel oblongo-obovatis obtusissimis margine distanter undulato-denticulatis vel integris et albo-ciliolatis, capitulis mediocribus solitariis subsessilibus, involucri 2-seriatis phyllis exterioribus oblongis obtusissimis dorso puberulis margine ciliatis omnino herbaceis quam interiora ovata obtusa itaque ciliata manifeste longioribus, ligulis circa 8 anguste obovatis, achæniis (crudis) valde compressis glabris exaristatis.

Hab. British East Africa, Kikuyu; *F. J. Jackson.*

Folia 1·5–3·0 cm. long., 1·0–1·5 cm. lat., per paria approximata, firme membranacea. Capitula pansa circa 2·5 cm. diam. Involucri phylla exteriora paullo ultra 1·0 cm. long., 0·33 cm. lat., paucinervosa; interiora 0·65 cm. long., quam illa tenuiora et distantius nervosa. Receptaculi paleæ oblongæ, acutæ, distanter paucinervosæ, 0·5 cm. long. Ligulæ 1·7 cm. long., usque 0·8 cm. lat., apice tridentatæ, 9–11-nervosæ. Achænia immatura 0·3 cm. long., 0·1 cm. lat.

The material serving for the above description is unfortunately a mere scrap, but the plant seems so different from any *Coreopsis* hitherto known, that I have no hesitation in giving it a name. The very small ovate epetiolate crowded leaves, the subsessile solitary capitula, and exaristate achenes are the main characteristics here.

Coreopsis Whytei, sp. nov. Verisimiliter elata, foliosa, caule erecto subtereti striato solido pubescente mox glabrato, foliis petiolatis pinnatifidis segmentis ovatis acutis dentato-lobulatis foliis summis sessilibus lanceolatis dentato-lobulatis integrisve foliis omnibus supra glabris subtus pubescentibus, capitulis submajusculis pedunculatis pedunculis quam folia brevioribus, involucri 3-seriatis phyllis exterioribus et intermediis anguste obovatis obtusis sursum puberulis obscure nervosis quam intima oblonga obtusa tenuiora decoloria pluri-purpureo-nervosa longioribus, ligulis —, achæniis maxime compressis angustissime alatis faciebus striatis apice incrassatis glabris exaristatis.

Hab. Mount Milanji, Nyassaland; *A. Whyte*, 1891, no. 35.

Caulis 0·4–0·5 cm. long., ad nodos tumidus. Folia modice 6·0–8·0 cm. et horum lobi 1·0–1·5 cm. long.; petioli 2·0–3·0 cm. long. Pedunculi 2·0–4·0 cm. long., pubescentes. Capitula circa 3·0 cm. diam. Involucri phylla exteriora 1·2 cm. long., summum 0·7 cm. lat.; intima vix 1·0 cm. long. Receptaculi paleæ oblongo-lanceolatæ, obtusissimæ, plurinervosæ, fere 1·0 cm. long. Achænia 0·5 cm. long., 0·2 cm. lat., griseo-brunnea.

This has some resemblance to *C. speciosa*, Hiern, of which the leaves are differently shaped, the involucre is not quite similar although nearly so, and *inter alia* the achenes are much longer and relatively narrower and provided with aristæ.

C. Kirkii, *Oliver & Hiern.*

Mau Forest; *F. J. Jackson.* Mau, 8000 feet; *G. F. Scott Elliot*, no. 6909.

COREOPSIS KILIMANDSHARICA, *O. Hoffm.*
Tropical East Africa; *Rev. W. E. Taylor.*

BIDENS, *Tourn.*

B. LINEARILOBA, *Oliver.*
Leikipia; *Dr. J. W. Gregory.*

B. ROBUSTIOR, sp. nov. Verisimiliter elata et erecta, crebro ramosa, ramulis validis teretibus striatis solidis hispidulis deinde glabris, foliis sessilibus pinnatim-trilobis lobis ovatis vel ovato-lanceolatis acutis grosse crenato-serratis raro lobulatis foliis summis lanceolatis integris omnibus supra scaberrimis subtus hispidulis, capitulis magnis brevi- vel longius pedunculatis cymam paucicapitulatam strictam angustam sparsim foliatam folia longe excedentem efformantibus, involucri 4-seriatis phyllis serr. I. et II. lineari-lanceolatis sursum herbaceis et utrinque hispidulis basi ciliatis quam interiora lanceolata dorso hispido-scaberrima decoloria longioribus, ligulis circa 14 oblongis apice undulatis, achæniis maxime compressis quam receptaculi paleæ paullo brevioribus anguste lineari-oblongis deorsum leviter attenuatis faciebus scabriusculis unicostatis margine ciliatis, aristis 2 brevibus unco unico vel uncis duobus munitis.

Hab. Masailand, Elmentaita at 6000 feet; *G. F. Scott Elliot*, no. 6846.

Ramuli penultimi 0·3–0·4 cm. long. Folia 4·0–5·0 cm. long.; lobi laterales usque ad 2·0 cm., lobus intermedius usque ad 3·0 cm. long., 1·0–1·5 cm. lat. Pedunculi 1·0–5·0 cm. long., hispiduli. Capitula pansa circa 4·0 cm. diam. Involucri phylla exteriora 1·0 cm. long., 0·17 cm. lat.; interiora 0·7 cm. long., 0·22 cm. lat. Receptaculi paleæ oblongæ, obtusæ, paucinervosæ, 0·8–1·0 cm. long. Ligulæ 2·5 cm. long., ægre 1·0 cm. lat., circa 12-nervosæ. Disci corollæ 0·6 cm. long. Achænia 0·6–0·8 cm. long., 0·15 cm. lat., sed aliqua angustiora et sterilia; aristæ vix 0·2 cm. long.

Easily distinguished by reason of the robust habit, large heads, hispid involucres, and achenes shorter than the receptacular paleæ.

The hooks on the awns are very slender and closely apposed to the shaft; on this account the plant might easily be mistaken for a *Coreopsis.*

B. LEUCANTHA, *Willd.*
Mount Kenia district; *H. J. Mackinder.*

Bidens ukambensis, sp. nov. Verisimiliter elata, pubescens, ramulis subteretibus striatis solidis sparsim foliosis, foliis subcoriaceis sessilibus pinnatim trisectis segmentis ovatis acutis paucilobatis segmento intermedio itaque trilobo, capitulis subsessilibus pedunculatisve, involucri 2-seriatis scabrido-pubescentis phyllis exterioribus oblongis obtusis herbaceis ab interioribus tenuibus decoloribus margine scariosis intus glabris paullulum superatis, ligulis circa 8 obovato-oblongis apice integris, achæniis receptaculi paleas haud excedentibus lineari-oblongis maxime compressis apice setosis faciebus insigniter unicostatis, pappi aristis 2–4 (sæpius 3 raro 4) nunc omnino levibus nunc unco unico prominulo instructis.

Hab. Ukamba at 5–6000 feet; *G. F. Scott Elliot*, no. 6462.

Ramuli ultimi circa 1·0 cm. diam. Folia summum 5·0 cm. long., sæpe vero breviora; segmenta lateralia 2·0–2·5 cm. long., 1·5 cm. lat. Pedunculi 5·0 cm. long. attingentes, sæpius circa 1·0 cm. long. Capitula pansa circa 3·0 cm. diam. Involucri phylla exteriora 1·4 cm. interiora 1·5 cm. long. Receptaculi paleæ lineari-oblongæ, obtusissimæ, obscure nervosæ, 0·75 cm. long. Ligulæ circiter 12-nervosæ, 1·5 cm. long., 0·7 cm. lat. Disci corollæ 0·55 cm. long. Achænia circa 5·0 cm. long., 0·1 cm. lat.; aristæ 0·1–0·25 cm. long.

Near the last, but with slender habit, smaller heads, different involucre, shorter ligules, and apically strongly setose achenes with their usually three awns either smooth or with a hook standing well out from the shaft of the awn.

Tribe Helenioideæ.

Hypericophyllum, *Steetz.*

H. scabrum, *N. E. Br.*

Nyassaland; *J. Buchanan*, 1895, no. 68.

Tribe Anthemideæ.

Eriocephalus, *Linn.*

E. Lüderitzianus, *O. Hoffm.* (ex descript.).

Damaraland; *T. G. Een.*

The specimen agrees in every respect with Dr. Hoffmann's description in Bull. Herb. Boiss. i. 1893, p. 86.

Eriocephalus Eenii, sp. nov. Fruticulosus, sparsim ramosus, ramis patentibus striatis sericeo-pubescentibus demum glabris, foliis anguste linearibus supra pubescentibus subtus sericeis foliis minoribus pseudo-fasciculatis ex axillis oriundis, capitulis paucis terminalibus vel subterminalibus mediocribus brevipedunculatis, involucri phyllis exterioribus 4 late ovatis obtusissimis obtusisve appresse sericeis, phyllis interioribus totidem liberis extus villosissimis, capitulis multiflosculosis, flosculis extimis tubulosis æqualiter vel inæqualiter 4-fidis diandris, antherarum loculis imminutis, styli ramis inæqualibus, flosculorum reliquorum limbo amplificato 5-lobo, antheris sursum subito appendiculatis, stylo clavellato integro.

Hab. Damaraland; *T. G. Een.*

Folia majora 1·0 cm. × 0·05 cm., patentia. Pedunculi circa 0·5 cm. long., sericeo-pubescentes. Capitula 0·6 cm. diam. Involucri phylla exteriora et interiora 0·4 cm. long. Paleæ lineares vel lineari-lanceolatæ, villosissimæ, harum lamina 0·2 cm. long. Flos. ext. corolla circa 0·3 cm. long., basi 0·04 cm. diam., sursum subito usque ad 0·12 cm. dilatata; lobi lanceolati, 0·1 cm. long. Flos. ext. antheræ 0·08 cm. long., verisimiliter cassæ: horum styli ramus alter satis attenuatus alterum latiorem excedens vel eo brevior. Achænia immatura compressa, 0·12 cm. long.

Allied to *E. Lüderitzianus,* and like it presenting the peculiarity of tubular instead of radiate outermost florets. The longer leaves pubescent above instead of silky all over, the four-leaved involucre and quadrifid corollas of the outermost florets, together with the diandrous condition of the latter, give the plant abundant claims to specific rank.

Anthemis, *Linn.*

A. Cotula, *Linn.*, var. atromarginata, *Vatke.*

Mau Forest; *F. J. Jackson.*

A remarkable form, stout and erect in growth, with larger heads than ordinary on unusually stout peduncles. This variety should, I think, be considered a distinct species, and this was the opinion of J. Gay as well as of Schultz Bipontinus.

Tribe Senecionideæ.

Gongrothamnus, *Steetz.*

G. Hildebrantii, *Oliver & Hiern.*

Mombasa; *G. F. Scott Elliot*, no. 6111.

CRASSOCEPHALUM, *Moench.* (Gynura, *Cass.*)

C. RUWENZORIENSE, sp. nov.; caule ascendente angulato canaliculato puberulo, foliis petiolatis ovato-deltoideis acutis basi aperte cordatis marginibus calloso-dentatis vel dentato-lobulatis carnosulis glabris, corymbis dense multicapitulatis rari- et parvifoliatis, capitulis mediocribus homogamis (flosculis omnibus hermaphroditis) circa 30-flosculosis, involucri subcylindrici phyllis 8 lineari-oblongis obtusis margine hyalinis adjectis paucis exterioribus minimis, flosculis involucrum bene superantibus, antheris basi minutissime sagittatis, achæniis immaturis cylindricis apice dilatatis 8–10-striatis glabris, pappi setis quam corolla paullo brevioribus scabriusculis.

Hab. Ruwenzori Mountain, 7–8000 feet; *G. F. Scott Elliot*, no. 7777.

Foliorum lamina 6·0–7·0 cm. long., 6·0 cm. lat.; costa centralis pinguis, costæ secundariæ paucæ, superiores obscures; petioli 3·0 cm. long., crassiusculi, basi dilatati. Corymbi 8·0–10·0 cm. diam., puberuli. Capitula 1·2 cm. long. Involucrum 0·8 cm. long., 0·6 cm. diam.; phylla 0·25–0·3 cm. lat., dorso carinulata. Corollæ paullo ultra 1·0 cm. long.; tubus angustus, ima basi necnon faucibus ampliatus; lobi deltoideo-lineares, 0·2 cm. long. Styli rami appendicibus subulatis adjectis 0·4 cm. long.

Known at once by the broadly cordate dentate or dentate-lobulate leaves and densely massed capitula.

C. VITELLINUM (*Gynura vitellina*, Benth.).
British East Africa, Sotik and Mau Forest; *F. J. Jackson.*

C. DIVERSIFOLIUM, *Hiern*, var. CREPIDIOIDES.
Valley of the Thika-Thika; *Dr. J. W. Gregory.* Somaliland, Sheik Mahomet; *Dr. Donaldson Smith.* Kikuyu; *F. J. Jackson.*

CINERARIA, *Less.*

C. BUCHANANI, sp. nov. Erecta, puberula, caule lignoso valido ramoso albo, foliis magnis late deltoideo-cordatis 5–7-lobatis lobis irregulariter dentatis tenuiter membranaceis inferioribus longissime superioribus brevius petiolatis, capitulis parvis heterogamis radiatis circa 20-flosculosis in cymas sublaxas multicapitulatas longipedunculatas terminales vel axillares digestis, nvolucri phyllis 8–9 oblongis vel oblongo-linearibus obtusis acutisve inæquilatis additis paucis subulatis minimis, ligulis 4–5 involucrum excedentibus oblongis brevissime 3-dentatis, disci flosculis omnibus fertilibus, antheris basi integris, achæniis omnibus sed præsertim exterioribus compressis apice cupulato-dilatatis.

Hab. Nyassaland; *J. Buchanan*, 1895, no. 10.

Planta fere semimetralis. Caulis deorsum 0·5 cm. diam., subteres, striatus. Foliorum lamina 5·0–7·0 cm. long., 6·0–8·0 cm. lat., sed folia superiora minora; petioli foliorum inferiorum 9·0–10·0 cm. long., 0·2–0·25 cm. lat., foliorum omnium basi auriculis duabus dentatis 0·3–0·5 cm. alt. instructi. Pedunculi modici 5·0–10·0 cm. long. Cymæ saltem 20-capitulatæ, 3·0–7·0 cm. diam. Involucrum 0·4 cm. long.; phylla 0·5–1·0 cm. lat., exteriora circa 0·15 cm. long. Ligulæ 0·45 cm. long., vix 0·2 cm. lat., 4-nervosæ. Disci corollæ sursum gradatim amplificatæ, 0·4 cm. long. Antheræ corollarum lobos paullo excedentes vel æquantes. Achænia immatura 0·1 cm. long.

Distinguished by the long-stalked very broad leaves, many-headed cymes, small heads, 8-lobed involucres, &c.

There is at Kew a specimen of this collected by Mr. A. Whyte in Nyassaland.

Cineraria kilimandsharica, *Engl.*

Sotik; *F. J. Jackson*. Mt. Kenia, 10,000 feet; *H. J. Mackinder*.

Notonia, *DC.*

N. trachycarpa, *Kotschy*.

Somaliland, Habrawal; *Dr. Donaldson Smith*. Dadáro; *Lord Delamere*.

N. Grantii, *Oliver & Hiern*.

Somaliland, Gan Liban; *Dr. Donaldson Smith*. Wagga Mt.; *Mrs. Lort Phillips*. Leikipia; *Dr. J. W. Gregory*. Between Zanzibar and Uyui; *Rev. W. E. Taylor*.

N. coccinea, *Oliver & Hiern*.

Near Lake Marsabit; *Lord Delamere*.

N. abyssinica, *Rich.*

Rabai, Mombasa; *Rev. W. E. Taylor*.

N. Gregorii, sp. nov. Glabra, caule carnoso pingui foliorum lapsorum cicatriculis munito, capitulis submajusculis solitariis longissime pedunculatis, pedunculis striatis omnino nudis, involucri phyllis 9 lineari-oblongis obtuse-acutis additis perpaucis exterioribus minimis, achæniis striatis puberulis, pappi setis quam flosculos paullulum longioribus sericeis.

Hab. British East Africa, Malewa River; *Dr. J. W. Gregory.*

Caulis circa 15·0 cm. alt., in sicco usque ad 1·0 cm. crassus, hac atque illac torulosim angustatus, apice bifurcatus. Pedunculi 13·0 cm. alt. Capitula 1·0 cm. long. Involucri 1·5 cm. long. et lat. phylla striata, in sicco fusca; phylla exteriora setacea, 0·2 cm. long. Flosculorum corollæ 1·8 cm. long., dimidio superiore parum dilatatæ; lobi anguste lineari-lanceolati, obtusi, 0·4 cm. long. Styli rami 0·5 cm. long.; appendices ovatæ, 0·035 cm. long. Achænia nondum matura 0·2 cm. long.; pappi setæ 1·9 cm. long., omnes simplices.

Distinguished chiefly by the fleshy stem, long naked peduncles, 9-leaved involucre, and pappus slightly longer than the corollas.

SENECIO, *Linn.*

S. DISCIFOLIUS, *Oliver.*

Ukamba and Kikuyu; *Dr. J. W. Gregory.*

S. EMILIOIDES, *Sch. Bip.*? (*Emilia integrifolia*, Baker.)

Mau, 7–8000 feet; *G. F. Scott Elliot*, no. 6864.

I have not seen authentic specimens of *S. emilioides*, and Schultz's description is exceedingly short. Possibly a distinct species.

S. MONTUOSUS, sp. nov.; caule robusto sulcato superne ramoso folioso strigoso-pubescente mox puberulo, foliis petiolatis ovato-oblongis acutis margine serratis lobulatisve scabriusculis petiolis laminæ sæpe fere æquilongis medio bi-appendiculatis basi haud dilatatis puberulis, capitulis parvis homogamis in cymas densiusculas pluricapitulatas quam folia breviores digestis, pedunculis propriis involucra subæquantibus bracteis parvis setaceis onustis, involucri cylindrici calyculati glabri phyllis 12 oblongo-linearibus obtusis margine late hyalinis, flosculis circa 60 involucrum bene superantibus, styli ramis apice penicillatis appendice brevissima acuta coronatis, achæniis immaturis cylindricis glabris, pappi setis albis integris.

Hab. British East Africa, between Machakos and Kikuyu, 5–6000 feet; *G. F. Scott Elliot*, no. 6587.

Foliorum lamina 4·0–6·0 cm. long., 2·0–2·5 cm. lat., tenuiter membranacea; petioli 2·0–5·0 cm. long., horum appendices circa

1·0–1·5 cm. long., serratæ. Cymæ circa 2·5 cm. diam. Bracteæ circa 0·15 cm. long. Involucrum 0·65 cm. long., 0·4 cm. lat. Calyculi phylla 0·15 cm. long. Corollæ aurantiacæ, 0·7 cm., styli rami 0·15 cm., achænia 0·08 cm., pappus ægre 0·6 cm. long.

Distinguished by the appendaged petioles, rather dense cymes of small somewhat *Emilia*-like heads, the 12 involucral leaves, numerous florets with corollas projecting well beyond the involucre, and the extremely small (young) achenes.

Var. *minor*. Folia brevipetiolata, in toto nec ultra 4·0 cm. long., calloso-serrata. Capitula paullo minora (0·6 cm. long.), tantum 40-flosculosa, et corollæ parum breviores.

Hab. Ruwenzori Mountain, 9600 feet; *G. F. Scott Elliot*, no. 7729.

SENECIO RUWENZORIENSIS, sp. nov. Herbaceus, glaber, caule folioso angulato striato aliquantulo sinuato, foliis sessilibus oblongis obtusis deorsum sensim angustatis membranaceis, paniculis elongatis paucicapitulatis rari- necnon parvibracteatis, pedunculis propriis involucra sæpe longe superantibus nudis vel fere nudis, capitulis submediocribus heterogamis multiflosculosis sæpe calyculatis, involucri subhemisphærici phyllis circa 15 lineari-oblongis obtusis margine hyalinis, ligulis circa 8 involucrum superantibus, flosculis hermaph. circa 40, styli ramis truncatis penicillatis, achæniis immaturis cylindricis pilosiusculis, pappi setis albis scabridis quam involucrum brevioribus.

Hab. Ruwenzori Mountain, at 5000 feet; *G. F. Scott Elliot*, no. 8043.

Planta circa 60·0 cm. alt. Folia 5·0–6·0 cm. long., circa 1·5 cm. lat., costa media subtus eminens. Paniculus circa 25·0 cm. long., pauciramosus, hujus bracteæ nequaquam ultra 1·0 cm. long. Pedunculi proprii 0·7–4·0 cm. long., graciles. Involucrum 0·7 cm. long., vix 1·0 cm. lat.; phylla 0·1–0·15 cm. lat. Calyculi phylla perpauca, setacea, 0·1 cm. long. Ligulæ luteæ, anguste obovato-oblongæ, apice vix denticulatæ, 0·5 cm. long. Flosculi hermaph. 0·55 cm. long. Achænia fusca, 0·2 cm. long. Pappus circa 0·5 cm. long.

Differs from *S. latifolius*, DC., in possessing broader capitula with more leaves to the involucre, a greater number of ray-florets, smaller, much more numerous disk-florets, &c.

S. URUNDENSIS, sp. nov. Elatus, præter collum lanosum glaber, caule erecto valido sursum ramoso subtereti insigniter striato, foliis radicalibus fere omnino evanidis, caulinis sessilibus haud decurrentibus ovatis vel ovato-oblongis acutis basi truncatis vel obtusis margine dentatis vel undulatis nervo centrali subtus prominulo, paniculis folia excedentibus multicapitulatis rari- et parvibracteatis, pedunculis propriis plerumque capitula excedentibus gracilibus, capitulis submediocribus homogamis circa 25-flosculosis, involucri subturbinati calyculati phyllis 12 lineari-lanceolatis acutis marginibus late hyalinis, calyculi phyllis perpaucis (circa 3), flosculis involucrum vix superantibus, styli ramis subcapitellatis truncatis penicillatis, achæniis immaturis parvis cylindricis 5-costatis puberulis, pappi setis albis integris quam corolla paullo brevioribus.

Hab. Urundi, 4–5000 feet; *G. F. Scott Elliot*, no. 8181.

Caulis usque ad 80·0 cm. alt., deorsum fere 0·5 cm. diam. Folia caulina modice 6·0–8·0 cm. long. (summa parum imminuta) et 2·0–3·0 cm. lat. Paniculi 12·0–15·0 cm. long. Pedunculi proprii usque ad 3·5 cm. long.; horum bracteæ anguste lineares, circa 0·5 cm. long. Involucrum 0·8 cm. long., deorsum 0·3 cm. sursum 0·55 cm. diam. Calyculi phylla setacea, circa 0·7 cm. long. Corollæ luteæ, 0·6 cm., styli rami 0·1 cm., achænia 0·12 cm. et pappus 0·55 cm. long.

Also near *Senecio latifolius*, DC., but differing from it, *inter alia*, in its homogamous capitula, its involucres, &c.

SENECIO BASIPINNATUS, *Baker*.

Near Lake Marsabit; *Lord Delamere*.

S. KARAGUENSIS, *O. Hoffm.* (ex descript.).

Urundi and Ruwenzori district, 4–5000 feet; *G. F. Scott Elliot*, nos. 7478, 8198.

S. MULTICORYMBOSUS, *Klatt*.

Ruwenzori; *G. F. Scott Elliot*, nos. 7635, 7843.

S. TRANSMARINUS, sp. nov. Ascendens, glaber, caule tereti folioso in longitudinem striato, foliis sessilibus oblanceolato-oblongis obtusis crebro necnon impariter calloso-dentatis basibus cordatis vix sagittatis amplexicaulibus, capitulis mediocribus heterogamis radiatis in paniculos sat apertos pluricapitulatos bracteatos folia longe excedentes digestis, pedunculis propriis involucra longe excedentibus vel subæquantibus, involucri cylindrici calyculati puberuli phyllis circa 13 linearibus acutis alterorum marginibus hyalinis alterorum membranaceis, ligulis circa 10 involucrum longe excedentibus, flosculis hermaph. circa 40 horum corollis involucro subæquialtis, styli ramis truncatis penicillatis, achæniis cylindricis 5-costatis glabris, pappi setis albis scabriusculis.

Hab. Ruwenzori Mountain, 8–9000 feet; *G. F. Scott Elliot*, no. 7730.

Folia 5·5–6·0 cm. long., 2·0–2·5 cm. lat., subtus obtuse puberula pallidioraque. Paniculi circa 20·0 cm. long.; hujus bracteæ inferiores foliaceæ, 3·0–5·0 cm. long., superiores lineari-setaceæ, summum 1·5 cm. long. Pedunculi proprii 4·0 cm. long. raro attingentes interdum vix 1·0 cm., graciles, paucibracteati. Involucrum circa 1·0 cm. long., 0·6 cm. lat. Calyculi phylla pauca, linearia, nunc involucrum subæquantia nunc quam id manifeste breviora. Ligulæ luteæ, oblongæ, apice integræ, 1·0 cm. long. Flosculorum hermaph. corolla 0·7 cm., styli rami 0·12 cm., achænia 0·6 cm., pappus 0·6 cm. long.

Apparently near *Senecio confertus*, Sch. Bip., but with many weighty points of divergence in respect of leaf, involucre, florets, &c.

SENECIO SOTIKENSIS, sp. nov. Herbaceus, perennis, glanduloso-pubescens, caule stricto valido dense folioso, foliis sessilibus oblongis obtusis basi amplexicaulibus pinnatifido-lobatis lobis utrinque circa 8 rotundatis obtusissimis integris, capitulis mediocribus heterogamis radiatis in corymbos breves terminales paucicapitulatos foliis æquilongos digestis, pedunculis propriis capitula excedentibus vel æquantibus glanduloso-pubescentibus bracteis subsetaceis onustis, involucri campanulati calyculati breviter pubescentis phyllis circa 22 anguste lineari-lanceolatis acuminatis marginibus hyalinis, calyculi phyllis paucis sat elongatis, ligulis circa 20 involucrum bene superantibus, flosculis hermaphroditis circa 60–70, achæniis immaturis cylindricis apice leviter attenuatis glabris, pappi setis albis scabridis quam involucrum brevioribus.

Hab. British East Africa, Sotik; *F. J. Jackson.*

Planta usque ad 40·0 cm. alt. Caulis summum 0·5 cm. diam., angulatus, foliis fere omnino obtectus. Folia chartacea, modice 4·0–5·0 cm. long., 1·5 cm. lat.; horum lobi 0·4–0·6 cm. long. et 0·4 cm. lat. Corymbi circa 5·0 cm. long.; pedunculi proprii circa 1·0–1·5 cm. long.; horum bracteæ circa 0·8 cm. long. Involucrum 1·0 cm. long. et lat. Ligulæ ægre 1·5 cm. long., luteæ, oblongæ, apice brevissime 3-dentatæ, 4-nervosæ. Flosculorum hermaph. corollæ 0·7 cm. long. Achænia 0·2 cm. et pappus 0·7 cm. long.

To be inserted in the genus next to *Senecio Purtschelleri*, Engl., from which it differs in its glandular pubescent clothing, the lobed leaves, larger heads with a greater number of narrower involucral leaves, long ligules, &c.

SENECIO TELEKII, *O. Hoffm.*

Mount Kenia, Teleki and Höhnel Valleys; *Dr. J. W. Gregory.*

S. SPARTAREUS, sp. nov.; caule gracili verisimiliter simplici tereti in longitudinem striato glabro fere efoliato, foliis linearibus sursum sensim longeque attenuatis deorsum cauli applicatis necnon eum vaginantibus glabris, capitulis parvis homogamis multiflosculosis in glomerulum apicalem 3–5-capitulatum digestis, involucri late turbinati fere ecalyculati ima basi pubescentis ceterum glabri phyllis 13 oblongis acutis vel breviter acuminatis margine late hyalinis, flosculis fere 40 involucro æquilongis, styli ramis truncatis eximie penicillatis, achæniis immaturis subcylindricis (deorsum paullulum attenuatis) glabris, pappi corollas haud excedentis setis albis scabriusculis.

Hab. Kavirondo, 4–6000 feet; *G. F. Scott Elliot*, no. 7029.

Caulis fere usque ad 40·0 cm. alt., summum 0·15 cm. diam., in sicco stramineus. Folia usque ad 2·5 cm. long., pleraque vero breviora, summum 0·2 cm. lat. Glomeruli circa 2·0 cm. diam. Pedunculi proprii circa 0·5 cm. long., puberuli. Involucrum 0·7 cm. long. et (sursum) lat. Corollæ luteæ, vix 0·5 cm. long. Styli rami vix 0·1 cm., achænia 0·13 cm., pappi setæ vix 0·5 cm. long.

Distinguished by the spartioid habit, the few scale-like leaves, and glomerules of small homogamous capitula.

S. JACKSONI, sp. nov. Planta subacaulis rhizomate sat valido abundanter fibrillifero fulta, foliis arcte congestis linearibus vel angustissime lineari-spathulatis obtusis carnosulis basibus membranaceis aliquantulo dilatatis insertis marginibus sæpissime saltem in sicco maxime revolutis supra scabriusculis subtus præcipue in nervo centrali eminenter albo-pilosis, capitulis mediocribus heterogamis multiflosculosis in corymbos perpaucicapitulatos quam folia brevioribus digestis, pedunculis propriis capitula excedentibus bracteatis, involucri campanulati calyculati glabri phyllis subbiseriatibus circa 20 lineari-lanceolatis acutis marginibus hyalinis, ligulis circa 20 involucrum superantibus, flosculis hermaph. circa 60, achæniis immaturis angustis cylindricis apice paullulum contractis obscure puberulis, pappi setis albis scabriusculis.

Hab. British East Africa, Sotik; *F. J. Jackson.*

Rhizoma 0·4 cm. diam. Caulis 1·0–2·0 cm. alt., foliorum vaginis omnino obtectus. Folia 3·0–6·0 cm. long., in sicco 0·15–0·35 cm. lat. Corymbus summum vix 3·0 cm. long. Pedunculi proprii usque ad 2·0 cm. long.; horum bracteæ lineares, basi dilatatæ, circa 1·0 cm. long., juniores vero breviores. Involucrum 1·0 cm. long., vix totidem lat.; calyculi phylla 0·5 cm. long., erecta. Ligulæ luteæ, obovato-oblongæ, brevissime 3-denticulatæ, 4-nervosæ, 0·8 cm. long. Flosculorum hermaph. corollæ 0·65 cm. long. Styli rami truncati, penicillati, 0·13 cm. long. Achænia 0·15 cm. et pappus 0·7 cm. long.

Perhaps near *Senecio pachyrhizus*, O. Hoffm., but with different leaves and inflorescence, smaller heterogamous capitula, &c.

SENECIO SARMENTOSUS, *O. Hoffm.*
British East Africa; *Dr. J. W. Gregory.*

S. MARANGUENSIS, *O. Hoffm.*
Mt. Ruwenzori, over 10,000 feet; *G. F. Scott Elliot*, no. 8110.

S. CYDONIIFOLIUS, *O. Hoffm.*
Tropical East Africa; *Rev. W. E. Taylor.*

S. MILANJIANUS, sp. nov. Planta herbacea, erecta, glabra, caule crasso humili folioso, foliis longipetiolatis peltatis suborbiculatis margine plurilobulatis tenuiter carnosulis, capitulis mediocribus homogamis paucifloscuiosis in corymbos elatos folia magnopere excedentes deorsum eramosos sparsim bracteatos digestis, pedunculis propriis capitula excedentibus sparsissime bracteatis, involucri cylindrici calyculati phyllis 12–13 linearibus vel anguste lineari-lanceolatis obtusis marginibus hyalinis, flosculis circa 17 involucrum paullulum superantibus, styli ramis truncatis penicillatis, achæniis subcylindricis superne leviter attenuatis 10-costatis dense sericeis, pappi setis substramineis scabridis involucrum paullo superantibus.

Hab. Nyassaland, Mount Milanji; *A. Whyte.*

Caulis 6·0–8·0 cm. alt., 0·5 cm. diam., deorsum sæpe foliorum dilapsorum petiolis quasi fibrillis onustus, intervallis 0·5–1·5 cm. foliigerus. Folia 3·5–6·0 cm. long. et totidem lat., tenuiter palmatinervia, horum lobuli inter se inæquales, sæpissime 0·3–

0·8 cm. long. et 0·5–1·5 cm. lat.; petioli ima basa aliquantulo dilatati, 0·3–0·6 cm. long. Corymbi 16·0–26·0 cm. long., deorsum validi, pluristriati, bracteis sessilibus ovatis oblongisve nec ultra 1·5 cm. long. onusti. Pedunculi proprii 1·5–2·5 cm. long., graciles. Involucrum florescens 1·0 cm. long., 0·7 cm. lat.; hujus calyculi phylla pauca, lineari-setacea, 0·3–0·4 cm. long. Corollæ luteæ, fere 1·0 cm. long. Styli rami 0·17 cm. long. Achænia 0·3–0·35 cm. necnon pappus 0·7 cm. long.

Perhaps near *Senecio tropæolifolius*, O. Hoffm., but different in respect of its lobulate leaves, longer corymbs, longer homogamous capitula, and many other characters.

Senecio nandensis, sp. nov.; caule valido fistuloso subtereti eximie striato folioso glabro, foliis rotundato-ovatis margine grosse et acute dentatis vel etiam lobatis basi late truncatis membranaceis supra glabris subtus crispe pubescentibus petiolis sat longis juxta medium necnon basi auriculatis pubescentibus fultis, capitulis parvis homogamis paucifloscculosis in paniculos cymosos densi- et multicapitulatos digestis, involucri anguste cylindrici calyculati phyllis 8 oblongo-linearibus acutis margine late hyalinis glabris, flosculis circa 12 involucrum insigniter excedentibus, styli ramis truncatis longiuscule exsertis, achæniis immaturis cylindricis puberulis, pappi setis albis scabridis involucrum excedentibus.

Hab. Nandí; *G. F. Scott Elliot*, no 6987.

Caulis circa 0·4 cm. diam. Foliorum lamina circa 4·5 cm. long. et lat.; petioli 2·0–2·5 cm. long. Paniculi 10·0–12·0 cm. long., 5·0–9·0 cm. diam. Pedunculi proprii circa 0·5–0·7 cm. long., bracteis setaceis 0·3–0·5 cm. long. onusti. Involucrum ægre 0·6 cm. long. et 0·4 cm. lat. Calyculi phylla subulata, circa 0·15 cm. long. Corollæ luteæ, 0·8 cm. long. Styli rami 0·2 cm., achænia 0·12 cm., pappus 0·7 cm. long.

Apparently near *S. subscandens*, Hochst., which has somewhat different leaves, capitula fewer together in small cymes, only 5 involucral leaves, &c.

S. Elliotii, sp. nov.; caule debili folioso mox fistuloso sulcato glabro, foliis ovatis vel ovato-oblongis longe acuminatis basi truncatis necnon aliquantulum obliquis margine dentatis vel dentato-lobulatis tenuiter membranaceis petiolis tenuibus sat longis ima basi dilatatis suffultis, capitulis submediocribus homogamis paucifloscculosis in cymas pluricapitulatas paniculum bracteatum folia excedentem efformantes digestis, involucri cylindrici calyculati phyllis 8 linearibus acutis in sicco stramineis marginibus haud hyalinis quam pedunculi proprii gracillimi longioribus, flosculis 11 involucro æquialtis, styli ramis truncatis penicillatis, achæniis immaturis cylindricis 10-costatis glabris, pappi albi setis scabridis quam corollæ paullulum brevioribus.

Hab. Ruwenzori Mountain, 7000 feet; *G. F. Scott Elliot*, no. 7826.

Foliorum lamina 3·0–4·0 cm. long., 1·5–2·3 cm. lat.; petioli 1·5–2·0 cm. long. Paniculi saltem 10·0 cm. long.; cymæ circa 3·0 cm. diam. Bracteæ inferiores foliaceæ, serrulatæ vel undulatæ, 1·5–3·0 cm. long.; superiores setaceæ, 0·3–0·7 cm. long. Penduneuli proprii modice circa 0·5 cm. long. Involucrum 0·8 cm. long. et dimidio lat. Calyculi phylla pauca, circa 0·3 cm. long. Corollæ luteæ, 0·7 cm., styli rami 0·15 cm., achænia 0·1 cm., pappus 0·6 cm. long.

Near the species last described, but with different leaves, fewer florets to the heads, longer and narrower involucral leaves, &c.

Senecio Marlothianus, *O. Hoffm.*

Var. minor, var. nov. Humilior (nec ultra 15·0 cm. alt.). Folia angustiora, modice circa 1·0 cm. long. Capitula vix 1·5 cm. diam. attingentia.

Hab. Damaraland; *T. G. Een.*

Euryops, *Cass.*

E. Jacksoni, sp. nov. Breviter caulescens, glaber, foliis carnosulis sessilibus elongatis anguste linearibus obtusis basi anguste vaginantibus (vaginis calvis) apicem versus caulis confertis, pedunculis axillaribus monocephalis folia multo excedentibus, capitulis pro genere magnis multiflosculosis, involucri phyllis circa 12 usque ad medium partitis ovatis obtusis microscopice ciliolatis trinervibus, ligulis circa 12 involucrum bene excedentibus oblongis apice integris vel brevissime trifidis, achæniis turbinatis conspicue costatis sursum pubescentibus, pappi setis achænio subæquilongis crispis scabridis albis caducissimis.

Hab. British East Africa, Kikuyu; *F. J. Jackson.*

Caulis ex exempll. mihi obviis 5·0–6·0 cm. alt., 0·25 cm. diam., sursum nudus. Folia modice 2·0–2·5 cm. long., 0·1 cm. lat., erecto-patentia. Pedunculi 8·0–10·0 cm. long., striati. Capitula expansa 2·5–3·0 cm. diam. Involucri 0·6 cm. long. phylla modica 0·15 cm. lat. Ligulæ 1·3 cm. long., 0·2–0·25 cm. lat., deorsum gradatim attenuata. Achænia 1·5 cm. long.; pappi setæ 1·3 cm. long.

The affinity of this is with *Euryops Antinorii* (*Werneria Antinorii*, Avetta), which is acaulescent, has much longer leaves and, relatively to those organs, shorter peduncles, also oblong-lanceolate scarioso-ciliate involucral leaves, &c.

Euryopsum Africæ tropicalis conspectus.

§ I. *Angustifoliæ.* Folia acicularia vel anguste linearia.
- Folia parva, acicularia, arcte imbricata.
  - Pedunculi abbreviati sc. capitulo paullo longiores .... 1. *E. dacrydioides*, Oliver.
- Folia elongata, anguste linearia, laxius imbricata.
  - Capitula corymbosa................ 2. *E. pinifolia*, Rich.
  - Capitula pedunculis elongatis solitatim suffulta.
    - Acaulis. Pedunculi folia paullo excedentes. Folia basi dilatata ciliata. Involucri phylla oblongo-lanceolata .... 3. *E. Antinorii*, nob.
    - Caulescens. Pedunculi folia multo excedentes. Folia basi calva. Involucri phylla ovata......... 4. *E. Jacksoni*, nob.

§ II. *Latifoliæ.* Folia oblanceolata vel oblanceolato-obovata.
- Breviter caulescens. Folia conferta.
  - Pedunculi folia multo excedentes .. 5. *E. somalensis*, nob.
- Caulis elongatus. Folia sparsa. Capitula brevius pedunculata .... 6. *E. Osteospermum*, nob.

E. Schenckii, O. Hoffm., in Bull. Herb. Boiss. i. 1893, p. 88, is not included. It is a native of Namaqualand, and probably does not reach the Tropic of Capricorn.

Tribe ARCTOTIDEÆ.

MERIDIANA, *Hill.* (Gazania, *Auct.*)

M. DIFFUSA (*Gazania diffusa*, Spreng.).

Trop. East Africa; *Rev. W. E. Taylor.* Ukamba and Masailand, 5–6000 feet; *G. F. Scott Elliot*, nos. 6421, 6761.

LANDTIA, *Less.*

L. RÜPPELLII, *Benth. & Hook. fil.*

British East Africa, Sotik; *F. J. Jackson.* Leikipia Plateau; *Dr. J. W. Gregory.*

HAPLOCARPHA, *Less.*

H. SCAPOSA, *Harv.*

Lukoma (Likoma?), Lake Nyassa; *Wm. Bellingham.* Stevenson Road and Shiré Highlands, 5-6000 feet; *G. F. Scott Elliot*, nos. 8337, 8583.

CROCODILODES, *Adans.* (Berkheya, *Ehrh.*)

C. SPEKEANUM, *O. Kuntze.*

Kikuyu; *F. J. Jackson.* Ukamba, 5–6000 feet; *G. F. Scott Elliot*, no. 6119.

PLATYCARPHA, *Less.*

P. CARLINOIDES, *Oliver & Hiern.*

Damaraland; *T. G. Een.*

Tribe CYNAROIDEÆ.

ECHINOPS, *Linn.*

E. AMPLEXICAULIS, *Oliver.*

Sotik; *F. J. Jackson*; Karagwe and near Albert Edward Nyanza, 4–5000 feet, nos. 7488, 8059.

E. (§ *Oligolepis*) ANGUSTILOBUS, sp. nov.; caule erecto valido crebro folioso sulcato floccoso-araneoso deinde glabro et rubescente, foliis alte bipinnatisectis subtus araneosis segmentis ultimis anguste linearibus debiliter spinoso-acuminatis integris vel alte 2–5-lobis lobis sæpe basalibus rhachide communi necnon rhachidibus partialibus anguste linearibus, capitulorum glomerulis mediocribus permulticapituliferis manifeste pedunculatis, globosis, receptaculo communi globoso verrucoso, involucri setis quam ejus phylla multo brevioribus stramineis phyllis exterioribus linearibus vel lineari-spathulatis quam intermedia lanceolata sursum longe spinoso-acuminata brevioribus et una cum iis margine sursum rigide ciliatis phyllis intimis fere usque ad medium connatis acutis, receptaculo partiali nudo, corolla bene exserta, antherarum auriculis barbatis, achæniis involucri phylla intima circiter semiæquantibus villosis, pappi setis ima basi connatis.

Hab. Masailand, at 8000 feet; *G. F. Scott Elliot*, no. 7005.

Folia usque ad 17·0 cm. long., juniora vero breviora; horum rhachis nunquam ultra 0·1–0·2 cm. diam.; lobi primarii 2·5–5·0 cm. long.; secundarii plerumque 0·8–1·0 cm. long. et circa 0·1 cm. diam. Pedunculi circa 5·0–8·0 cm. long., araneosi. Glomeruli 3·5 cm. necnon receptaculum commune 1·0 cm. diam. Involucri circa 1·5 cm. long. et 0·7 cm. diam.; horum setæ 0·3–0·9 cm. long.; phylla extima 1·0 cm. intermedia usque ad 1·7 cm., intima 1·4 cm. long. Corolla verisimiliter alba, in toto 1·3 cm. long.; tubus 0·45 cm., pilis brevibus glandulosis sparsiuscule indutus. Achænia 0·8 cm. et pappus 0·15 cm. long.

Easily distinguishable from its congeners, in addition to the characters determining its sectional position, by the weakly spinous leaves with their very narrow divisions and rhachis, by the globular glomerules and common receptacle, &c.

I have not been able to see the outer (common) involucre of this plant.

CARDUUS, *Linn.*

C. RUWENZORIENSIS, sp. nov.; caule ascendente folioso angulato sulcato puberulo mox glabro, foliis ambitu oblongo-lanceolatis deorsum lobatis sursum serrato-crenatis lobulatisve amplexicaulibus nunc longiuscule nunc brevius spinosis membranaceis cito fere omnino glabris subtus pallescentibus adjectis paucis præsertim apicem versus parvis ovatis rarispinosis, capitulis parvis paucis (circa 8) ad apicem caulis approximatis multiflosculosis, pedunculis abbreviatis sc. quam folia brevioribus, pedunculis propriis ab involucris superatis vel iisdem æquilongis, involucri late cylindrici circa 8-seriatis phyllis lanceolatis breviter spinosis (spinis sæpe mox recurvis) dorso eximie nervoso-striatis margine rigide ciliolatis, receptaculo plano, corollis fere usque ad medium partitis, achæniis nondum maturis cylindricis glabris, pappi setis pluriseriatis fuscis scabridis achænia longe excedentibus.

Hab. Mt. Ruwenzori, 10,000 feet; *G. F. Scott Elliot*, no. 8108.

Folia majora modice 8·0–16·0 cm. long., 2·5–3·0 cm. lat.; minora modo 0·6 cm. long., et vix totidem lat.; lobi 0·5–1·3 cm. long.; nervi supra fere plani subtus prominuli et laxe reticulati; spinæ majores 0·5–1·0 cm. minores modice 0·15–0·2 cm. long., omnes basi atratæ sursum stramineæ. Pedunculus communis circa 1·0 cm. long. Involucrum 1·0 cm. long. vel parum majus, 1·2 cm. diam.; phylla extima 0·3–0·4 cm. long.; intermedia

0·6–0·7 cm., intima fere 1·0 cm. long., horum spini terminales 0·1–0·3 cm. long. Receptaculi setæ fuscæ, circa 0·5 cm. long. Corollæ in toto fere 1·5 cm., hujus lobi 0·6 cm. long. Pappi setæ 1·0 cm. long.

Leaves much like those of *Carduus leptacanthus*, Fres., only less deeply divided, but with its small heads and shortly spinose involucral leaves the difference between this and *C. leptacanthus* is very striking.

CARDUUS LEPTACANTHUS, *Fres.*

Mt. Kenia, terminal moraine of sheet glaciation; *Dr. J. W. Gregory*. Mt. Ruwenzori, 5300 feet, and Kiriba, N.E. of Lake Tanganyika, 7–8000 feet; *G. F. Scott Elliot*, nos. 7609, 8379.

Var. STEUDNERI, *Engl.*

Tropical East Africa; *Rev. W. E. Taylor*. Mau; *G. F. Scott Elliot*, no. 6961.

CNICUS, *Linn.*

C. POLYACANTHUS, *Hochst.*

Usambara; *Buchwald*, no. 318.

CENTAUREA, *Linn.*

C. AYLMERI, *Baker*.

Somaliland, above the Upper Sheik; *Mrs. Lort Phillips*. Gan Liban; *Dr. Donaldson Smith*.

Tribe MUTISIACEÆ.

PLEIOTAXIS, *Steetz.*

P. VERNONIOIDES, sp. nov. Verisimiliter herbacea, caule erecto tereti robusto striato albo-tomentoso deinde efoliato sursum sparsim ramoso ramis juvenilibus crebro foliosis, foliis sessilibus anguste lineari-lanceolatis acutis basibus caulem laxiuscule amplectantibus margine crenulatis rugosis supra griseo-araneoso-pubescentibus subtus dense albo-tomentosis, capitulis solitariis majusculis globosis multiflosculosis breviter pedunculatis, involucri phyllis circa 7-serialibus extimis (serr. I.–III.) parvis una cum interioribus manifeste longioribus oblongo-ovatis intimis elongatis et late oblongis omnibus obtusissimis glabris sursum atratis, flosculis exsertis, achæniis anguste cylindricis vel (apicibus leviter coarctatis) subcylindricis pubescentibus quam pappus stramineus paullo brevioribus.

Hab. Near Lake Tanganyika; *G. F. Scott Elliot*, no. 8352.

Caulis 0·4 cm. diam., intervallis brevibus vestigiis vel saltem cicatricibus foliorum transitorum onustus. Folia circa 6·0 cm. long., 0·6–0·9 cm. lat. Pedunculi circa 2·0–3·0 cm. long., araneosi, bracteis parvis scalariformibus instructi. Capitula circa 2·0 cm. long. et 2·5 cm. lat. Involucri phylla extima 0·3–0·4 cm. long., fere 0·3 cm. lat.; interiora usque ad 1·2 cm. long., intima 1·7 cm. long., 0·4 cm. lat. Corollæ tubi pars attenuata 0·8 cm., pars ampliata vix 0·2 cm. long.; lobi 0·7 cm. long. Achænia 1·0 cm., pappi setæ usque ad 1·3 cm. long.

Judging from Dr. Hoffmann's clavis (Bot. Jahrb. xv. p. 536), this is nearest *Pleiotaxis affinis*, O. Hoffm., a species which I have not seen. From this it differs *inter alia* in the shape and size of its leaves and pubescent achenes. According to Hoffmann, *P. affinis* is very like *P. rugosa*, O. Hoffm., which has heads differently shaped from those of Mr. Scott Elliot's plant, with the involucral leaves in many series, there being several series of very small outer ones for instance. In this characteristic I presume that *P. affinis* shares, this being another and important point of difference between it and *P. vernonioides*.

Erythrocephalum, *Benth.*

E. zambesianum, *Oliver & Hiern.*

Shiré Country, Sotchi; *G. F. Scott Elliot*, no. 8535.

Var. angustifolium, var. nov. Folia anguste lineari-lanceolata, crebro serrulata, 0·65–0·8 cm. long., basin versus 0·7–0·9 cm. juxta medium 0·5–0·7 cm. lat.

Nyassaland; *Simons.*

Achyrothalamus, *O. Hoffm.*

A. marginatus, *O. Hoffm.*

Rabai Hills, Mombasa; *Rev. W. E. Taylor.* Near Lake Marsabit; *Lord Delamere.*

Dicoma, *Cass.*

D. anomala, *Sond.*

Damaraland; *T. G. Een.* Nyika Country, N.W. of Lake Nyassa, 6500–7890 feet; *Richard Crawshay.* German East Africa, Urigi, 4–5000 feet; *G. F. Scott Elliot*, no. 8144.

Hochstetteria, *DC.*

H. Schimperi, *DC.*

Somaliland, Wagga Mt.; *Mrs. Lort Phillips.*

S. M. del.
J. N. Fitch lith.

West, Newman imp.

AFRICAN COMPOSITÆ
Ha-Hf Höhnelia. a-k Artemisiopsis.

PERDICIUM, *Linn.* (Gerbera, *Auct.*)

P. JAMESONI (*Gerbera Jamesoni*, Bolus).

Transvaal, Pilgrim's Rest Goldfield; ***Rev. W. Greenstock.***

P. ABYSSINICUM, *Hiern.*

Between Zanzibar and Uyui; ***Rev. W. E. Taylor.*** Nandi and Shiré Country; *G. F. Scott Elliot*, nos. 7056, 8604.

Tribe CICHORIACEÆ.

CREPIS, *Linn.*

C. KILIMANDSHARICA, *O. Hoffm.*

Tropical East Africa; *Rev. W. E. Taylor.*

C. RÜPPELLII, *Sch. Bip.*

Nandi, 7–8000 feet; *G. F. Scott Elliot*, no. 6937.

LACTUCA, *Tourn.*

L. GLANDULIFERA, *Hook. fil.*

Uganda; *G. F. Scott Elliot*, no. 7328.

An almost glabrous form.

L. PARADOXA, *Sch. Bip.*

Mt. Ruwenzori, 7000 feet; *G. F. Scott Elliot*, no. 7908.

SONCHUS, *Tourn.*

S. BIPONTINI, *Aschers.*, var. PINNATIFIDUS, *Oliver & Hiern.*

Rabai Hills, Mombasa; *Rev. W. E. Taylor.* Machakos; *Dr. S. L. Hinde.*

EXPLANATION OF PLATE 8.

Figures more or less magnified unless otherwise stated.

a–k. Artemisiopsis linearis, S. Moore.

a. A secondary branch of the plant, nat. size. *b.* A flower-head. *c.* An involucral leaf seen from within. *d.* A circumferential and, *e*, a central (hermaphrodite) floret. *f.* Circumferential floret seen under compound microscope low power. *g.* Two stamens showing the long tails and terminal appendage of the anthers. *h.* Style and style-arms from a hermaphrodite floret. *i & k.* Achenes of a circumferential and of a central floret respectively, as seen under the compound microscope.

Ha–Hf. Höhnelia vernonioides, Schweinf.

Ha. Part of a plant, nat. size. *Hb.* A floret at time of pollination. *Hc.* Two of the stamens, showing anthers with sagittate bases and a terminal appendage. *Hd.* A style with the style-arms. *He.* Achene with a cupular pappus, somewhat like that of *Sparganophorus*. *Hf.* Part of an achene showing its unilateral pappus.

The Use of Linnean Specific Names.

By Henry Groves, F.L.S., and James Groves, F.L.S.

[Read 16th January, 1902.]

While attempting to revise in some measure the nomenclature of Babington's 'Manual of British Botany' in connection with a posthumous edition of that work, we have been much impressed with the great diversity in practice among botanists, both here and abroad, in dealing with the Linnean specific names, and we have therefore thought it desirable to bring before the Society some considerations as to the different methods adopted, with a view to a discussion as to which is the least open to objection.

It seems necessary to arrive at something like an agreement as regards the use of the Linnean names, before we can make any certain progress in the direction of a stable system of nomenclature, and a termination of the present diversity of opinion, resulting as it does in the continual changing of the names of familiar plants, which all feel to be so inconvenient.

The Linnean specific names fall roughly into three groups:—

(1) Those applied to distinct species, fairly well understood in Linnæus's time, and still generally accepted.

(2) Those which are now considered to include two or more species combined by Linnæus owing to either
  (*a*) the imperfect knowledge of the plants at the time; or,
  (*b*) the different ideas then and now as to the extent of species.

(3) Those about which there is more or less doubt as to the proper application, owing to
  (*a*) the descriptions being imperfect;
  (*b*) the synonymy (often more important than the description) being contradictory; or
  (*c*) the confusion arising from changes made by Linnæus himself after the first publication.

With regard to the first group, "Those applied to distinct species, fairly well understood in Linnæus's time," nothing need be said, except to point out that they are liable at a future time, through advance in our knowledge of the plants, to fall into the second group. As an instance of this, we may mention the

Common Eyebright (*Euphrasia officinalis*), which up to quite recently has been regarded as a single species, but, in Mr. Townsend's recent Monograph, 13 species are discriminated from this country alone.

With regard to the second group, "Those which are now considered to include two or more species combined by Linnæus," the methods adopted are:—

(*a*) To discard the Linnean names altogether, or to employ them for sectional or mother species only, adopting more recent names, originated to represent, more or less exactly, the species as at present constituted.

(*b*) To retain the names for one or other of the segregate species.

The arguments in favour of the first alternative, that of rejecting the names, appear at first sight very forcible. Its advocates contend that to employ a Linnean name to denote a part only of the Linnean species, is a wrong use of words, and is making Linnæus say what he did not mean, that the provision in the "Laws of botanical nomenclature" for adding "*pro parte*," "*ex parte*," or the like, after the authority, to show that it is not intended to denote the whole of the original species, is really no safeguard against this misrepresentation; experience showing that although such explanations may be added in Monographs and other works on a large scale, in the more ordinary use of names, such as for labelling and cataloguing, the explanations would be dropped, besides which, such additions to the authority are undesirable, both as lengthening the reference and introducing an ambiguity. It is also contended that by retaining the names for segregates, the same name at different dates represents altogether different values, and that confusion is likely to arise therefrom.

In favour of the second alternative, that of retaining the name for one or other of the segregate species, it is urged that it is, broadly speaking, the plan generally adopted, that it conduces to greater stability in nomenclature, and that it avoids a considerable and continuous increase in the number of names.

If the limits of the systematic knowledge of plants were reached, it might perhaps be desirable to use the names given to the species by the first authors who thoroughly understood the limits of each of them; but so far from this being the state of things, species are continually being split up, and to carry the rejection plan to its only logical conclusion, each time one of these splits takes place, the residue of the species should also be re-named, as the old inclusive name will no longer be applicable. The common Bur-reeds of our ditches afford a good example. In the 'Species Plantarum' (1753), Linnæus recognized but the one species, which he named *Sparganium erectum*, with a var. β, the *Sparganium non ramosum* of C. Bauhin. In 1778, Hudson split up Linnæus's *S. erectum* into two species, using the name *ramosum* for the type, and *simplex* for Linnæus's var. β. In 1885, more than a century later, Mr. Beeby discriminated *S. neglectum* as a species. This last is considered by some botanists to be a variety of *ramosum*, and there is, we think, no reasonable doubt that it formed a part of Hudson's species. Now to carry out the rejection theory, Mr. Beeby, who, by the way, is an advocate of that view, ought to have re-named the other portion of *S. ramosum*, for it is quite clear, from the strictly logical position, that *ramosum* minus *neglectum* cannot be equal to *ramosum*. We should then have two new names instead of one. Then there is L. M. Neuman's variety *microcarpum* of *ramosum*. Who shall say that some botanist will not separate this also as a species? and then we must have another name for *ramosum* minus *neglectum* and *microcarpum*. This is a comparatively simple instance of the consequences of the rejection plan.

The objection that by the retention plan the same name has two or more different values at different dates, is to our thinking more apparent than real, for anyone studying the botanical works of past times must make himself acquainted with the history of the species concerned, whether they bear the same or different names.

Taking the arguments on both sides into consideration, we think the balance is in favour of the plan of retaining the names for one or other of the segregate species; but there are possibly a very few exceptions, e.g., *Rubus fruticosus*, of which, according to most recent ideas, there are 100 species in Britain alone. If we accept this conclusion, the next question is, to which of the segregate species should the name be applied? and here again there is difference of opinion. Where the segregate species are already distinguished as varieties by Linnæus, there will probably be little doubt that his specific name should be applied to the type or var. *a*, but this rule would dispose of comparatively few cases. Some botanists have applied the Linnean name to the segregate species represented in Linnæus's herbarium, but this view we do not think should be adopted. To regard the specimens in Linnæus's herbarium as the types of his species, in the same manner as those of other authors, to our thinking is to display an entire misconception of his unique position in this matter. Most of Linnæus's species are unlike those of later authors, in that they do not represent plants discovered or discriminated by Linnæus, but plants already more or less identified, which he has formulated as species under binominal names; and the specimens which happen to bear the names, often incorrectly, in his herbarium afford but little evidence of what was intended, as against that to be gathered from the synonymy quoted and from contemporary works.

Some authors have applied the names to the segregates most commonly found in Sweden; but this view is to our thinking wrong, as Linnæus botanized in other countries than his own, besides which, as we have pointed out, most of his species are the outcome of the accumulated knowledge of earlier botanists.

Another plan, and the one which seems to us the most satisfactory, is to apply the Linnean name to that segregate which, from being the most distinct, and usually also the most widely distributed, of those considered to be included in Linnæus's species, may fairly be accepted as his type. Where there is no segregate which stands out from the rest in this manner, we think the best course is to retain the name for the residue of the species after the other segregates have been carved out of it by subsequent authors; but in applying this principle, it should, we think, be quite clear that such subsequently named species were discriminated by their authors from the residue, and were not merely synonymous names, originated through a misconception as to Linnæus's species.

As regards the third group, "Those names about which there is more or less doubt as to the proper application," the two courses pursued are :—

(*a*) To discard them altogether in favour of later names, as to the application of which there is less doubt or no doubt at all.

(*b*) To retain them for the species for which, from the balance of evidence, there is a reasonable probability that they were intended.

The obvious argument in favour of discarding these more or less doubtful names, is that in scientific matters the nearest approach to accuracy should be aimed at, and that it is therefore better to use a name which, from being accompanied by a full and accurate description, or a satisfactory illustration, is known to belong to the species, rather than one about which there is a doubt.

On the other side it is urged that a large number of the earlier post-Linnean descriptions, and many of the more modern ones too, are open to the same objection as are those of Linnæus, being of themselves insufficient for identification. What we now consider essential characters were often altogether omitted, and variable characters of no import made much of. It would be equally necessary to discard these, while to do so would involve the changing of an immense number of names. Moreover, in the case of most of the more or less doubtful Linnean names, if all the evidence is examined closely, a very strong presumption can be arrived at as to the plants that were intended.

We are of opinion that it is the better course to retain the names when, although the descriptions are imperfect and of themselves inadequate, there are reasonable grounds for inferring that they belong to certain plants.

The following are a few specimen cases in which Linnæus's names, coming under Group 3, have been set aside or, to our thinking, wrongly used:—

1. Hypericum quadrangulum. Linnæus describes this as *Hypericum floribus trigynis, caule quadrato herbaceo*, and cites *Hypericum Ascyron dictum, caule quadrangulo* of J. Bauhin. For many years the name was used in this country to denote our common four-angled St. John's Wort, a good distinct species, with very conspicuous angles to the stem, occurring almost all over Europe. Koch, Fries, Sir Joseph Hooker, and others, however, have used the Linnean name for the much less distinct and less widely-distributed species, which was known as *H. dubium*, Leers, a plant which it is true also has a four-angled stem, but the angles are much less strongly marked and are distinctly unequal, and its general aspect is much more that of our common perforate St. John's Wort, *H. perforatum*, Linn. Syme, on the other hand, altogether rejects the name on the ground of ambiguity. We quote his words as a good example of this view:—

"There can be no doubt that Linnæus under his Hypericum "quadrangulum included both H. dubium (Leers) and H. tetra- "pterum (Fries); and as botanists are pretty equally divided in "their opinion as to which of these two ought to receive the "name 'quadrangulum,' it is much better to abandon an "appellation which really belongs to neither exclusively, when "the two plants have distinctive names of their own. In the "Linnean Herbarium, H. quadrangulum is represented by a "specimen of each of the two species; and that being the case, "it is of no use trying to determine to which of the two he first "gave the name quadrangulum, or which is the common Swedish "plant; there is evidence to show that he considered the "species extensive enough to include both." (Eng. Bot. ed. 3, vol. ii. p. 153.)

Now to our thinking Smith and the other earlier modern British botanists were right in applying the Linnean name to the distinct widely-distributed conspicuously four-angled plant; and Koch, Fries, and the rest are wrong in using it for the less distinct, obscurely four-angled plant, and Syme and his party are also wrong in rejecting it on the ground of ambiguity. There is not the least doubt that Linnæus knew the more distinct plant, for there is a specimen in his herbarium; it is not likely he meant the less distinct plant exclusively, and the fact that there is a specimen of the latter also in his herbarium under the name, is no proof that he meant to include it.

2. Rosa Eglanteria. This is an instance of a Linnean name having been incorrectly applied, or rejected, through alterations in the specific characters introduced in a subsequent publication. The plant referred to in 'Species Plantarum,' 1753, p. 491, was, as pointed out by Woods in this Society's Transactions, xii. (1818) p. 208, clearly the Sweet Briar. In the second edition of 'Species Plantarum,' however, Linnæus introduced characters of *R. lutea*, and some authors have applied the name to that species, but the majority of writers in recent years have discarded it altogether.

3. Epilobium tetragonum. The description of this in 'Species Plantarum,' 1753, p. 348, reads "*Epilobium foliis lanceolato-linearibus denticulatis imis oppositis caule tetragono. Sauv. Monsp.* 75." Tabernæmontanus's plate (Ic. 854) which is cited does not agree with the description; the specimen in Linnæus's herbarium is *E. roseum*, Schreb., and in the second

edition of 'Species Plantarum' the leaves are described as "*lanceolatis.*" Professor Haussknecht, the monographer of the genus, has rejected the name in favour of the comparatively recent *Epilobium adnatum*, Grisebach, and his example is followed by some botanists in this country. We think, however, inasmuch as the original description clearly indicates the one plant, the contrary evidence of the plate, the specimens in the herbarium, and Linnæus's subsequent amendment of the description, should not weigh against it. If, however, these three points were taken into account, and the species construed as including *E. adnatum*, *E. obscurum*, and *E. roseum*, according to the view advocated, by the process of exclusion, the first-named would still bear the name of *E. tetragonum*.

4. EPILOBIUM ALPINUM. The description in 'Species Plantarum,' 1753, p. 348, reads *Epilobium foliis oppositis ovato-lanceolatis integerrimis siliquis sessilibus caule repente.* The habitat given is "Alpibus Helveticis, Lapponicis." The character of the fruit being sessile is evidently an error. The specimen in Linnæus's herbarium is *E. lactiflorum*, Haussk., an Arctic species. The name has been pretty generally, and rightly as we think, applied to the most distinct and widely distributed alpine species, which answers fairly well, and better than any other, to the description, but Haussknecht and others have rejected it in favour of *E. anagallidifolium*, Lamarck.

Our conclusions are that it is desirable, in dealing with Linnean specific names, in all doubtful cases to disregard specimens altogether, and also to disregard any modifications made in his subsequent publications, and, as far as possible, to rely on the original descriptions, in conjunction with the references to earlier authors—construing the species liberally.

Then, as regards Group 2,—to retain the name for the type if such is specified, or, if none, for the species which may be most fairly regarded as the type; and in the absence of such a species, for the residuary species after others have been cut off.

As regards Group 3,—unless the evidence is hopelessly vague or contradictory, to retain the name for the species for which the weight of evidence points to its having been intended.

On some Species of *Dischidia* with Double Pitchers. By H. H. W. Pearson, M.A., F.L.S., Assistant, Royal Botanic Gardens, Kew; formerly Frank Smart Student of Botany, Gonville and Caius College, Cambridge.

[Read 5th June, 1902.]

(Plate 9.)

Introduction.

In his account of the Asclepiadaceæ of British India, Sir Joseph Hooker quotes * Griffith's description of *Dischidia complex*, a Malacca species which is represented in the Kew Herbarium by a single imperfect specimen. In this description reference is made to the remarkable double pitchers which the plant possesses. Although first noticed almost 50 years ago, no investigator has taken them in hand, and all that we know about them is contained in Griffith's rather meagre note. Sir William Thiselton-Dyer therefore suggested that I should study the morphology of these curious organs, and endeavour to elucidate their bearing upon the mode of life of the plant.

Griffith's original account occurs in his 'Notulæ ad Plantas Asiaticas' (part iv. p. 50), and the complete description of the pitchers as it there appears may be reproduced. It is as follows:—"These ascidia are very complete (? complex), presenting a rather small orifice near the petiole, the outer margin of this orifice being inflexed and formed into a second pitcher much smaller than the outer one, opening on each side by an oblique aperture, deeply lobed or furrowed on the upper, carinate on the lower side. A transverse section makes it very reniform. The cavity of the outer pitcher [is] crammed with radicles, the inner surfaces of both [being] lurid purple with inconspicuous white spots."

On looking through the specimens of the genus *Dischidia* in the Kew Herbarium, I found three other species possessing double pitchers very similar to those of *D. complex*. Of these also the material available was entirely in the dried condition.

* 'Flora of British India,' vol. iv. p. 51.

One was represented only by the type specimen, which it was important to disturb as little as possible; the other two possessed each one pitcher. The observations, an account of which follows, are therefore founded upon a strictly limited number of pitchers, and these not in the most favourable condition for investigation.

The four species in which these double pitchers occur are: (1) *Dischidia complex*, Griffith (Malacca); (2) *D. pectenoides*, H. H. W. Pearson (Philippines); (3) an undescribed species represented by a single leafless and flowerless specimen collected at Kuching, Borneo (*Haviland*, 2015) *; and (4) a second undescribed species of which there is only one equally imperfect specimen from Bangarmassing, Borneo (*Motley*, 525).

The pitcher of *D. Rafflesiana* has been studied in detail from a morphological point of view by Treub †, and anatomically by Scott and Sargant ‡. These and other authorities are in perfect agreement as to its morphology and, as is now well known, regard it as a modified leaf the apical growth of which is early arrested. A rapid growth of the central portion of the morphologically upper surface ensues, resulting in the formation of a hollow pitcher the inner surface of which is homologous with the lower surface of the leaf. The organic apex of the leaf is at a point in the margin of the pitcher exactly opposite the insertion of the petiole. Additional evidence of the correctness of this view has recently been furnished by a plant in cultivation at Kew, which shows a series of transitions from the normal leaf to the pitcher §.

That the descriptions which follow may be more intelligible, it may be stated at once that the pitchers which form the subject of this note are equally to be regarded as modified leaves. Their formation is no doubt similar to that described for *D. Rafflesiana*, but with certain modifications the nature of which will be discussed.

* Mounted on the same sheet with this specimen are leafy branches which strongly resemble those of *D. borneensis*, Becc., which is not known to possess ascidia. I believe that these are two distinct species under the same Collector's number.

† Treub, M., Annales du Jardin Botanique de Buitenzorg, vol. iii. pp. 13–36.

‡ Scott, D. H., and E. Sargant, Annals of Botany, vol. vii. pp. 243–269.

§ Thiselton-Dyer, W. T., Annals of Botany, vol. xvi. pp. 365–369.

Of the four species here dealt with, that from the Philippines may conveniently be considered first, as its pitcher is in some respects less complex than those of the other species. I am unable to assign it to any hitherto published species, and as one of the two specimens possesses flowers as well as foliage-leaves, it is here described.

DISCHIDIA PECTENOIDES, *H. H. W. Pearson*, sp. nov. *Planta* epiphyta, volubilis, glabra. *Folia* ovata vel elliptico-ovata, crassiuscula, acuta, basi angustata, breviter petiolata, 1–1$\frac{1}{4}$ poll. longa, $\frac{1}{3}$–$\frac{1}{2}$ poll. lata. *Ascidium* brevissime petiolatum, duplex, solitarium in nodo; exterius pecteniforme, complanatum, margine distale rotundato breviter 2-alato, orificio parvo subter petiolum basi depressionis infundibularis angustæ instructum, plicatura exteriore basi propinqua margini distali subparallela instructum, 2–2$\frac{3}{4}$ poll. longum, 1$\frac{1}{2}$–2 poll. latum; interius sulco medio utrinque, margine libero assurgente 3-lobato (lobo medio nonnunquam obsolete) instructum. *Racemi* breves, pauciflori, ramulis brevibus axillaribus terminales. *Flores* purpurei, pedicellis glabris circ. $\frac{1}{4}$ poll. longis suffulti. *Calyx* alte 5-lobatus; lobi membranacei, ovati, apice obtusi vel rotundati, vix carinati, marginibus parce minutissimeque ciliatis, ceterum glaberrimi, circ. $\frac{1}{6}$ poll. longi. *Corollæ* tubus urceolatus, extra glaber, intra pilis longis tenuissimis erectis villosus, $\frac{1}{6}$ poll. longus; lobi lanceolati, acuti, subanthesin erecti, glabri, intra carinati, circ. $\frac{1}{2}$ lin. longi. *Coronæ* squamæ 5, tubo stamineo affixæ, membranaceæ, erectæ, apice 2-fidæ, lobis longiusculis recurvis. *Antheræ* erectæ, marginibus apiceque membranaceis. *Stigma* complanatum, obsolete 2-lobatum, vix e antheris exsertum. *Folliculi* non visi.

Philippine Islands. Luzon: Zombales, *Loher* 4066; Montalban, Monte Dugo, *Loher* 4066 A.

Structure of the Pitchers.

The ascidia of *D. pectenoides* are solitary at alternate nodes, being separated by pairs of ordinary foliage-leaves (Pl. **9.** fig. 1). They are large flat structures (the largest measuring 2$\frac{3}{4}$ × 2 in.), in shape resembling a pecten-shell, and are inserted by very short petioles. About $\frac{1}{2}$ an inch from the insertion, and almost parallel to the distal margin, is a projecting fold which is not seen in the other species (Pl. **9.** figs. 1, 2, *f.*). When the pitcher is removed from the branch, a narrow funnel-shaped depression is disclosed (Pl. **9.** fig. 5, *d.*). At the bottom of this depression, immediately underneath the petiole, is situated the narrow orifice which gives into the main cavity of the pitcher. Its course is seen on removing a portion of the wall (fig. 3, a pointer, *p.*, is inserted into the orifice). One or two roots arising from the petiole or from points on the stem close to it * enter the pitcher through the orifice (fig. 3, *r.*) and give rise to numerous branches, which in some cases almost fill the cavity. The greatest long diameter of the funnel-shaped depression is 12–13 mm., that of the orifice being 2 mm. Fig. 3 also shows the remarkable structure which may be called the "inner pitcher." It is formed by the inflexed margin of the outer pitcher. The inflexion takes place in the funnel-shaped depression opposite to the insertion of the petiole (fig. 3, *nk.*). The inflexed tissue is deeply grooved on the side towards the petiole—thus forming three sides of the depression—and correspondingly convex on the other side. This neck of tissue is considerably thicker than the wall of the inner pitcher. The neck passes directly into the main cavity, at once expanding into the broad thin wall of the inner pitcher, which is quickly bent upwards through 180°, until its free margin rests almost in contact with the convex side of the neck (fig. 3, *m.*). The pocket thus formed is almost divided into two by a deep groove (fig. 4, *g.*), which extends in the middle line from the free margin to the bottom of the pitcher. The margin shows two lateral lobes (fig. 4, *l.*), and a small median lobe, which, however, is not always present (fig. 4, *ap.*). Very minute glandular hairs are abundant on both walls of the inner and on the inner wall of the outer pitcher.

The description just given will almost apply also to the Bornean specimen collected by Haviland (2015). The outer pitcher is approximately circular in outline (Pl. **9.** fig. 5). The inner one is smaller than in *D. pectenoides*, but shows indications of a higher degree of complexity. The character of the involution is the same, but the lateral portions of the free margin are continued upwards farther than in the last species, thus forming

* My material does not enable me to ascertain the exact place of origin of these roots. The question is discussed with reference to *D. Rafflesiana* by Wallich (Pl. As. Rar. vol. ii. p. 36), Treub (Ann. Jard. Buit. iii. p. 18), and by Scott & Sargant (Ann. Bot. vii. p. 259).

a more complete pitcher (Pl. 9. fig. 6, *m.*). The median lobe, which occurred in at least one specimen of *D. pectenoides* (fig. 4, *ap.*), is absent. The median groove seen in that species (fig. 4, *g.*) is present, but extends much farther, for, starting at the margin (fig. 6, *g.*), it passes round the base of the pitcher and is continuous on the other side with the groove of the funnel-shaped depression (*gd.*). It should further be noticed that the wall of the inner pitcher is thickly beset with very small glandular hairs. Similar hairs are found also on the inner surface of the outer pitcher. The inner and outer walls of both pitchers retain, even in the dry condition, abundant traces of a lurid purple colouring-matter, which was probably more generally diffused during life *.

The Malacca species, *D. complex*, Griffith's account of which has already been quoted, may next be considered. The inner pitcher, though differing much in form, may conveniently be compared with that of Haviland's plant. As to the shape, the one figured is probably abnormal (fig. 8). The presence of an insect-puncture (fig. 8, *pu.*) suggests the belief that some degree of hypertrophy may have been caused thereby. I am, however, unable to confirm this view by examining further material. The involution of the sides of the inner pitcher is as complete as in the preceding species (fig. 8, *m.*). A deep median groove runs from the free margin to the base, round which it passes, disappearing at the point *x* (fig. 8). The median lobe is obsolete, or represented only by an inconspicuous projection. Small glandular hairs are abundant on both inner and outer walls of the inner and on the inner wall of the outer pitcher.

The Bornean specimen collected by Motley (525) shows a more advanced type of structure. The inner pitcher is deeply two-lobed (figs. 9, 10), owing to the deepening of the median groove, which is as extensive as in Haviland's plant. The free margin, instead of resting against the neck as in the preceding species, is again inflexed, forming two covered passages, one leading into each lobe of the pitcher. This is seen in fig. 10,

* In Wallich's figure of *D. Rafflesiana* (Pl. As. Rar. vol. ii. t. 142) the *outside* of the pitcher is coloured reddish-brown. Treub (Ann. Jard. Buit. iii. p. 18) in noting this points out that neither Wallich himself nor Griffith mentions the presence of colouring-matter in the outer wall of the pitcher, and further states that he has never seen the pitchers of the Buitenzorg plants so coloured on the outside.

which represents one lobe of the pitcher seen from within, a portion of the near lobe seen in Pl. 9. fig. 9 having been removed. This pitcher also is thickly covered both outside and inside with small glandular hairs, and similar hairs are present also on the inner wall of the outer pitcher.

Morphology.

The material available furnishes very little direct evidence as to the morphology of these complicated structures. A comparison with what is known about the pitcher of *D. Rafflesiana* affords, however, fairly clear indications of the probable course of events. The first modification of the type found in *D. Rafflesiana* is the flattened form of all these double pitchers, which suggests an organ formed by two leaves with their margins united. If, however, this view be entertained for a moment, it is at once dispelled by an examination of the structure. The principal vein, obviously homologous with a midrib, traverses the margin of the outer pitcher from the petiole to the orifice, where it divides into two or more branches, though it is not clear that either of these enters the wall of the inner pitcher. The pitcher must therefore be regarded as a single leaf. The same observation disposes of Lindley's suggestion (to account for the origin of the pitcher of *D. Rafflesiana*), that it is a leaf the margins of which are united *. Such evidence as there is, however, seems to support the now accepted explanation of the morphology of the pitcher of *D. Rafflesiana* which has already been outlined (p. 376), and we must suppose the double pitcher to be formed upon the same plan. In other words, the outer pitcher of these double-pitchered forms is part of a modified leaf, strongly reflexed on both sides from the midrib, whose apex and base, by the growth and consequent curvature of the intermediate portion, are closely approximated. In considering the origin of the inner pitcher, we must revert once more to *D. Rafflesiana*. I have copied two figures of the pitcher of that species, one (fig. 11) from Beccari † and the other (fig. 12) from Treub ‡. Fig. 11 shows the inside of the attached end of the pitcher. The apical lobe projects into the cavity of the pitcher. The apex of the inflexed lobe (*ap.*) is the morphological apex of

* Lindley, 'Introduction to Botany,' i. p. 302.

† Beccari, 'Malesia,' vol. ii. Tav. 61. fig. 5.

‡ Treub, Ann. Jard. Buit. iii. pl. 4. fig. 8.

the modified leaf. Treub's figure (12) shows a median longitudinal section taken in a plane at right angles to that of fig. 11. Here the apex of the projecting lobe (*ap.*) is shown to be slightly incurved. The obvious inference is that the inner pitchers under consideration have been formed from the inflexed apical lobe, which in *D. Rafflesiana* projects into the cavity of the pitcher, but has undergone no further complication. It would appear that the apex has become again inflexed by the growth and resulting curvature of the morphologically upper surface (seen *en face* in Pl. 9. fig. 11) between the apex and the "neck." On this view the morphological apex of the leaf is represented in *D. pectenoides* by a small projecting tooth (fig. 4, *ap.*): in *D. complex* and in Haviland's specimen it is situated in a similar position at the summit of the median groove (figs. 8, 6, *g.*); while in Motley's specimen, owing to the further inflexion of the free margin, it is directed downwards into the cavity of the pitcher (fig. 10, *ap.*). It is of interest to enquire whether the inner or the outer pitcher was first formed. It has been shown, in the very young pitcher of *D. Rafflesiana* * (3 mm. long), that the growth was most active and the tissues showed least differentiation in the region immediately behind the apex. In a more advanced pitcher (1 cm. long) growth at the base and apex had ceased, but was very active over the whole curved surface. And as at this stage the pitcher "has attained its definite form," it does not appear that apical growth is resumed. I therefore suggest that in these double-pitchered forms the involution of the apical portion of the leaf which gives rise to the inner pitcher takes place early in the formation of the organ, and precedes the general growth of the central portion of the leaf which produces the outer pitcher.

Functions of the Pitchers.

The functions of the pitcher as a whole, and of the inner pitcher in particular, remain to be discussed. At the outset, I am conscious of the danger and dissatisfaction of founding views as to function on such evidence as my material furnishes. At the same time, such indications as the pitchers examined do afford are of so striking a character that, in view of

* Scott & Sargant, Ann. Bot. vii. pp. 253–4.

the difficulty of studying the living plants under natural conditions, they should not be disregarded. Such suggestions as I shall put forward will, I trust, result in stimulating the interest of botanists who may be in a position to confirm or disprove them.

A fairly complete study of the pitchers of *D. Rafflesiana* by numerous investigators leads to the conclusion that they are to be regarded as living "flower-pots."* They are well supplied with a root-system; they contain usually water and soil. The double pitchers undoubtedly serve the same purpose, and my object now is to show that they are very specially adapted to this end.

All four species are epiphytes, and probably resemble *D. Rafflesiana* in having an entirely adventitious root-system. In addition to the roots already mentioned which branch inside the pitchers, they bear others which serve to attach the plant to the bark of the host. The latter may be assumed to have also an absorptive function as in *D. Rafflesiana* †. With or without dissection, I have been able to examine the contents of about 9 pitchers. They all contain roots in the outer pitcher, but none at all in the inner. In all cases more or less soil ‡ is present in the outer pitcher among the roots; and it seems that the greater the amount of soil present, the greater is the development of roots in the outer pitcher. Groom believes this to be the case in the pitchers of *D. Rafflesiana* §. It has been clearly demonstrated that soil-particles in the pitchers of that species are attached to the root-hairs in a perfectly normal manner ||, and there is every reason to believe that the solids form a not unimportant source of the food-supply of the plants. My material being entirely in a dried condition, there is no direct evidence as to the presence of water in the pitchers. That the roots must be supplied with moisture is obvious. The presence of numerous stomata on the inner surface of the outer pitcher—

* Thiselton-Dyer, Ann. Bot. vol. xvi. p. 369.

† Groom, Annals of Botany, vol. vii. p. 236.

‡ The term "soil" is used in a wide sense to include the organic and inorganic débris in the pitchers, the nature of which it is usually impossible to determine.

§ Groom, *l. c.* pp. 227, 228.

|| Groom, *l. c.* p. 227, pl. 10. fig. 10; Scott & Sargant, Ann. Bot. vol. vii. p. 260, pl. 12. fig. 11.

very similar in form to those from the inner surface of the pitcher of *D. Rafflesiana* figured by Griffith *—is important in this connection. The modified leaf of *Dischidia*, from the slightly concave organ of *D. Collyris* to the highly complex structures we are considering, is obviously of service in the water-economy of the plant, since it renders transpired water available for re-absorption by the roots †. That rain-water and tree-washings also find their way in through the orifice must certainly happen at least in some positions of the pitcher. In all cases it appears to be fixed in the same plane as the branch on which it is borne (Pl. 9. fig. 1). The petiole being very short, the mouth of the funnel-shaped depression is in close contact with the surface of the branch. In *D. pectenoides* the orifice of a pitcher on an *erect* branch is directed upwards (*cf.* figs. 1 and 3). My material does not prove this in the case of other species, but on morphological grounds it is in the highest degree probable. But the fact that the plant is a climber must not be overlooked. If the stem is erect, the position of the orifice in *D. pectenoides* (and probably in the other species also) will be such as to prevent the entrance of rain-water or washings. But, owing to the climbing habit of the stem, comparatively few of the pitchers are likely to be in such a case. A very slight inclination of the stem would place the orifice in such a position that the inflow of water would be possible.

The small size of the orifice and the occlusion of the wider opening of the depression of the stem would seem to effectively preclude the possibility of any considerable amount of solid matter being washed in. Groom's view with regard to the solid particles in the pitcher of *D. Rafflesiana* is that they are brought in mainly, if not entirely, by ants. This opinion is supported by Ridley's observation ‡, that earth similar to that found at the foot of the host tree is present in the pitchers. Then we have Treub's statement relating to the same species. "Les ascidies sont devenues de véritables nids de fourmis, abritant des centaines d'individus et beaucoup de larves" §. Treub's words would

* Griffith, Trans. Linn. Soc. vol. xx. tab. 17. fig. 4.

† Groom, Ann. Bot. vol. vii. p. 228; Karsten, Ann. Jard. Buit. xii. (1895) p. 167; Thiselton-Dyer, Ann. Bot. vol. xvi. p. 368.

‡ Groom, *l. c.* p. 229.

§ Treub, Ann. Jard. Buit. vol. iii. p. 29.

almost describe the state of affairs in the pitchers of *D. pectenoides* and of Motley's Bornean plant. The outer pitcher of the latter was "crammed" with roots, among which were the dead bodies of numerous ants and a large quantity of dark-coloured soil. The inner pitcher was full of ants*, a few of which were examined by Colonel Bingham, who kindly informs me that "the specimens were unfortunately in fragments, but, as well as I could make out, they belong to the genus *Dolichoderus*, and are probably *D. bituberculatus*, Mayr, which is spread from India to New Guinea." In the pitcher of *D. pectenoides* fragments of ants were present which Colonel Bingham identifies as probably a species of *Aphænogaster*, a genus numerously represented in the Indo-Malayan region. A large number of ant-pupæ were also found in the same pitcher †. The pitchers of *D. complex* and of Haviland's Bornean specimen were well supplied with soil, but contained nothing that I could recognize as ant-remains. But it is needless to point out that the absence of insect-remains from dried plants proves nothing except that the insects, if present when the plant was collected, took an early opportunity of leaving.

We have, then, four species bearing pitchers into which soil cannot find its way by the action of gravity. Soil is, however, present in marked quantity. It is also proved that ants frequent the pitchers and make their nests in them. There is no evidence of any other means by which solid matters can find their way in. The conclusions on these grounds seem to be perfectly justifiable (1) that the "soil" in the pitchers is brought in by ants as

* A carnivorous function has been suggested for the pitchers of *D. Rafflesiana* (Delpino, Nuovo Giorn. Bot. Italiano, vol. iii. pp. 174–6, and Malpighia, vol. iv. pp. 13–17), and, although there are now no grounds for believing this to be the case, it was not, on the face of it, absurd to suppose that the inner pitcher might serve such a purpose. I therefore submitted these ants to careful microscopic examination, but their remains showed no signs of having undergone anything of the nature of a digestive process.

† Dr. Forel figures a "paste-board" nest of *Dolichoderus bituberculatus* from Bangkok. At the same time he states that "the chief feature of ant architecture is its irregularity." Judging from the details given of the various forms of nest adopted under different conditions by the same species, there would be nothing surprising in the fact that this species should nest in two such different places as a paste-board structure on the bough of a tree and the cavity of a *Dischidia*-pitcher. Species of *Aphænogaster* are stated to use earth as a nesting-material. (Forel, Smithsonian Report, 1894, pp. 480–490, pl. lvi. fig. 15.)

nesting-material; (2) that the pitchers have no other adequate source of supply. To what extent the welfare of the plant is dependent upon the food-materials obtained by these pitcher-roots is unknown. Their abundant development and their behaviour towards the soil in the pitchers, point to their being of no inconsiderable importance. These four species of *Dischidia* must therefore be regarded as myrmecophilous to a marked degree.

The presence of ants in the pitchers being highly desirable from the point of view of the plant, we are led to enquire what special characters, likely to be attractive to ants, the pitchers have acquired. In the first place, they are convenient shelters and nesting-places, and it may be presumed that the narrower entrance and more commodious form renders them more suitable for these purposes than the simpler pitchers of *D. Rafflesiana*. The danger of drowning which is risked by ants nesting in the pitchers of *D. Rafflesiana* must be considerable, though drowned ants are stated to be rarely found *. The branching root-system entering through a comparatively large opening (4 mm. in diameter in adult pitchers grown at Kew) would seem to provide them with abundant means of escape in case of a sudden rise of water in the pitcher. But they do not always escape; Wallich records the presence of "a great number of small and harmless black ants, most of which find a watery grave in the turbid fluid which frequently half fills the cavity" †. But whatever the danger here, it is almost certainly greater in a nearly closed pitcher, such as we are considering. We can hardly imagine ants with their pupæ making their escape through an orifice 2 mm. in diameter, already partially filled up by roots, and through which a stream of water is entering. Attention is at once directed to the inner pitcher as a possible refuge during a temporary flooding of the outer one. As any of the figures will show, the opening into the inner pitcher is entirely on the convex side of the neck. On the other side the neck is concave, and provides a channel down which a liquid entering the orifice must perforce be directed. Indeed, it is difficult to see how any water can enter the inner pitcher until the outer one is at least three-quarters filled; and this holds good for any position of the organ in which water can

* Groom, Ann. Bot. vol. vii. p. 233.

† Wallich, Pl. As. Rar. vol. ii. p. 36.

flow into the outer pitcher. If this be a possible function of the inner pitcher, it is not without interest to note that it has recently been suggested that ants resort to the Cecropias and other "myrmecophilous" plants of the Amazon Valley only in situations and under circumstances in which there is danger of their nests being flooded if made at a lower level*.

Inside the three inner pitchers of *D. pectenoides* which I was able to examine, I found a large number of small irregularly shaped masses which were quite sweet to the taste. Between the teeth they crumbled like so much chalk. On examining the wall with a view to ascertaining their origin, I found that the outer tissues of the convex side of the neck were in an advanced stage of decomposition. Yellow strings of cells embedded in mucilage hung from the wall, and were clearly the source of the yellow masses in the pitcher below. The appearance was very remarkable, and one who saw the most marked of the three cases aptly likened it to a stalactite. When submitted to microscopic examination, these masses were seen to consist of parenchymatous cells with highly cuticularized walls, and here and there a tracheid, embedded in mucilage which quickly swelled up in water. The blue colour with copper sulphate and potash, characteristic of cane-sugar, was obtained. Numerous fungus-hyphæ were present in the mucilage. Signs of a similar decomposition were detected here and there in the wall of the outer pitcher, usually in places were a callus had been formed. The callus appeared to be the result of an injury—probably an ant-puncture,—was circular in shape, and usually had a circular depression or hole in the centre. A transverse section showed a layer of periderm, beneath which was a mucilaginous mass embedding ordinary parenchymatous cells, some with apparently unaltered cellulose-walls, others in which the wall was strongly cuticularized. Fungus-hyphæ occurred here as in the former case. I did not observe a similar decomposition in the pitchers of the other species, but owing to the very limited supply of material I am unable to say that it does not occur. This is obviously a pathological condition, and is probably brought about by the combined action of ant-punctures and fungus-growth. It is strongly suggestive of that form of tissue-degradation known as "gummosis." The presence of sugar in the product of decomposition suggests its use by the ants as a

* Buscalioni & Huber, Beiheft zum Bot. Centralbl. Bd. ix. (1900) pp. 85–88.

food-substance. From its production in such large quantities in the inner pitcher, we may perhaps suppose that this structure, in *D. pectenoides* at least, serves also the purpose of a feeding-ground. Whether the fact that the wall of the inner pitcher is usually bitten through in one or more places has any connection with the presence of this sweet substance, it is impossible to say. In this connection attention may be directed to the profuse supply of short stalked glands. They appear to be very similar in structure to those present in *D. Rafflesiana* *. With regard to the latter the authors state: "It is quite evident that they have nothing to do with any function of the mature pitcher—first, because they occur indiscriminately on ordinary leaves and on pitchers; and secondly, because they become functionless and are cut off by periderm, long before the pitcher is mature" †. This may be equally true for the double pitchers. I was, however, unable to see that the glands in these pitchers were cut off by periderm; and, as far as I was able to judge from the nature of the materials, their appearance suggested no loss of function. When the living plant can be studied, the possibility of the secretion of these glands being palatable to the ant-inhabitants will be worthy of consideration ‡.

The mesophyll of the walls of both pitchers consists normally of parenchymatous cells whose walls give the cellulose reaction with Schulze's solution. The epidermis (inner and outer) is composed of small cells with cuticularized walls, the outer walls being for the most part strongly arched and finely grooved. Within the mesophyll the much-branched "cells" of the laticiferous system are abundant (fig. 13, *la.*). Microscopic examination of the inner surface of the outer pitcher revealed the presence of a dense waft of superficial mycelium which was easily removed on the point of a needle (fig. 13, *mg.*). The growth of this mycelium appeared to be radial, starting from the centre of a curious rosette-like structure (fig. 13, *ro.*), formed by shorter hyphæ of a peculiar character. These bore a profuse crop of minute abstricted gemmæ. At the centre of each rosette the tissue of the pitcher-wall appeared to have been punctured. A precisely similar mycelium was present on the inner surface of

* Scott & Sargant, Ann. Bot. vol. vii. pl. 11. fig. 4 *a*.

† Scott & Sargant, *l. c.* p. 258.

‡ "Most of the *Dolichoderi* .... lick up the secretions of plants." Forel, Smithson. Rep. 1894, p. 496.

the outer pitcher in all four species and in every specimen examined. Curiously enough, no trace of such a mycelium could be found on either wall of the inner pitcher in any species. It may be that the secretion of the glands of the inner pitcher is of such a nature as to limit the growth of the fungus to the outer pitcher. The explanation of this remarkable occurrence I must leave to a more fortunate investigator. I can only draw attention to the extraordinary similarity between the hyphæ of the rosette and the "Stranganschwellungen" and "Perlenfaden" which Möller found in the "fungus-gardens" of the South-American species of *Atta* *. Termites of both continents are fungus-growers †, but I am not aware that "fungus-gardens" have yet been described for any of the true ants in the Old World.

Conclusion.

The details of my suggested explanation of the adaptation of these double pitchers for the purpose of accommodating their ant-population will undoubtedly require modification when the living plants can be studied. But the general conclusion that they are peculiarly modified in such a manner as to render them specially attractive to ants is, I venture to think, hardly open to doubt. How is the plant the better enabled to compete in the struggle for existence by the adoption of this highly specialized form of pitcher? This question is one of peculiar difficulty, and impossible of solution except by a study of the natural conditions in which the plant lives. An obvious suggestion is that this complicated pitcher is a response to a demand for an increased economy of water in a xerophytic environment. The condensation of transpired water upon the profusely branched root-system in an almost closed bag must be more effectively attained than in the less complex pitcher of *D. Rafflesiana.* That our four species are markedly xerophytic is sufficiently indicated. The foliage-leaves of *D. pectenoides* are very small; *D. complex* is described by Griffith as leafless; the specimens of the other two species are also without leaves. But it is impossible to pursue this subject further in the present

* Möller, 'Die Pilzgärten einiger südamerikanischer Ameisen' (Jena, 1893), Taf. 6. fig. 18.

† Haviland, G. D., in Journ. Linn. Soc., Zool. xxvi. (1898) pp. 359–360, 382–383.

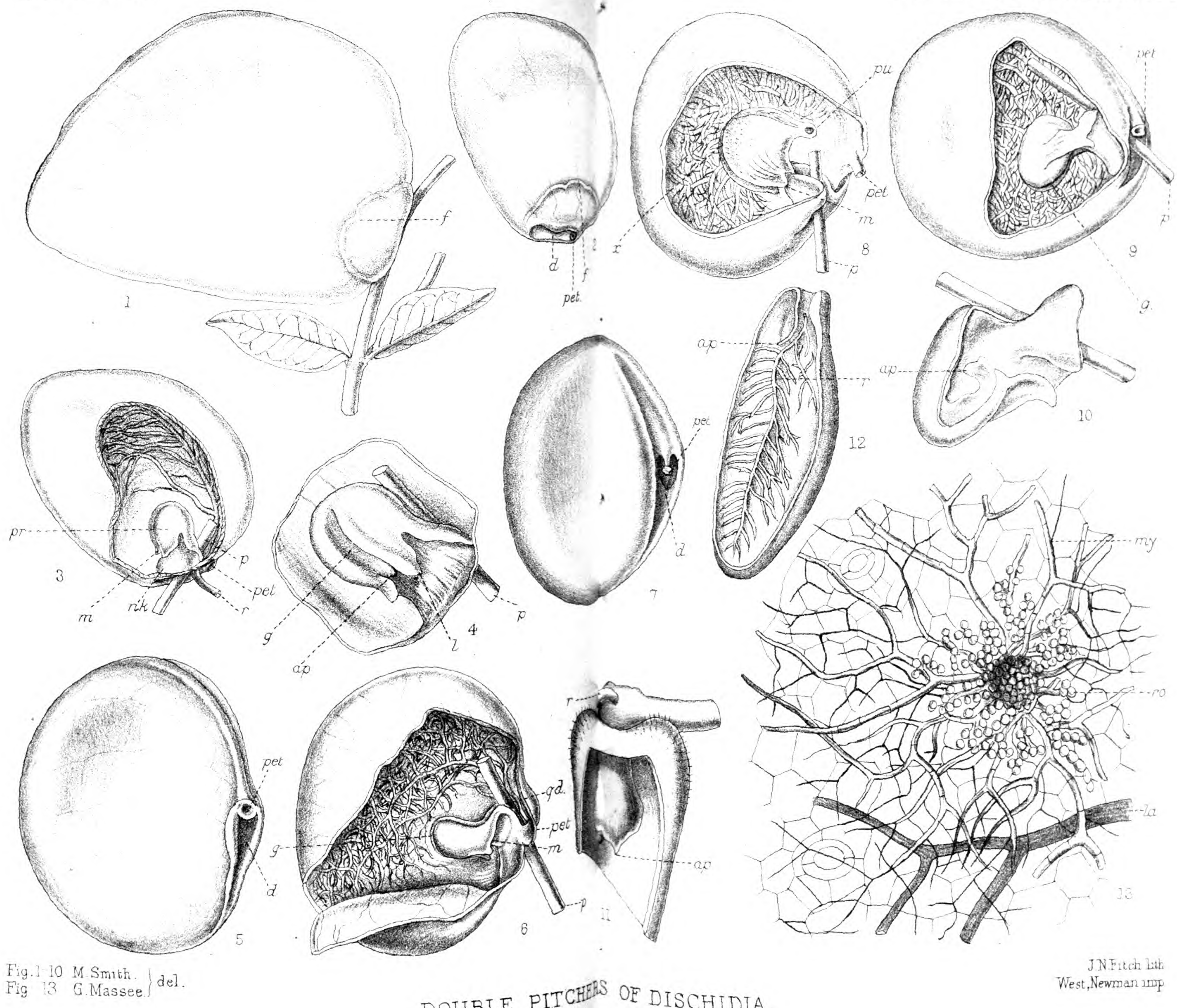


Fig. 1-10 M. Smith. } del.
Fig 13 G. Massee.

J.N. Fitch lith
West, Newman imp

DOUBLE PITCHERS OF DISCHIDIA.

state of our knowledge without becoming involved in unprofitable speculations.

The genus *Dischidia* thus shows a series of leaf-modifications more remarkable perhaps than any other known genus of Phanerogamic plants. In *D. Collyris* and other species we find the root-sheltering concave shell-like leaf. *D. Rafflesiana* has assumed the distinct pitcher-form in which a higher degree of water-economy is reached, and the specialization is already so marked that the assistance of ants seems to be necessary in order that the roots may obtain an adequate supply of raw food-material. This species is the more interesting in that in cultivation it has produced a series of less specialized leaf-forms leading up to the normal pitcher *. The highest degree of specialization is attained in these double-pitchered species, whose existence seems to be intimately connected with the residence of ant-colonies within the pitchers, and which have acquired characters that appear to especially fit them to be the abodes of such colonies. Here the water-economy seems to have reached its highest point. But much of the story yet remains to be told.

In conclusion, I desire to express my thanks to Sir William Thiselton-Dyer for kindly placing this material at my disposal; to Dr. D. Sharp and Colonel Bingham, who have allowed me to refer insects to them for determination; to Mr. Massee, who gave me the benefit of his opinion respecting the mycelium represented in fig. 13, and made the drawing from which that figure was prepared; and to Miss Smith, to whom I am indebted for figs. 1–10.

EXPLANATION OF PLATE 9.

[All figures natural size, except 4, 10, and 13. Except in figs. 2, 3, 11, and 12, the pitchers are represented in the position they would occupy if growing upon *erect* branches.]

Figs. 1-4. *D. pectenoides.*

Fig. 1. Leaf-bearing branch with pitcher attached.

Fig. 2. A pitcher removed from the branch.

Fig. 3. Pitcher shown in fig. 2, with portion of wall removed to show the inner pitcher.

Fig. 4. Inner pitcher (enlarged).

---

* Thiselton-Dyer, Ann. Bot. vol. xvi. p. 366.

Figs. 5, 6. Bornean specimen, *Haviland*, 2015.
  Fig. 5. Pitcher removed from the branch.
  Fig. 6. Pitcher shown in fig. 5, with portion of wall removed.
Figs. 7, 8. *D. complex*.
  Fig. 7. Pitcher removed from the branch.
  Fig. 8. Pitcher shown in fig. 7, with portion of wall removed.
Figs. 9, 10. Bornean specimen, *Motley*, 525.
  Fig. 9. Pitcher with portion of wall removed.
  Fig. 10. Lobe of inner pitcher (enlarged).
Fig. 11 (after Beccari). A portion of a longitudinal section through the pitcher of *D. Rafflesiana*, showing the inflexed apex.
Fig. 12 (after Treub). A portion of a longitudinal section through the pitcher of *D. Rafflesiana*, showing the inflexed apex in longitudinal section (*ap.*).
Fig. 13. Mycelium on the inner surface of the wall of the outer pitcher of *D. pectenoides*. (× 400. Slightly diagrammatic.)

ap., morphological apex; *d.*, depression at base of pitcher; *g.*, median groove in wall of inner pitcher; *l.*, lateral lobe of free margin of inner pitcher; *la.*, latex-cell; *m.*, free margin of inner pitcher; *my.*, mycelium; *nk.*, neck; p_1, pointer inserted into the orifice leading into the cavity of the outer pitcher; *pet.*, petiole; *pu.*, insect-puncture; *ro.*, rosette of hyphæ.

"Silver-Leaf" Disease.

By Prof. John Percival, M.A., F.L.S.

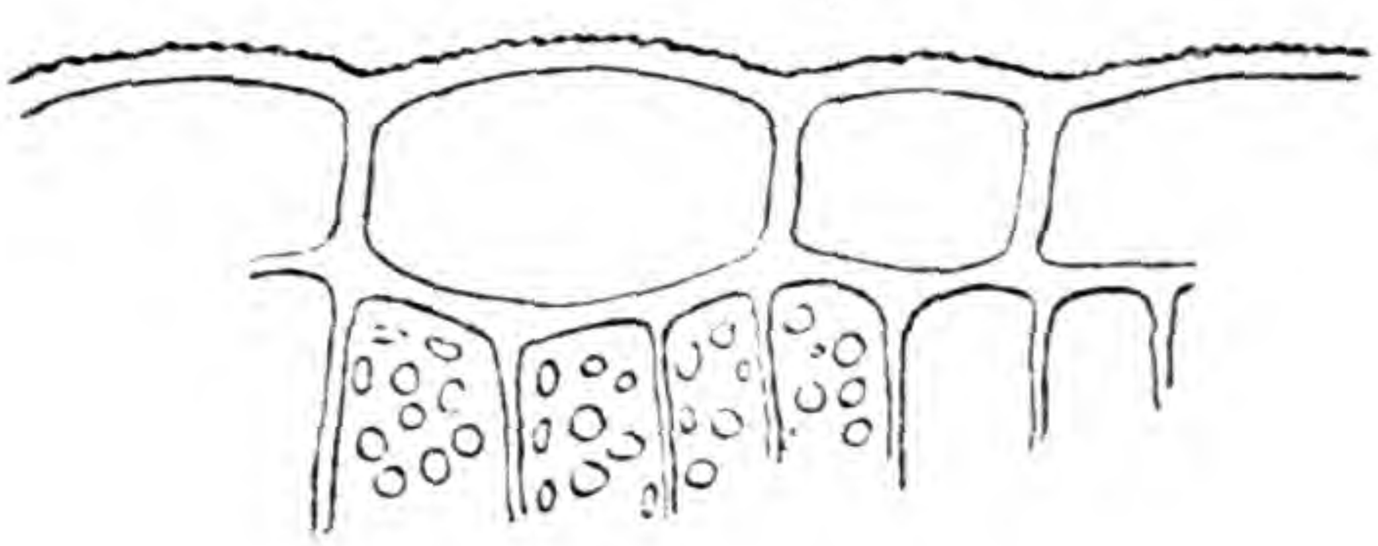
[Read 5th June, 1902.]

(Plate **10.**)

The disease known as "Silver-leaf" is, so far as I am aware, confined to the *Pruneæ*, and has been the subject of observation and investigation for more than a quarter of a century. The species which it most frequently attacks are the plum and peach, but it is not uncommon upon the apricot, and I have seen it occasionally upon the sloe. The leaves of the diseased trees are generally normal in form and size, but their surfaces, instead of being green, are of a peculiar ashy-grey colour, which is very readily recognized but not easily described. The affected trees produce little or no fruit, and although plants suffering from the disease may live many years before being killed outright, they are always sickly and unprofitable.

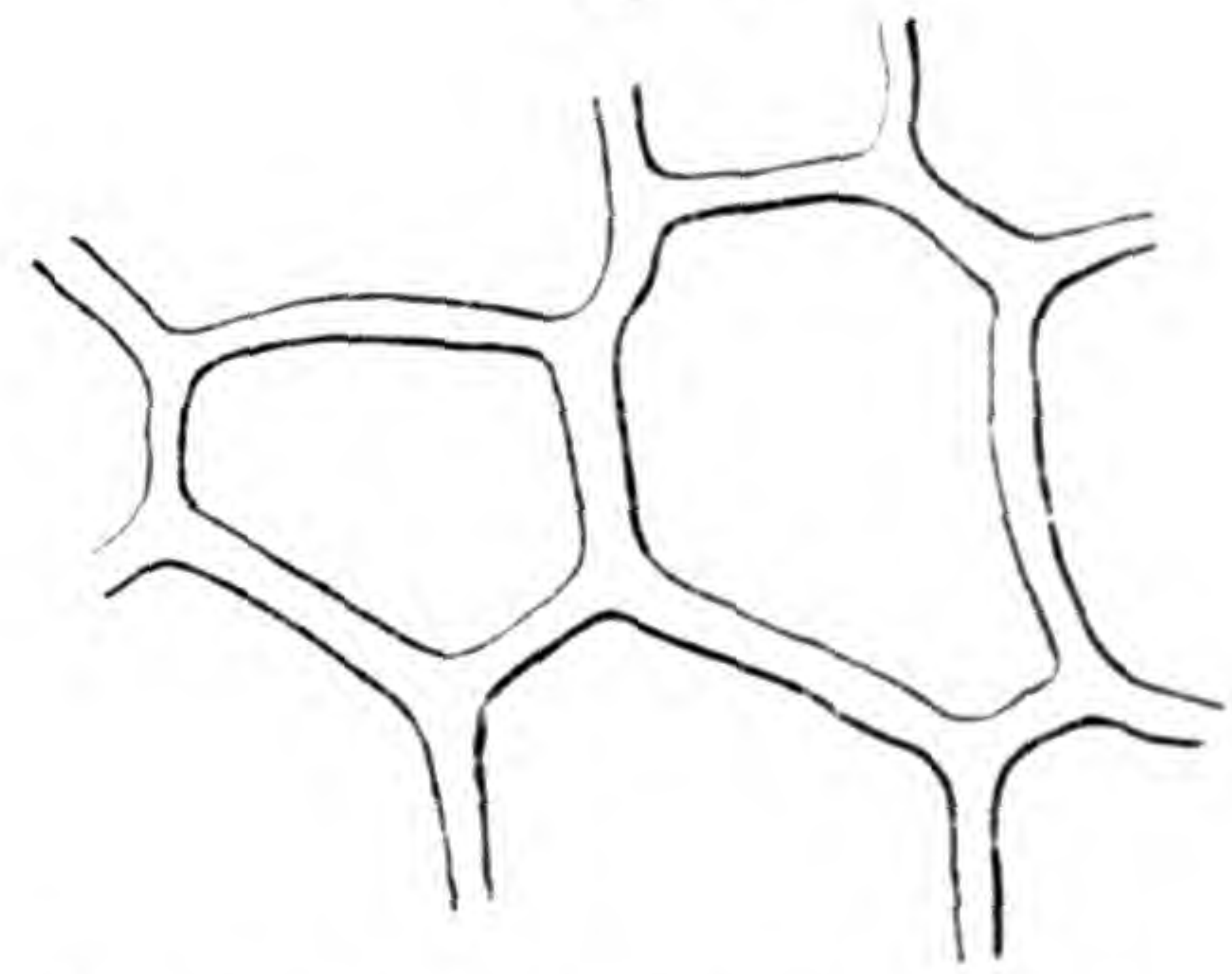
A transverse section of the upper epidermis of a healthy plum-leaf is given in fig. 1, and the corresponding surface view in fig. 2. Here it is seen that the cell-walls of the epidermis are

Fig. 1.



Transverse section of the upper epidermis of a normal plum-leaf.

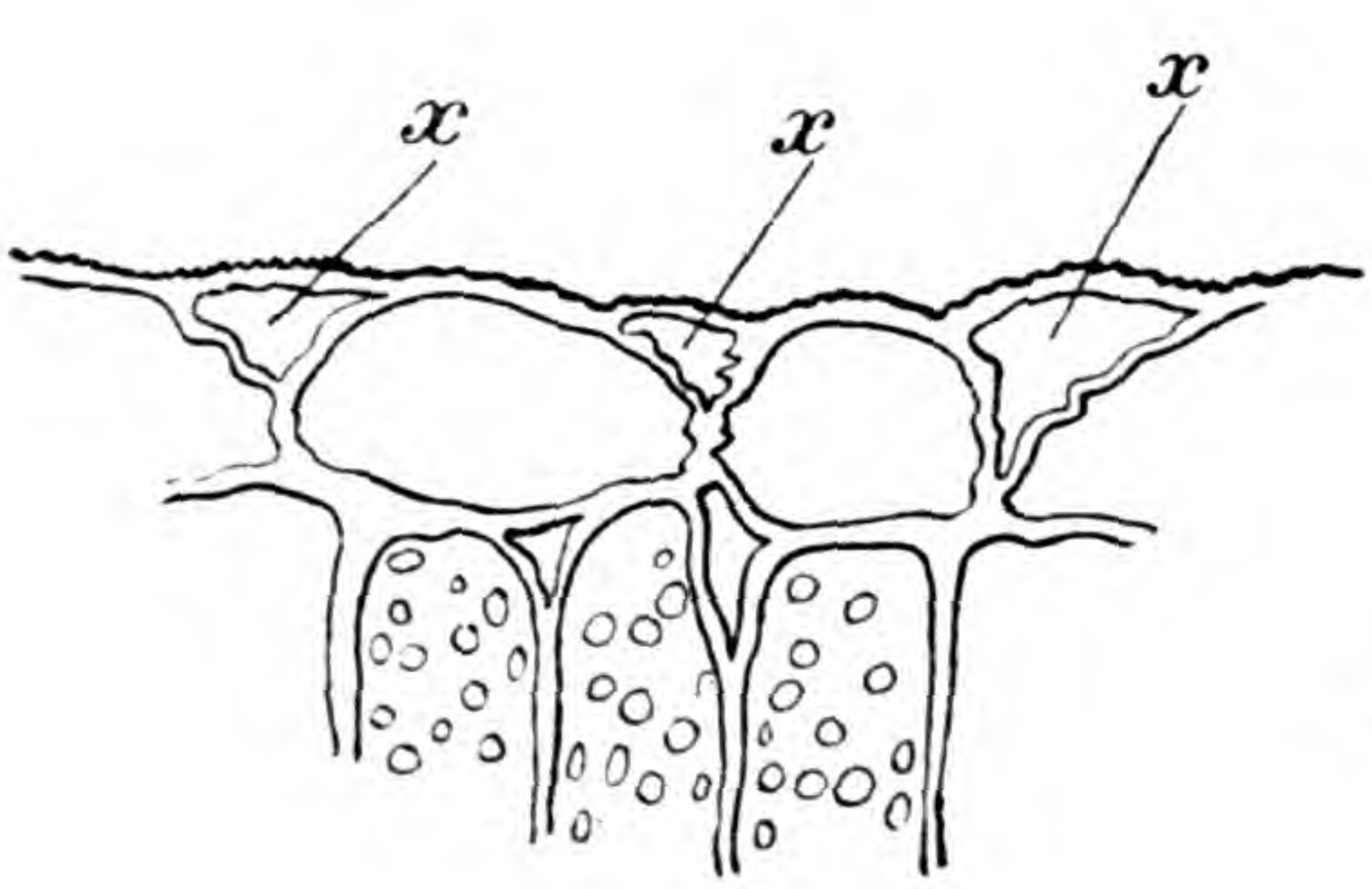
Fig. 2.



Surface view of upper epidermis of a normal plum-leaf.

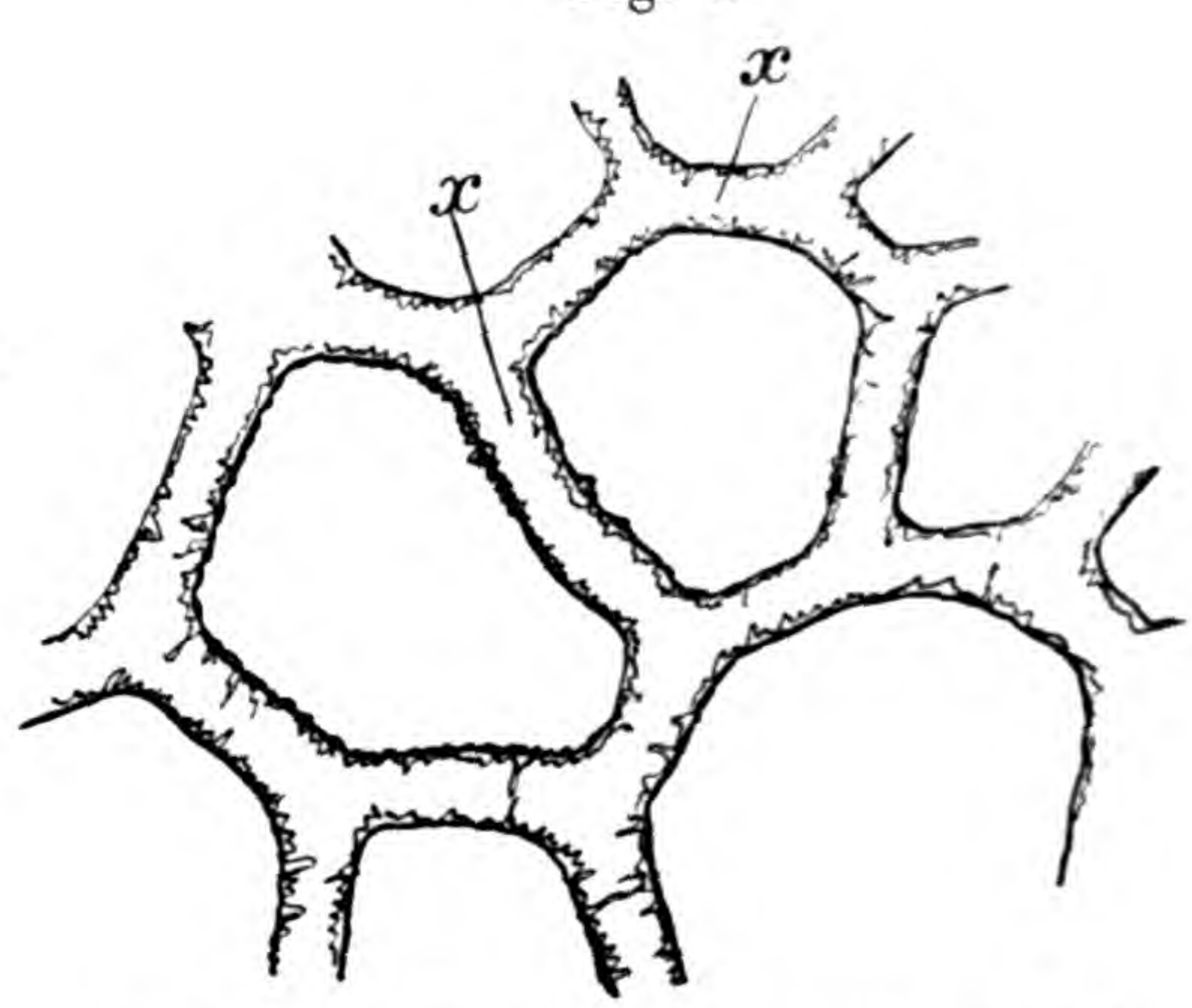
thick and without intercellular spaces. In figs. 3 and 4 are illustrated the transverse section and surface view of the epidermis of a leaf affected with "silver" disease. Large intercellular spaces filled with air are present beneath the cuticle along the lines of union of the epidermal cells. The peculiar light

Fig. 3.



Transverse section of upper epidermis of a plum-leaf affected with "silver-leaf" disease.

Fig. 4.



Surface view of upper epidermis of a plum-leaf affected with "silver-leaf" disease.

grey colour of the leaves is due to these air-filled spaces, and not to any alteration in the chloroplasts; the latter structures are of the same size and appearance as those in healthy leaves.

How these air-channels are produced is not clear at present. The appearances presented by the jagged irregular pieces of cell-wall substance which project into the air-spaces (fig. 4) suggest that the middle lamella, or part of the cell-wall corresponding to it, has been dissolved or softened and then torn asunder.

Various suggestions have been made in regard to the cause of the disease. Some authorities have hazarded the opinion that it is caused by bacteria, others that it is due to a deficiency of certain food-constituents in the soil.

No spots or blisters are visible upon the leaves, and fungi are absent both from the affected leaves and the external and internal tissues of the stem and branches.

In advanced cases a discoloration of the central parts of the wood is observable when the stems are cut across, and this sometimes extends to the wood of the finer branches, and into the wood of the leaf-petioles. In milder attacks, where the disease is of recent origin, the wood of the stems and branches is not visibly discoloured so far as the naked eye can determine, but microscopic examination often reveals brown stains on the walls of the vessels and medullary-ray cells.

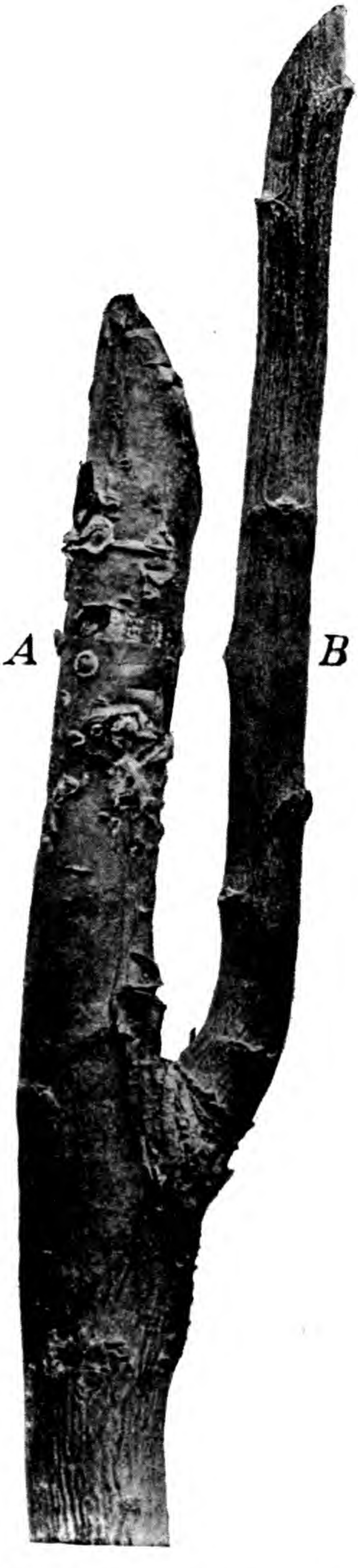
When first noticed it is often confined to a few of the branches on one side of the tree, but sooner or later the whole tree becomes affected.

Last September I dug up a fifteen-year-old plum-tree which had been subject to "silver-leaf" for several years. Many of the large roots were diseased. When cut across, the wood of these roots was seen to be discoloured, being dark brown instead of yellow as in the healthy wood. No rottenness or disintegration of tissue was observable; the discoloured parts were quite as hard as the uninjured tissues.

The bark and cortex of the root covered the wood completely as in the healthy parts; and unless a transverse section had been made of the roots, the internal damage would scarcely have been suspected.

Microscopic examination of the discoloured wood, especially where it bordered on the healthy tissues, revealed the presence of fine fungus-hyphæ, which were traced for a considerable distance in the lumen of the vessels. Many of the vessels and medullary-ray cells were filled with a brownish-red substance, and the walls of these cells were stained brown.

I sawed the thick diseased roots into one-inch lengths and placed them in a damp chamber. In two or three days a dense white mycelium of very delicate hyphæ was developed upon each piece, round the edge of the diseased patch, as in fig. 5.



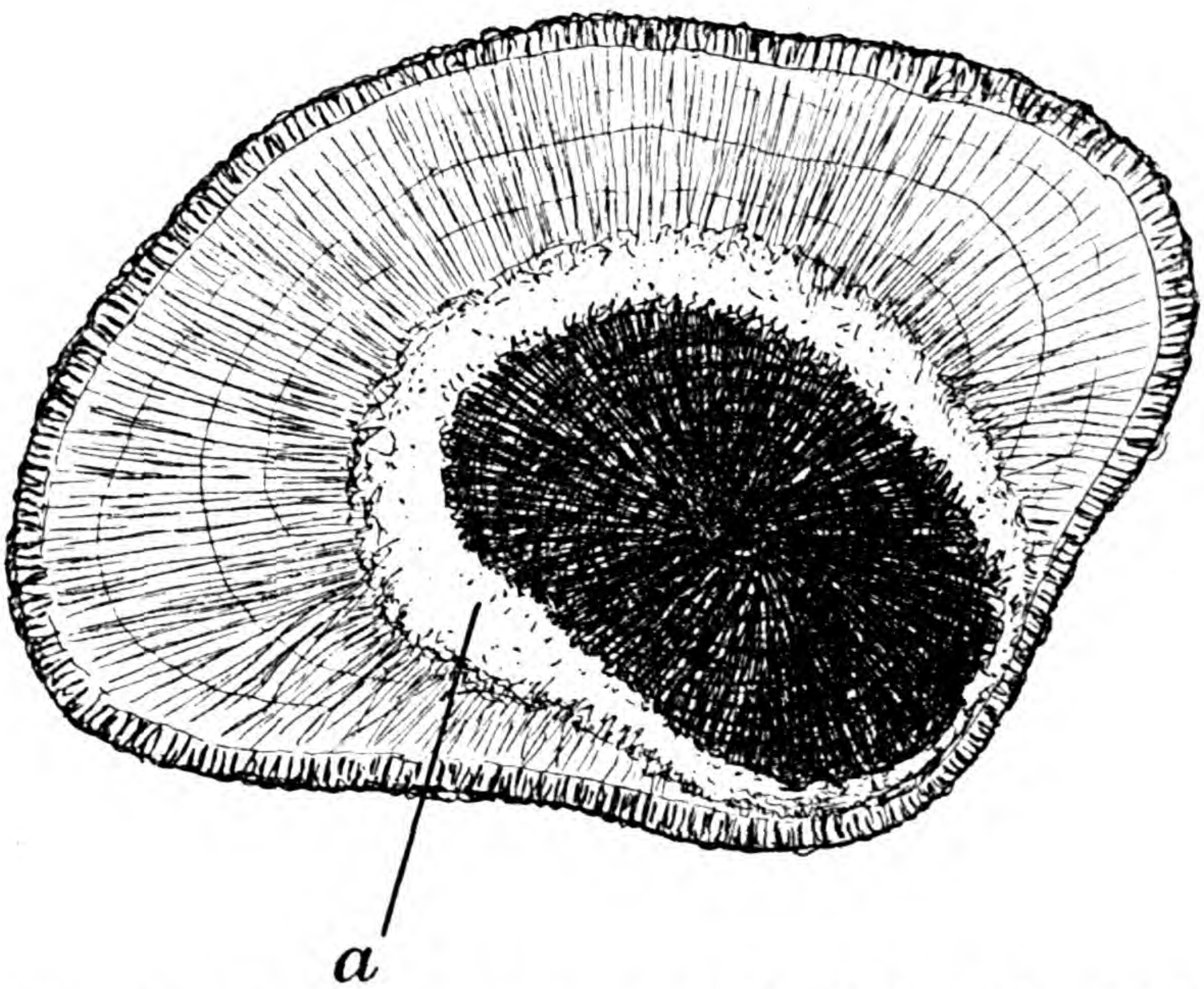
SILVER-LEAF DISEASE.

A. Diseased stock.

B. Shoot from inserted bud, all leaves of which were silvered.

I afterwards procured from nurserymen and fruit-growers in different parts of the South of England specimens of plum- and apricot-trees affected with "silver-leaf" disease. The plants were dug up completely, so as to obtain as much of the root-system as possible. Trees of various ages were obtained, some of them being maiden trees of one season's growth only. In every case the root or underground portion of the stock was found to be diseased, the wood invariably showing internal discoloration when sawn across, although outside there was

Fig. 5.



Transverse section of root from a plum-tree affected with "silver-leaf" disease. After being kept three days in a damp atmosphere the mycelium (a) developed.

frequently no evidence of unhealthiness. Fungus-hyphæ were always found in the wood near the junction between the living and dead portions, and in most cases a good growth of mycelium was obtained when pieces of the diseased root were kept in a fairly damp atmosphere.

At first no spores or conidia were visible upon the mycelium, but after three or four months' growth small sporophores of *Stereum purpureum* appeared upon the pieces of root. On several pieces of diseased root-stock which were dug up and exposed during the winter, *Stereum purpureum* also appeared. In one case only (Pl. **10**) have I seen the fully developed fruiting-stage of the fungus on diseased trees; such examples must be rare, or earlier investigators would have noticed them.

This solitary example was sent to me among a batch of specimens from a nurseryman, and was only one year old from the bud. The bud had been inserted in a stock apparently infected with the fungus near the surface of the ground, and the strong vigorous shoot (about 4 feet long) developed from the bud had every leaf upon it "silvered." When I received the tree, the stock of course had been cut back, and small sporophores of the fungus were growing on the outside of the bark. A cross-section of the stock, both above and below the inserted branch, showed that its wood was completely killed, with the exception of a very thin cylinder just inside the cambium. The wood developed from the inserted bud was, however, not in the least discoloured, and looked quite healthy, although, as previously mentioned, the leaves upon it were all "silvered."

The constant presence of the fungus upon the roots and root-stocks of trees suffering from the "silver-leaf" disease justified the conclusion that it was in some way responsible for the trouble. The complete proof, however, was not obtained until this year.

In the early part of March I inoculated some young healthy plum-trees of various sorts with soaked pieces of the sporophores of *Stereum purpureum*, obtained from the specimens cultivated from diseased roots and also from some blocks of dead wood. A T-shaped cut was made through the bark, and after inserting the fungus the wound was bound round with bast. The cuts were made above ground on one- and two-year old branches, from 18 inches to 2 feet from the ends. In the first week in May, *i.e.* 8 or 9 weeks after inoculation, the leaves upon these branches exhibited the characteristic silvery appearance.

It was of especial interest to notice that while the disease showed itself above the wound right to the top of the shoot, below the wound it only appeared on the leaves of the next bud or spur two or three inches away. Moreover, the disease has only appeared hitherto (May 19th) on those leaves developed from buds which are placed on the same side of the shoot as that on which the inoculation was made, the leaves from buds off the straight line drawn from the wound to the tip of the shoot being normal. From these experiments, and other observations on the course of the disease, it would appear that the disturbing cause is conducted rapidly in the sap of the plant; other observations I have made also support this view.

Although there is often little or no visible difference between the wood and other tissues of a sound branch and one on which "silvery" leaves are produced, I found that a diseased branch gives to water a faint brown tint when its end is placed in the latter for 24 hours, which is not the case with healthy branches. The tinted water gives a bright blue colour immediately with guaiacum and hydrogen peroxide, due to the presence of an oxidase. An oxidizing ferment exists also in the bast and cortex of healthy branches of *Prunus* species, but it does not leak out when the ends of such branches are dipped in water, although it dissolves out fairly readily when slices of these tissues are soaked.

By cutting thin successive longitudinal slices from the branches of diseased plum-trees, from the bark inwards into the wood, and soaking these separately in water, it is seen that not only is the oxidase present in the cortex and bast in a very soluble condition, but it is also present in considerable quantity in the wood of the branch, which is not the case in healthy trees.

From the evidence obtained during the examination of many cases, I have no doubt that the infection takes place below ground, no sign of any wound being visible above, and the internal damaged wood in which the fungus-hyphæ are detected is generally confined to the root or the lower portion of the stem within the soil.

In some instances, perhaps the majority, there were old partially occluded wounds through which the infection might have taken place; but in others no abraded surface was noticeable, and the fungus appeared to have entered through the unwounded surfaces of the roots. Where horizontally placed roots contained the fungus, it was usually on the damp side facing downwards that the parasite had apparently entered, for this side of the root showed damaged wood and cortex when sawn across.

Whether other species of *Stereum* are capable of setting up the disease, and the relationship of the superabundant oxidase in the diseased branches to the peculiar changes in the epidermal cells, are matters which I hope to investigate later, when more material is available.

The biology of *Stereum hirsutum* has been investigated by Prof. Marshall Ward, who has published his results in the 'Philosophical Transactions' of the Royal Society, Series B, vol. 189 (1897), pp. 123–134, pls. 17–21.

The Occurrence of Calcium-oxalate Crystals in Seedlings of Alsike (*Trifolium hybridum*, Linn.). By Prof. John Percival, M.A., F.L.S.

[Read 5th June, 1902.]

The very definite and characteristic position in which the crystals of calcium oxalate occur in the leaves of most leguminous plants led me to consider that a detailed study of their first appearance and distribution in young seedlings would be of interest, and might possibly throw some light upon their formation.

The seedlings were grown under the different conditions described below, and after reaching various stages of development were placed first in boiling water, then in alcohol, and finally transferred to chloral-hydrate on large glass slides, where the complete plants could be examined. Polarized light was generally employed to determine the presence of the smallest crystals. Various species of Leguminosæ were tried at first, but *Alsike* was eventually selected for further examination on account of the absence of hairs upon the surface of the plant, which facilitated the examination of the internal tissues of the cleared specimens.

The seeds were germinated upon the purest filter-paper moistened with distilled water.

Germination occurs in a few hours, and the cotyledons become free from the testa and develop a green colour in three or four days. At this stage of growth no crystals are present anywhere in the plants. As soon as the plants were sufficiently large to handle, they were removed from the filter-paper bed, and placed with their roots dipping into small bottles of distilled water, the bottle being lined with paraffin to prevent contact of the water with the glass. The water used was distilled in a metal still and collected in paraffin-lined flasks. Rapid growth takes place as soon as the plants are allowed a free supply of water, and by the time they are six or eight days old the small folded primary leaf can be seen between the bases of the cotyledons.

At this stage of development, crystals appear along the vascular bundles in the petioles of the cotyledons, and are distributed evenly from a point close to the blade down to the connection of the bundle with its continuation in the hypocotyl of the seedling. Above and below these limits, crystals very rarely develop at this or any subsequent stage of growth.

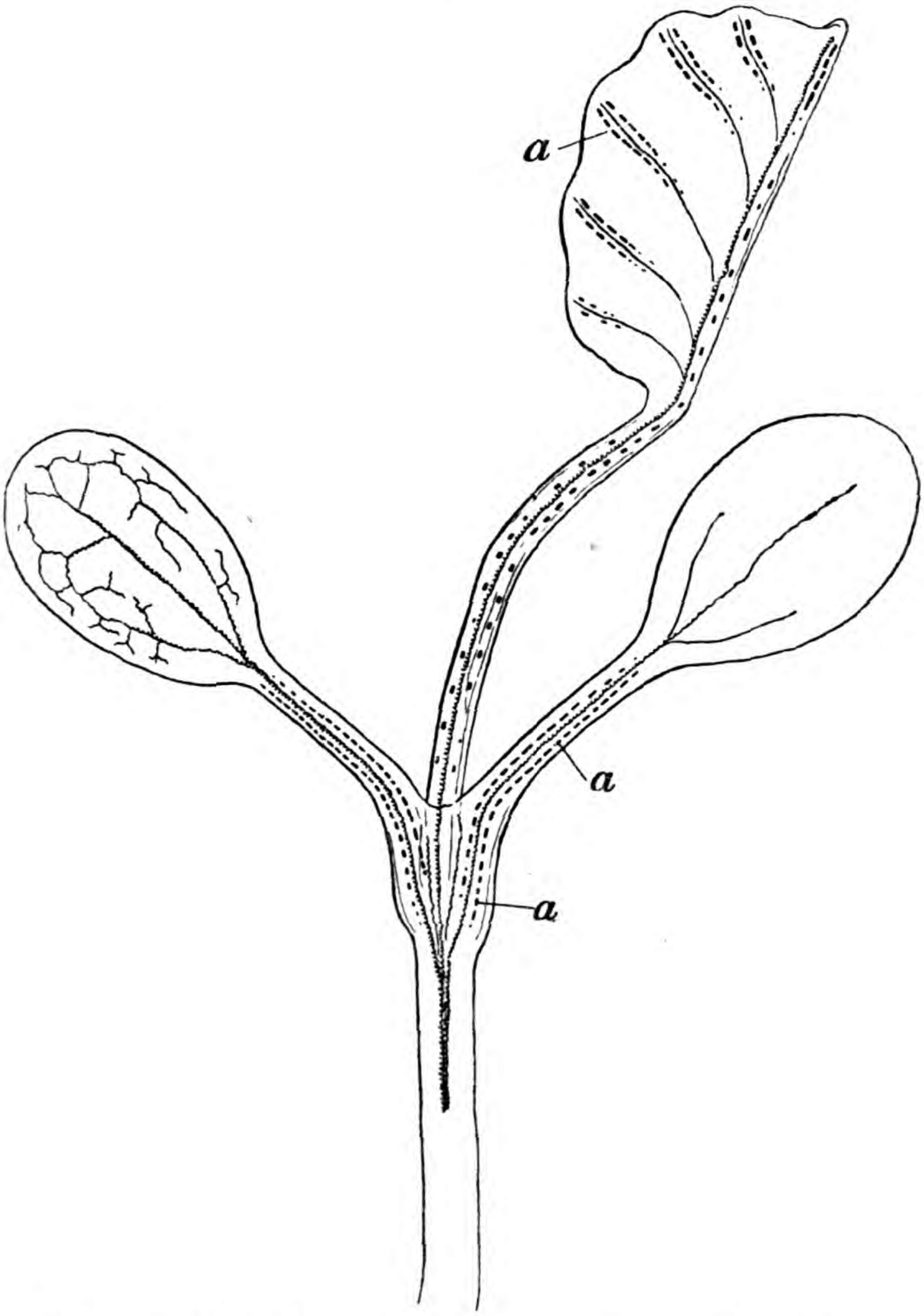
With increasing age a very few crystals may sometimes be noticed along the central vascular bundle running through the cotyledons, especially when the latter are of large size, and occasionally one or two may develop just within the hypocotyl; but usually a sharp line of demarcation exists in the petioles, beyond which no crystals form. As soon as the blade of the primary leaf can be detected, crystals begin to appear in it along the vascular bundles. The crystals are most abundant near the edges of the folded leaf, and develop backwards along the bundles towards the midrib. They are produced most abundantly and rapidly along the second and third pair of vascular bundles nearest the apex of the leaf, a slightly smaller proportion occurring along the short upper portion of the midrib-bundle (fig. 1, p. 398). With increasing growth in length of the petiole of the primary leaf, the simple blade is pushed forward and unfolds; stipules are developed also. Crystals soon form in the petiole in small numbers, and it was noticed that they are more abundant in the upper than in the lower portion of the same petiole; a similar development and distribution is seen in the leaves which arise subsequently. Along the straight unbranched bundles of the stipule crystals are produced in especial abundance, almost as soon as in the primary leaf-blade veins, and earlier than those occurring in the petiole.

I was able to keep the plants growing in distilled water without calcium other than that originally contained in the seed for five or six weeks, during which time the simple primary leaf and one or two fully-developed trifoliolate ones were produced. The third leaf was usually very minute and contained very few crystals.

The fact that crystals are formed in the first foliage-leaf before it is unfolded, and when it is only just visible to the naked eye, suggested that their production is not entirely dependent upon carbon assimilation. In order to prove this point, plants were grown in distilled water in an atmosphere free from carbon dioxide. The plants grew for 20 days and unfolded their primary leaves. An examination of them at different times during this period showed the presence of crystals distributed in a manner similar to that in plants grown in the ordinary way.

Experiments were carried out with seedlings grown in Knop's solution and in ordinary garden-soil. The distribution of the crystals was the same as that indicated above, but their number was increased. In some of these cases I removed the blade or the primary leaf with forceps as soon as it was possible to do so. The petiole of this leaf rather unexpectedly continued to grow until it reached a length of an inch or an inch and a half. In it crystals appeared just the same as when the blade was left attached, from which it may be concluded that the material

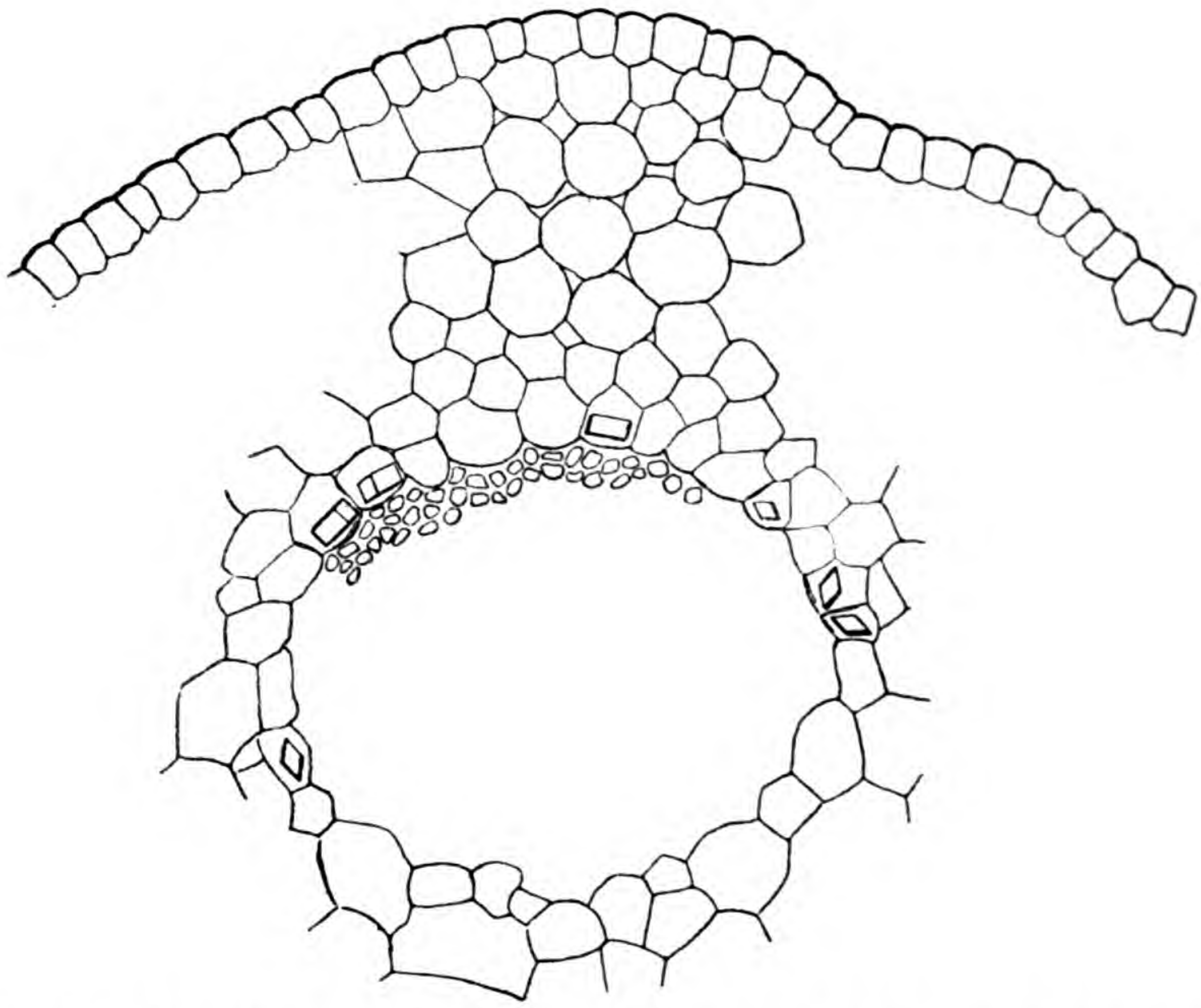
Fig. 1.



Seedling of *Trifolium hybridum*. *a*, lines of crystals.

supplying the calcium and the oxalic acid is derived from the reserve-food of the cotyledon, the blade of the leaf supplying nothing from which the crystals of oxalate in the petiole are produced. In most cases where the blade of the primary leaf was removed there was an increase in the number of crystals in the petioles of the cotyledons, and they were developed slightly

Fig. 2.



Section of petiole of *Trifolium hybridum*, showing crystals *in situ*.

Fig. 3.

Lateral views of crystals attached to base on side of fibre.

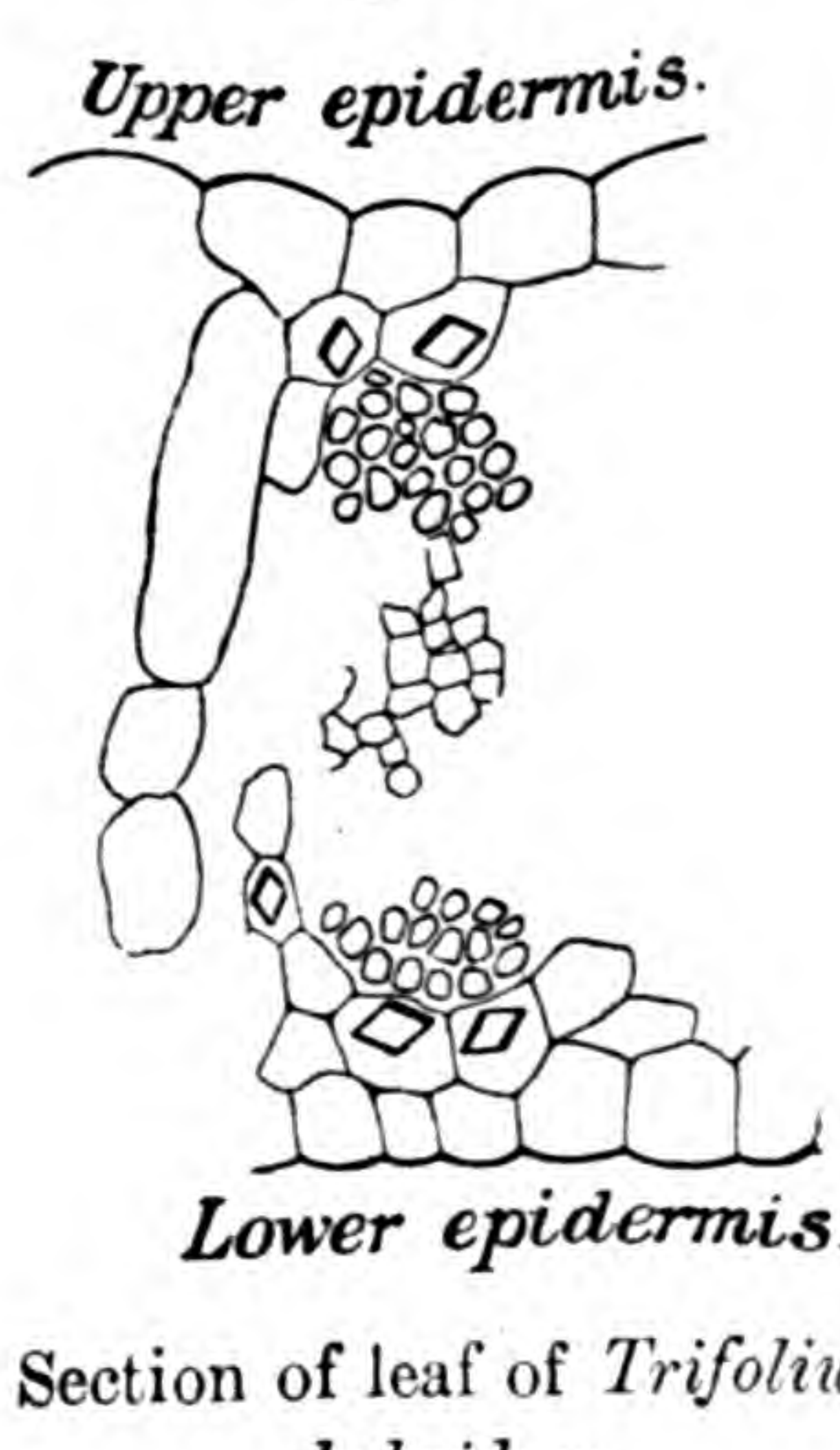
Fig. 4.

Single crystal.

Fig. 6.

Side view of gelatinous matrices of crystals, after ten days in saturated chloral hydrate.

Fig. 5.



Section of leaf of *Trifolium hybridum*.

nearer to the blade of the cotyledon than in normal unmutilated plants of the same age.

To study the effect of darkness upon the crystal-formation, seeds were germinated in the dark. Some were allowed to grow on the filter-paper, while others were placed in distilled water as before. In both cases the hypocotyls grew to a very great length, but the cotyledons were unable to free themselves from the testa of the seed. Crystals were not met with in any of these plants.

Some plants grown in ordinary soil in the light until the cotyledons were free and the primary leaf just visible were covered with an opaque jar. The petioles of the primary leaves continued to grow, and the blades were pushed upwards for an inch or so, but remained folded. After 14 days the plants were examined and crystals were found in a similar position to those in plants grown in the same soil exposed to the light, the only difference noticeable being that the crystals in the petiole of the primary leaf of the darkened plants were much fewer than in normally grown specimens.

Provided growth goes on, it would appear that darkness has but little or no direct influence upon the formation of calcium-oxalate crystals in these plants. It was observed that plants grown in the dark in a complete culture solution, and also in the same solution in an atmosphere free from carbon-dioxide when exposed to light, the cotyledons are smaller and die more rapidly than those plants grown in distilled water under the same conditions. No doubt, if the salts of the culture-solution are absorbed by the plant and not utilized, they accumulate to a poisonous extent and tend to damage the tissues of the leaves.

A large number of seeds were germinated on filter-paper in Petri dishes in the usual way, and the seedlings were allowed to continue their growth in these. Where the plants were very crowded and the cover of the dish kept on, crystals did not form, although their primary leaves unfolded and grew almost as large as those of plants grown for the same length of time in exposed bottles and in which crystals were abundantly produced.

A comparison was made between seedlings grown in the open and plants grown in the same box of soil, but covered with an inverted glass beaker to prevent transpiration. In the former crystals were more abundant than in the latter plants, their leaves were larger, and the vascular bundles were more completely developed.

Plants grown with a reduced water-supply I found to be always much longer in forming crystals than those to which plenty of water was given.

A number of plants were also grown in nutrient solution without calcium. During the time the experiment was carried on, namely 39 days, the plants grew as well as specimens supplied with a complete Knop's solution, but no crystals appeared in any part of the plants.

A number of petioles of the leaves I subjected to gradually increasing strain up to 75 grams during 14 or 15 days. By a comparison of leaves of practically the same age on the same plant, I found that the number of crystals formed at first in the petiole decreased very largely under strain.

The crystals in Alsike and the majority of leguminous plants I have examined are either in the form of short prisms or tetragonal pyramids, and invariably occur in the first row of parenchymatous cells next the fibres on the bast side of the vascular bundles. They are never quite in the middle of the cell-cavity in which they are produced, but lie close to the side immediately adjoining the fibres, and each crystal is imbedded in, or attached to, a matrix of a mucilaginous or pectic substance which is adherent to the inside of the cell-wall (figs. 3 & 4, p. 399). The crystal matrix stains readily when treated with methylene-blue in caustic soda, the surrounding cell-walls remaining colourless under the same treatment (fig. 6).

The position of the crystals is indicated in the portion of the transverse section of a petiole given in fig. 2. In the leaves of the plants the crystals occupy a similar position in regard to fibres as in the petiole, but are met with opposite both the wood and bast next the upper and lower surfaces of the leaves (fig. 5).

The object of my present communication is mainly to describe the distribution and first appearance of calcium-oxalate crystals in seedlings grown under various conditions; and it would be premature to make positive assertions in regard to the processes involved in their formation. The whole evidence, however, obtained during the study of these plants seems to point to the conclusion that the production of the crystals is connected with the formation of fibres in the petioles and leaves. Wherever there is an abundant development of fibres, as near the ends of the vascular bundles in the leaves, and in the simple stipular bundles, these crystals are especially numerous. In the upper parts of the petiole of a leaf there are usually more crystals than in the lower part, and transverse sections show a corresponding difference in the development of fibres at these points.

Moreover, in seedlings grown in a very damp atmosphere, or in the dark, fibres are poorly represented, and the crystals are proportionately diminished in number.

In the cotyledons of the plants there are few or no fibres, and crystals are rarely present. I have also noticed that crystals are not produced near the finest terminations of the vascular bundles or the delicate fibreless portions which connect the main veins, but in some species where these narrow connecting-veins are thicker, fibres and crystals occur together. It must, however, be noted that the absence of crystals in the hypocotyl and root of the plants where fibres are common militates against the view just expressed, and further work is needed to clear up the point.

I have gone through the vast amount of literature on plant-crystals, and am perfectly acquainted with the work of A. F. W. Schimper, Kohl, Kraus, Wehner, and others. It appeared to me unnecessary to take up space with a *résumé* of previous work, most of which is too speculative to be of value.

Note on *Carex Tolmiei*, Boott. By C. B. Clarke, F.L.S.

[Read 20th November, 1902.]

The species *Carex Tolmiei*, Boott, has proved so very troublesome to American caricologists, that an immediate account of the material in herb. Boott, and of some of that in herb. Kew which Boott probably saw, may be acceptable.

C. Tolmiei, Boott, was founded in Hook. Fl. Bor.-Amer. vol. ii. [1839] p. 224, on a single collection of Tolmie made on the Columbia River in N.W. America. At the same time, Boott founded on the next page (p. 225) his species *C. nigella*, on a single collection of Tolmie made on the Columbia River.

Subsequently, Boott in his Illustr. Carex, p. 100, t. 299, described and figured *C. Tolmiei*. Here Boott added to the original material Seemann n. 2207, C. Wright n. 22, C. Wright n. 23, and *C. melastoma* herb. Fischer; of which four plants no one is equal to *C. Tolmiei*, nor, in my opinion, can be made conspecific with it. However, the figure t. 299 is taken wholly from *C. Tolmiei*, the original type; though the description includes the four other plants, and probably some other things marked "*C. Tolmiei*" in herb. Kew.

We have, then, for *C. Tolmiei* the six excellent culms originally collected by Tolmie, and Boott's good figure, t. 299. I first give a diagnosis founded on these only.

Carex Tolmiei (*Hook. Fl. Bor.-Amer.* ii. [1839] p. 224) spicis 9–6, summâ masculâ, fœmineis anguste ellipsoideis densis; glumis fœmineis utriculos non aut vix superantibus; stylo 3-fido; utriculis (rostro perbrevi incluso) 2–2½ mm. longis, anguste ellipsoideis (fere oblongis) trigonis, basi angustatis; nuce utriculum inplente.

Habitat. Columbia River; *Tolmie.*

No one of the 6 culms of *C. Tolmiei* has less than 6 spikes; no one of the culms added to it by Boott has more than 4. On none of these added culms (except some I call *C. nigella*, Hook.) is the female spike dense as in *C. Tolmiei.* The definitely trigonous nut has always a 3-fid style; the material called *C. Tolmiei* var. *subsessilis* by L. C. Bailey (in Mem. Torrey Club, vol. i. (1889) p. 47), with bifid style, I refer to *C. rigida*, Gooden., and *C. pulla*, Gooden.

Seemann no. 2207 was pasted down in herb. Boott on the type-sheet of *C. Tolmiei* (with Tolmie's plant). It appears to me widely different; the utricle is broad, flattened, and the nut is much narrower than the utricle. I call it simply *C. ustulata*, Wahlenb.; if not that, I maintain it to be very close thereto.

I give next a diagnosis of Boott's adjacent species:—

CAREX NIGELLA (*Hook. Fl. Bor.-Amer.* ii. [1839] p. 225); spicis 4; utriculis 3 mm. longis (*i. e.* quam ii *C. Tolmiei* longioribus); glumis fœmineis apice lanceolatis utriculos plane superantibus; ceteroquin ut *C. Tolmiei—Boott, Carex*, p. 194 et *Ic. Ined.* 654 in herb. Kew.

C. Tolmiei, Boott, Carex, p. 100 partim (*i. e.* Fischeri exemplum et C. Wright n. 22).

C. melastoma, Fischer MS.

Habitat. Columbia River; *Tolmie.* Behring Straits: Arakam Ins., *C. Wrighti* n. 22; St. Paul Ins., *Langsdorff* in herb. Fischer.

It appears doubtful whether this species can be retained as other than a variety of *C. Tolmiei.* In the type of *C. nigella* of Tolmie the spikes are little less dense than in *C. Tolmiei*; but there is in herb. Kew another plant collected by C. Wright on the Ringold and Rodgers Expedition, called "*C. Tolmiei*" in herb. Kew, in which the spikes are much more lax. As to Fischer's plant and C. Wright n. 22, they agree with *C. nigella* much better than with *C. Tolmiei.*

The remaining *C. Tolmiei* in Boott's herb. I call new species as follows:—

CAREX LEPTOSACCUS, sp. nova; spicis 4, terminali musculâ; spicis fœmineis 3 mm. latis, vix densis; utriculis 2 mm. longis, ovoideis, compressis, suberostratis, papyraceis; stylo 3-fido; nuce obovoideâ, trigonâ, quam utriculus paullo angustiore.

C. Tolmiei, Boott, Carex, p. 100 partim.

Habitat. Behring's Straits: Arakam Ins., *C. Wright* n. 23.

The young female spikes are deep brown; but the fruiting spikes are variegated with white, the female glumes having in them broad scarious margins towards their summits. This, as well as the papyraceous utricles, might possibly be a consequence of imperfect ripening, *i. e.* the glumes may here be withered. But, if that should be so (and in one of the utricles I have found a nearly ripe nut), the broad utricle will not do for *C. Tolmiei*, Hook.; indeed, the plant appears nearer *C. compacta*, Boott. It was in this plant that Boott found the rudiment of the axis within the utricle as noted by him.

There is yet another *C. Tolmiei* in herb. Kew, viz. :—

Carex microsaccus, sp. nova; spicis 4, terminali masculâ, fœmineis 2½ mm. latis; utriculis 1 mm. longis, globoso-trigonis, erostratis, minute glandulosis, etiamque a glandulis magnis rubris remote inspersis.

Habitat. Japan?

This is "n. 985" in herb. Kew, perhaps collected by Wilford in Japan or Korea, and was referred in herb. Kew to *C. Tolmiei* (possibly by Boott). It seems to me near *C. bidentula*, Franchet, rather than to *C. Tolmiei*.

In this species, as in the three preceding, I have looked through the North-west American and the North-east Asian without being able to find any plant that fairly matches it.

On the Electric Pulsation accompanying Automatic Movements in *Desmodium gyrans*, DC. By Prof. Jagadis Chunder Bose, C.I.E., M.A., D.Sc. (Communicated by the President.)

[Read 19th February, 1903.]

In my paper on the "Electric Response of Ordinary Plants under Mechanical Stimulus," read before the Linnean Society (Journ., Bot. xxxv. 1902, pp. 275–304), I have shown how, in response to an external stimulus, an electric pulsation is produced in a non-motile and apparently insensitive plant-organ. In these cases the molecular changes due to stimulus are revealed, not by any visible movement, but by electromotive changes. We have again plants which exhibit very marked mechanical response, as seen in sensitive plants; the responses, however, being evoked by the action of an external stimulus. Still more wonderful are the automatic movements exhibited by certain plants by the action of some periodic internal stimuli. Of these, the autonomic variation-movement of the lateral leaflets of *Desmodium gyrans* is a striking example. These, as is well known, exhibit a periodic up-and-down or elliptical movement, the period varying from about two to four minutes.

The excitation produced in ordinary plants by external stimulus was evidenced by electric responses. I was desirous to find out whether these automatic periodic movements, due to the action of internal stimuli, were attended by concomitant electric pulsations.

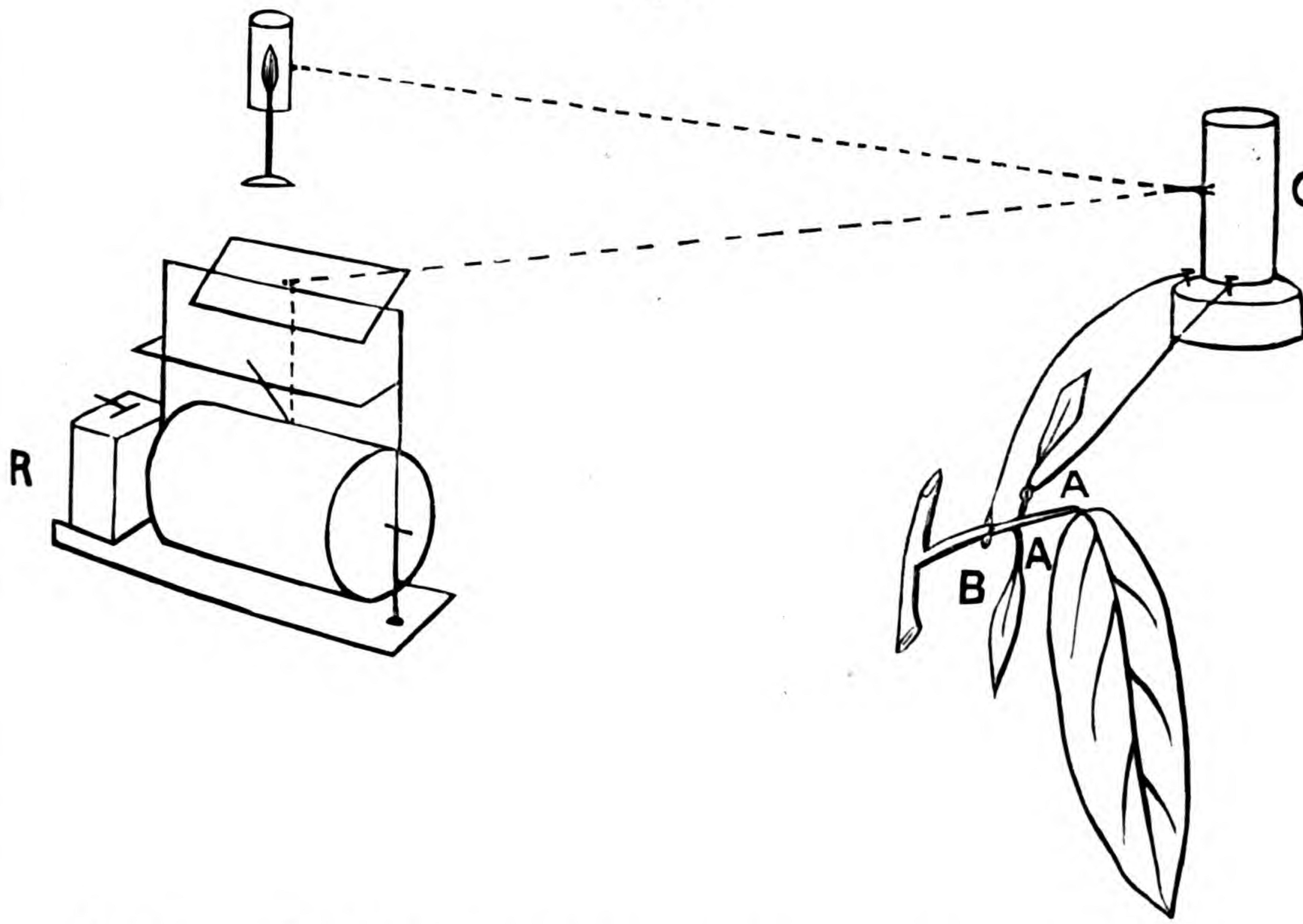
Experimental Arrangements.

I have shown in my previous paper (Journ. Linn. Soc., Bot. xxxv. (1902) p. 278) that stimulus gives rise to electric changes in the plant, and that an electromotive force is thereby induced between the excited and unexcited portions of a tissue. The direction of the current of response in the tissue is, normally speaking, from the more excited to the less excited point. If the plant-tissue is in the same physico-chemical condition throughout, the surface is iso-electric, local excitation giving rise to electromotive variations. If the tissue is not in the same physico-chemical condition, there will be a more or less permanent current—the current of rest. This, however, does not alter the general result; the electromotive changes due to excitation are simply superposed on the existing electromotive force.

In order, then, to get the responsive electromotive changes which accompany the automatic movements of the leaflets, it was necessary to make one of the electric contacts at a point of tissue which was in a relatively resting condition; the second contact being made at the place where the excitatory movement was at its maximum. It is to be borne in mind that the internal changes, to which the movement is due, take place in the slender petiolules to which the leaflets are attached, the latter serving merely as indicating flags. Acting on the considerations referred to above, I made one contact with the slender stalk of the lateral leaflet, the other being made with the common petiole.

The contacts are securely made by means of cotton threads moistened with normal saline solution and connected with non-polarisable electrodes not shown in the figure. The electrodes lead to a sensitive and dead-beat galvanometer. The electromotive variations produced in the plant cause corresponding deflections in the galvanometer. The excursions of the spot of light are recorded by means of the response-recorder, fully described in my previous paper. We have thus contacts made at two points; one of which undergoes periodic excitation, the other remaining quiescent. From the results of my previous experiments, I was led to expect that there would be periodic electric pulsations accompanying the periodic mechanical movements of the leaflets. From the experiments now to be described it will be seen that my anticipations have been fully justified.

Fig. 1.

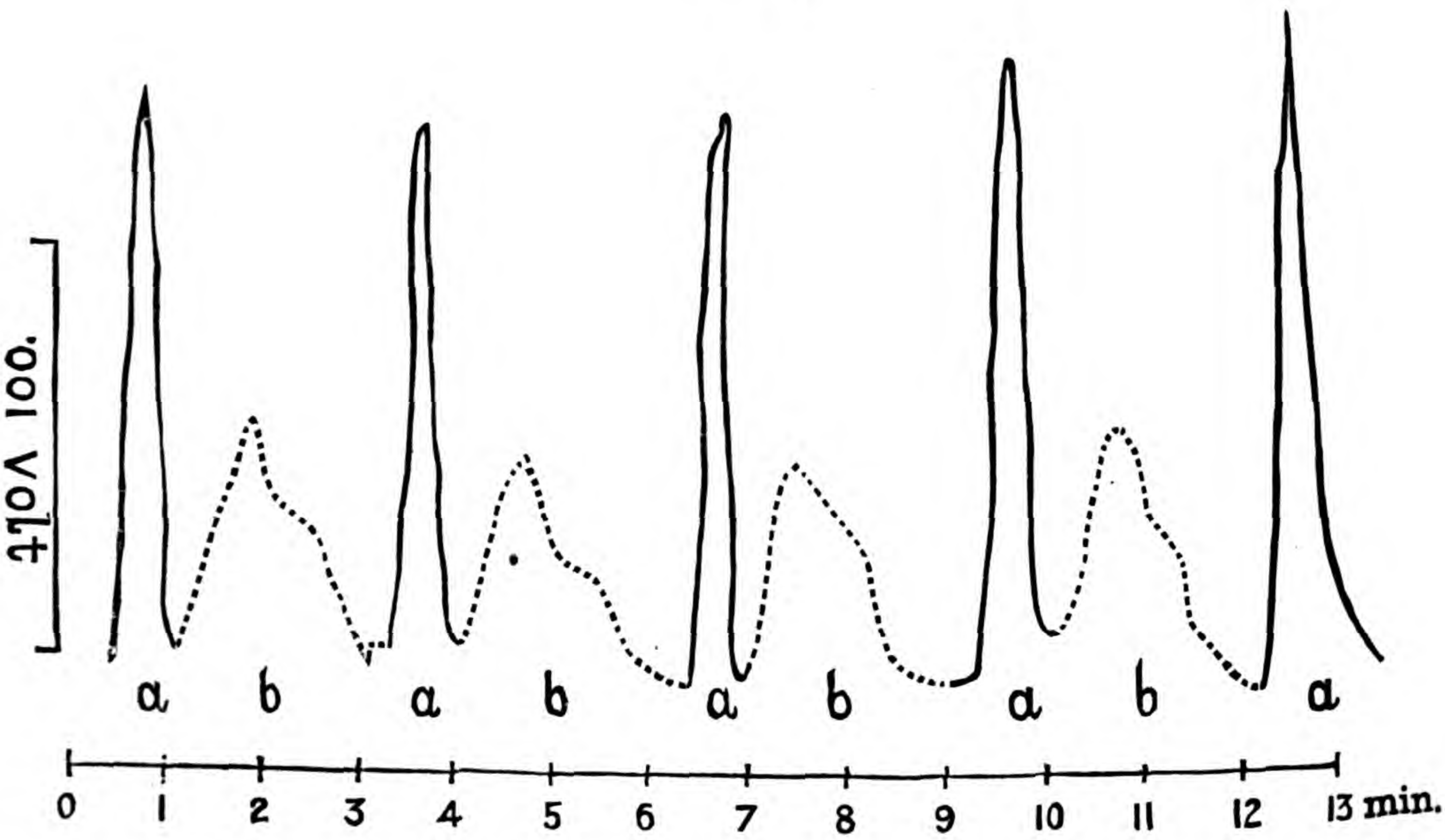


Arrangement for exhibiting electric response in *Desmodium gyrans*. Electric connections are made with the galvanometer by means of non-polarisable electrodes, one point of contact being made with the excitable tissue at A and the other with the resting-point B. G is the galvanometer and R the response-recorder. The current of response in the plant is from the excitable A to the resting B.

The habitat of these plants is the Gangetic plain, and I was able to secure several specimens from their natural surroundings. The plants could not be at their best condition at this time of year—the beginning of winter (November); besides, they have already commenced flowering. The vital activity, on which depends the intensity of the electric response which I sought to detect, is not therefore so great now as it would be in spring or summer. But I had no difficulty in obtaining very well-marked effects, even at this season of the year. I have, however, postponed some further and more delicate experiments for a more favourable season.

The movement of the leaflet, in some instances, takes place by jerks; in others it is more uniform. The period for a complete up-and-down movement was on an average about 3·5 minutes. From the normal or highest position the leaflet sinks somewhat rapidly; having reached its maximum depressed position, it rests for a while; there is then produced a rather

Fig. 2.



Electric response in *Desmodium gyrans*. The electric response corresponding to one complete mechanical vibration consists of a principal wave (*a*) shown in continuous line, and a subsidiary wave (*b*) shown in dotted line.

slow rise to its original position. The up-and-down motion is in some cases approximately straight, the curve described being a very elongated ellipse. In other cases the petiolule of the leaflet is slightly twisted after its descent, and the corresponding curve described becomes more circular.

The numerous varieties of these mechanical responses give rise to corresponding modifications of the curves of electric response. It will, however, be best to take the records of some typically simple cases, on consideration of which it will be easy to understand what happens under more complex conditions.

Electric Response-curve.

I selected specimens where the movement of the leaflet took place gradually, without jerks, and where the up-and-down movement was approximately in a straight line. On taking a record of electric response, I was surprised to find that, corresponding to each complete mechanical vibration, there is produced a double electric pulsation—a large principal wave (*a*), followed by a smaller subsidiary wave (*b*). Such double response, mimicking the dichrotic pulse-record of the heart-beat, I have found in all the specimens I have tried. In the case whose record is given (fig. 2), the period of complete mechanical vibration was about 3·5 minutes. The period of the principal electrical wave of response was slightly less than one minute, that of the subsidiary wave was slightly over 2·5 minutes. These double electric pulses, corresponding to a single mechanical vibration, are at first very puzzling, and I undertook special investigations to clear up this obscure point. In the concluding part of this paper I shall adduce experimental results which will satisfactorily explain the peculiarity.

The Sign and Intensity of Electric Response.

As regards the sign of response, I have shown (Journ. Linn. Soc., Bot. xxxv. (1902) p. 277) that in ordinary plants and under normal conditions the current of response flows, in the plant, from the more to the less excited portion of the tissue. This is generally the case also in the electric response in animal tissue. In *Desmodium gyrans* I have found it so in all cases hitherto examined; that is to say, the current of response in the plant flows from the excitable petiolule A to the resting petiole B (fig. 1).

I may, however, mention here certain conditions which might give rise to a reversed response. I have shown that when a plant is in a depressed vital condition, the direction of current of response is apt to be reversed. Again, the response under feeble stimulation may be abnormal or reversed, but under stronger stimulation it may become normal again *. Curiously enough, I have obtained similarly opposed responses, to feeble and strong stimuli respectively, with inorganic substances—in metals under mechanical stimulus and under the stimulus of

* Bose, 'Response in the Living and Non-Living' (Messrs. Longmans).

Hertzian radiation *. It will thus be seen that the sign of response, in certain cases, may vary with the molecular condition of the substance or tissue, and also with the intensity of stimulus.

As regards the intensity of electromotive variation, I have often obtained as high a value as ·0025 volt for the larger or principal wave. In a more favourable season of the year and with a vigorous plant, this value will probably be considerably enhanced. I give below the absolute values of electromotive variation obtained with two different specimens, five successive observations being taken in each case.

TABLE I.

Number of Observation.	E.M. Variation. Principal wave.	E.M. Variation. Subsidiary wave.
1	·0014 volt.	·00055 volt.
2	·0013 „	·00051 „
3	·0014 „	·00054 „
4	·0015 „	·00054 „
5	·0016 „	

TABLE II.

Number of Observation.	E.M. Variation. Principal wave.	E.M. Variation. Subsidiary wave.
1	·0024 volt.	·0016 volt.
2	·0025 „	·0015 „
3	·0025 „	·0016 „
4	·0025 „	·0017 „
5	·0026 „	

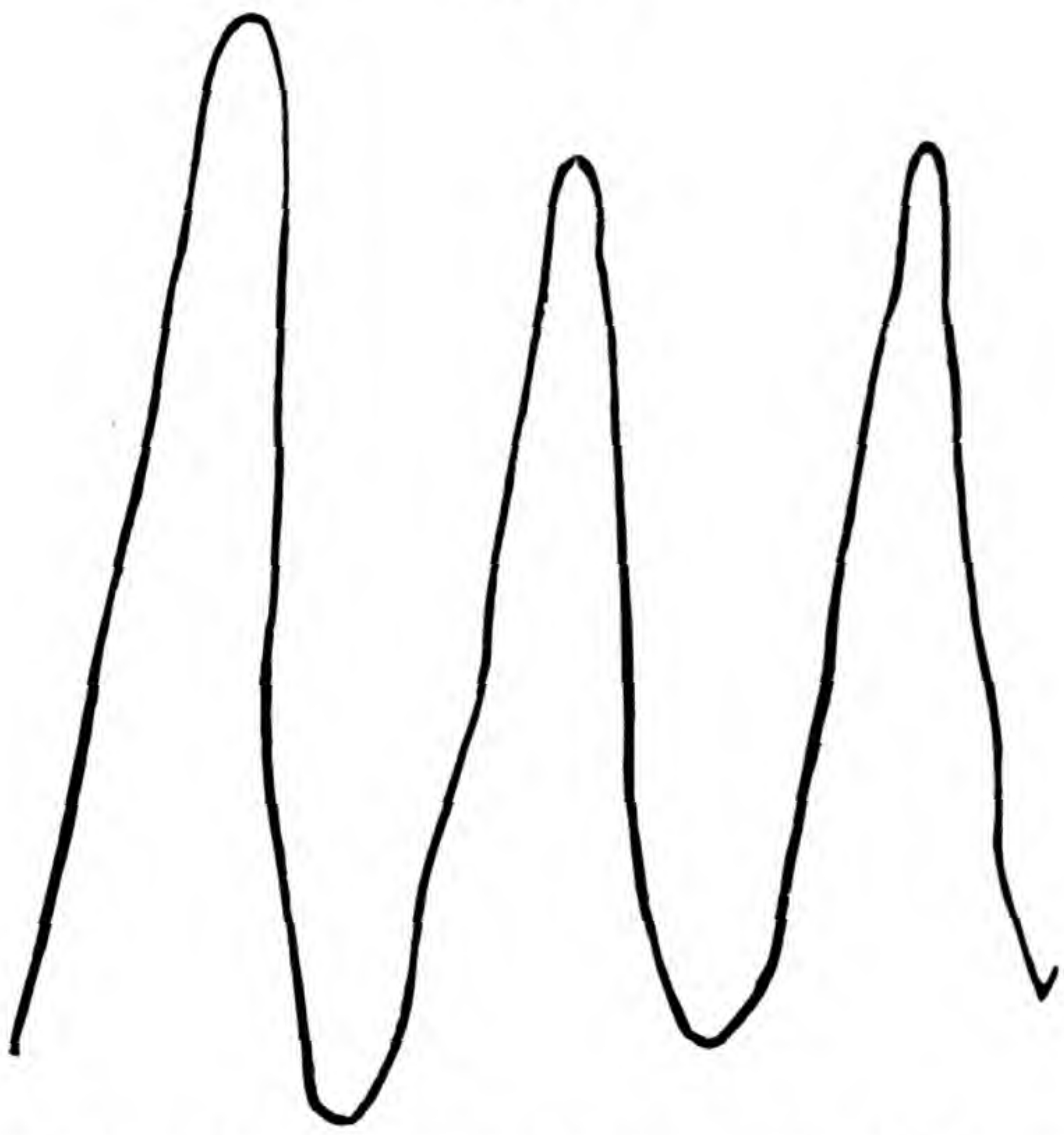
Fatigue.

Some specimens exhibit responses which are uniform, as in the case given in fig. 2: by uniform I mean that the double wave repeats itself without undergoing any variation. But in other instances signs of fatigue are evident, the successive

* Bose, J. C., "On Electric Touch and the Molecular Changes produced in Matter by Electric Waves," Proc. Roy. Soc., Feb. 1900, pp. 452–474.

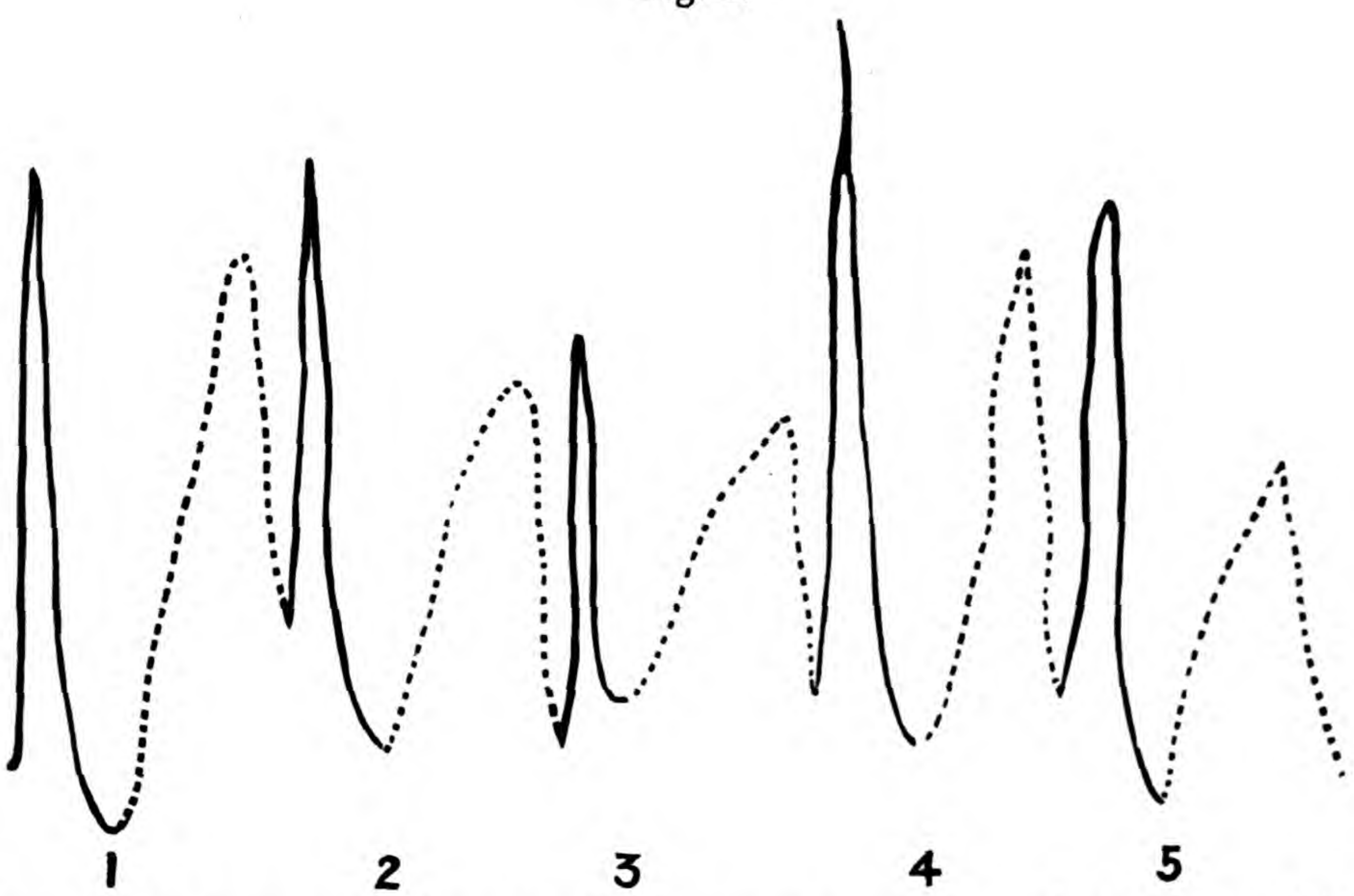
electric responses undergoing a diminution. A similar sign of fatigue (fig. 3) is also seen with the mechanical responses

Fig. 3.



Fatigue exhibited in the mechanical responses of *Desmodium gyrans.*

Fig. 4.



Periodic fatigue exhibited in the electric responses of *Desmodium gyrans.* The principal wave is represented by a continuous line and the subsidiary wave by a dotted line. The double responses undergo continuous diminution till the third complete period; at the fourth they attain a large value, similar to the first; after this the cycle is repeated.

given by the plant. But the most curious case, which is occasionally exhibited, is that of periodic fatigue; that is to say, the electric response undergoes gradual diminution from a maximum to a minimum, after which it again attains the maximum value and repeats the cycle. In the record given (fig. 4) the electric response gradually declined to a minimum at the third set of double responses, after which it attained the first maximum value, only to repeat the cycle.

In connection with this it is interesting to note that I obtained exactly similar periodic fatigue with ordinary plants in responses to uniform mechanical stimuli. In the record

Fig. 5.

Periodic fatigue exhibited by a specimen of petiole of Cauliflower. The responses are to successive uniform mechanical stimuli applied at intervals of one minute.

given in fig. 5, alternate responses exhibit fatigue. In other cases, I found the cycle completed after the third or fourth response.

Interference Effects.

It will be understood from what has been said before, that the direction of the responsive current in the plant, and the consequent direction of the galvanometric deflection, depend on the relative quiescence or excitability of the two contacts. If, of the two contacts (see fig. 1), B be quiescent and A excited, the current of response in the plant will be from A to B; the galvanometer connection being properly adjusted, this will give rise to an upward or, say, positive deflection. The petiolule being periodically excited, there would be produced a periodic (double) electric pulsation, whose sign would be positive.

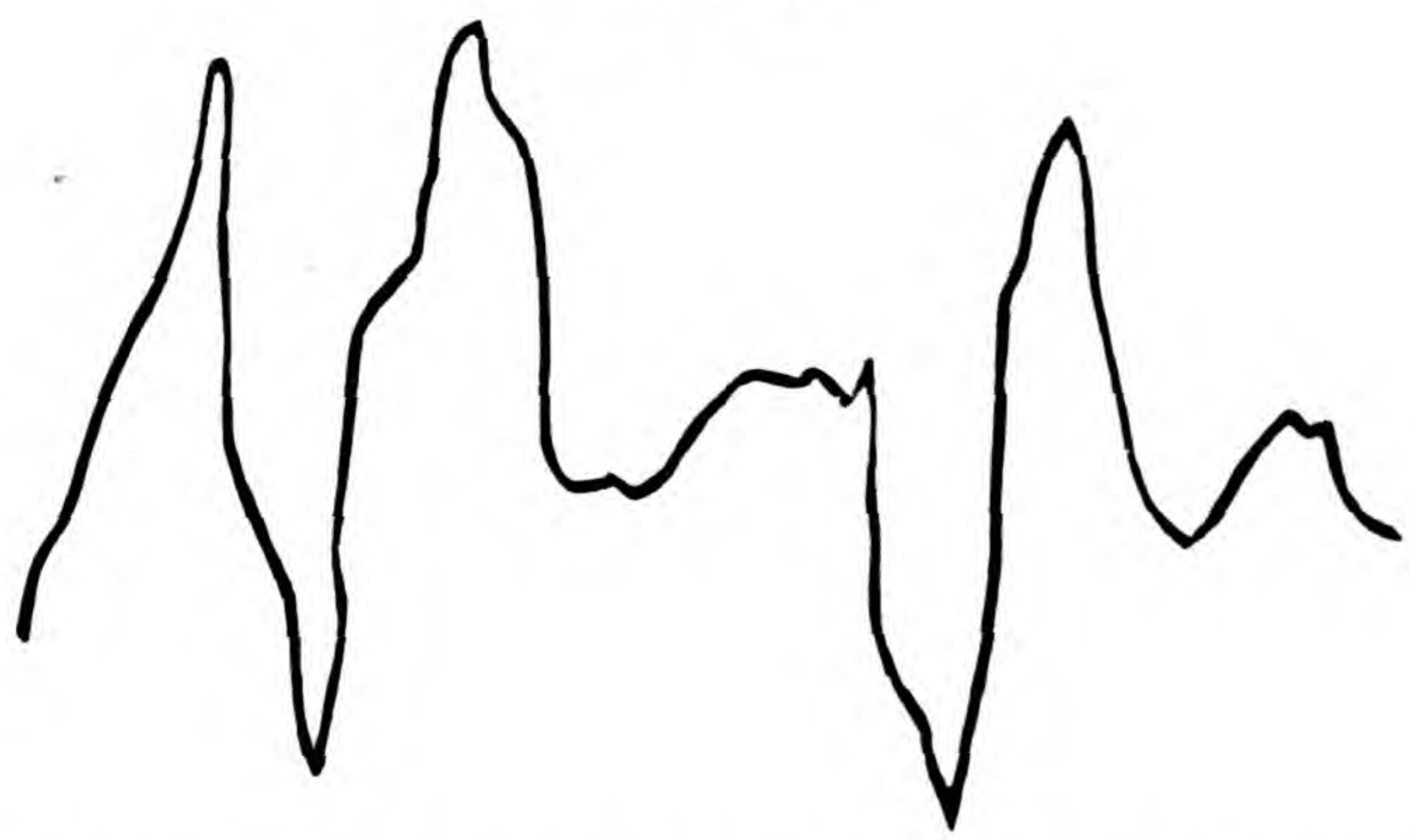
In *Desmodium* there are two lateral leaflets, and both of them, usually speaking, execute periodic movements. If now one of the contacts be shifted from the resting-point B in the main petiole to the petiolule A′, we shall get extremely interesting interference effects.

1. Suppose both the leaflets execute periodic movements, and suppose the mechanical oscillations of both are in the

same phase; in such a case the points A and A′ would both be at a given moment in the same state—either of excitation or quiescence. But it has been shown that electric response can only take place when there is a relative difference in the excitability of the two contacts. In the present case, the electric variations at A and A′ being similar, one balances the other, and there is no resultant response.

2. If the excitation of the two leaflets be not simultaneous, but if there be a constant phase-difference of half a period between the two—that is to say, if while A′ is in a state of quiescence A is most excited and *vice versâ*—then in the former case the responsive current in the plant will be from the excitable A to the quiescent A′; this will give rise to an upward

Fig. 6.



Electric interference-effects due to the excitations of the two opposite leaflets.

electric pulsation. The excitation of A will then subside, while that of A′ will reach a maximum. The responsive current will therefore change its direction, and we shall get a negative or downward response. Under these conditions, the responsive pulses would be regular and alternately up and down.

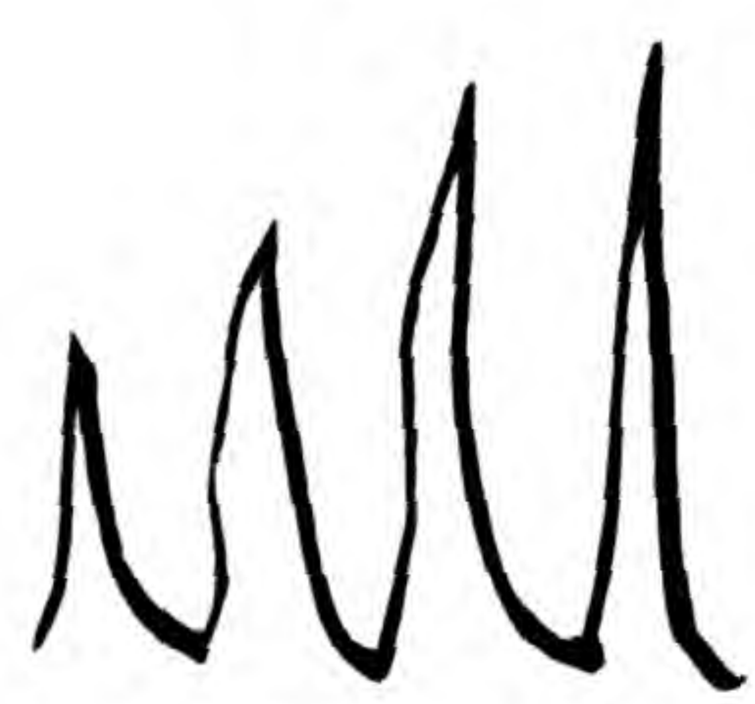
3. There is again a third case where the phase-difference is not exactly half a period. In practice this is often found to be the case. Again, the periodicity of each leaflet may not remain absolutely constant, and the phase-difference may therefore undergo a continuous change. Under these conditions, we may expect a somewhat complicated curve due to the algebraical summation of A and A′ effects. I give here (fig. 6) a record which I obtained under these conditions.

Investigation on the Cause of the Double Electric Response.

I now proceed to adduce considerations and experiments which will offer an explanation of the double electric response corresponding to a single mechanical vibration. We have to explain (1) why the response should be double, and (2) why, of the two, the principal wave of electric response should be larger than the subsidiary wave.

I must here recapitulate briefly certain results I obtained with ordinary plants, which have a special bearing on the present subject. I found (Journ. Linn. Soc., Bot. xxxv. (1902) p. 283) that when a plant is mechanically stimulated, say by torsional vibration, then keeping the amplitude of vibration constant, the intensity of electric response depends on the quickness with which the vibration is effected,—the quicker the motion, the stronger is the response. This is clearly seen in the records given in fig. 7, where successive

Fig. 7.



Successive responses to vibrational stimulus of the same amplitude 30°, imparted with increasing rapidity. It will be seen how the response is enhanced with the rapidity of the onset of disturbance.

vibrational stimuli of the same amplitude were imparted to the plant, but with increasing rapidity. Again, when the plant is in any way disturbed mechanically, whether by bending or by torsion, the electric response takes place *during* distortion. Thus, when the plant was twisted through a definite angle, there was a response, say an upward galvanometer movement during twist, but while the plant continued to be held in the twisted position the electric disturbance disappeared, the deflected galvanometer spot of light returning to zero. If, then, the plant were untwisted and brought back to its original position, there was a second response, in the same direction as before, and the usual recovery took place once more on the return of the tissue to the condition of rest. It will be thus seen that (i) the electric response takes place *during* the mechanical movement of the plant; (ii) that the sign of electrical response is independent of the direction of motion; and (iii) that the intensity of response depends on the rate of motion.

In *Desmodium gyrans*, starting from the uppermost position, the leaflet moves down, and having attained its maximum swing stops in that position for a while. The first or principal wave of electric response attains its height during this movement, and recovery takes place while the leaflet is undergoing its temporary rest. The latter now commences an upward movement, and the subsidiary wave of response is similarly obtained during this process. The mutual relation which thus exists between the mechanical wave and the concomitant double electric wave will be clearly seen from the inspection of two records taken simultaneously, to be given presently.

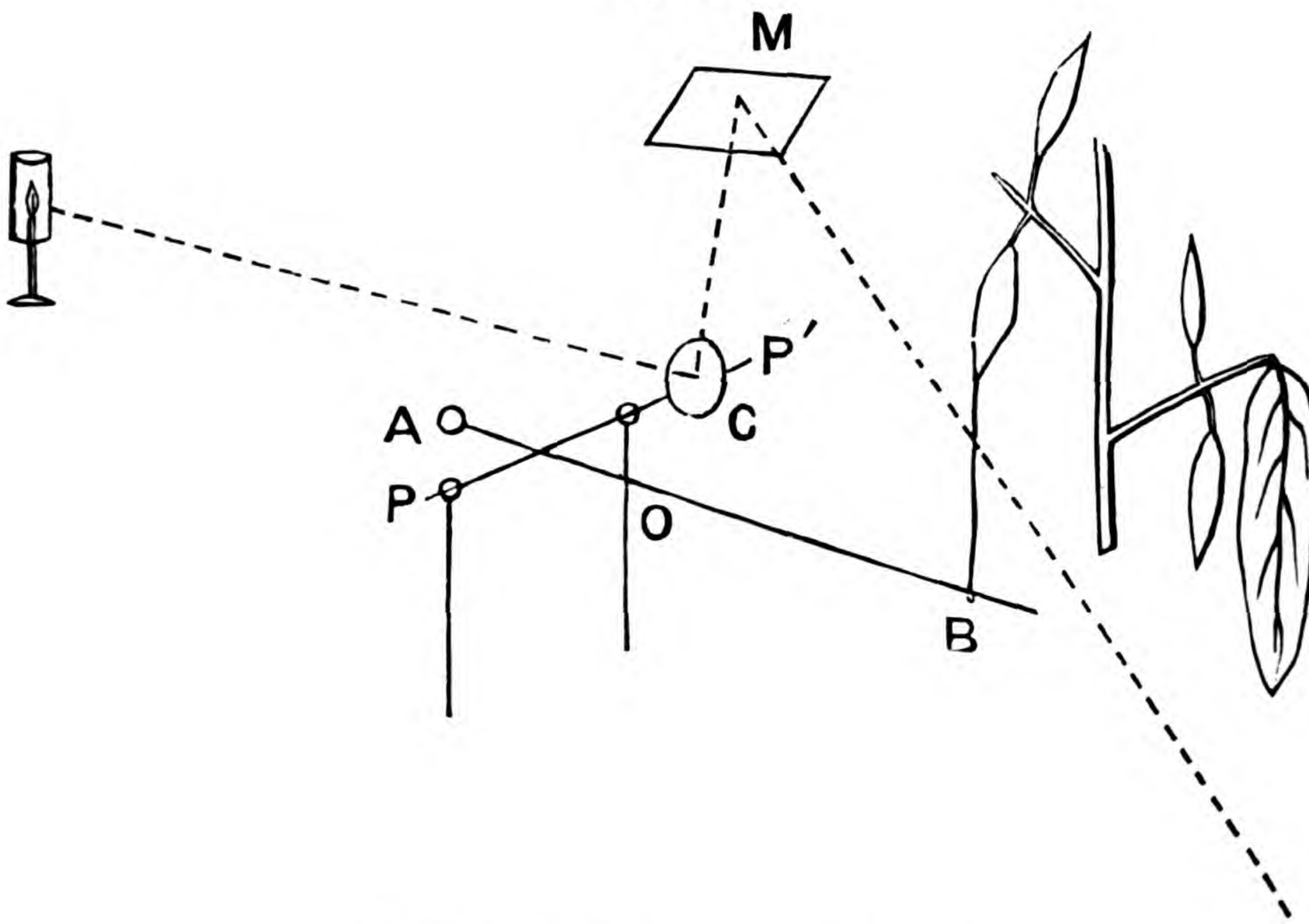
Apparatus for taking the Record of Mechanical Response.

The difficulty of the mechanical record lies in the extreme slenderness of the leaflets, in consequence of which the attachment of an index is apt to produce a great constraint on their natural movement. This difficulty has been overcome in the following manner, by which it is possible to obtain the mechanical record with ease and accuracy.

A lever having two unequal arms, OA and OB, is made of aluminium wire. It is balanced about the pivot PP′, which rests on frictionless bearings. The long arm has a slight overweight, which makes it tilt somewhat downwards. One end of a single cocoon-thread is attached to the tip of the leaflet by means of a small quantity of shellac varnish, the other end of the thread being fixed to the long arm of the lever. A light concave mirror C is attached to the prolongation of the pivot (fig. 8). From the perfect balance of the arrangement, it will be seen that the slightest movement of the leaflet causes a corresponding tilt in the lever, the pull exserted by it being negligible. A spot of light reflected from the mirror C gives a record of the movement of the leaflet on a magnified scale. The magnification is increased by increasing the distance of the point of attachment of the thread on the long arm, away from the fulcrum; it is also increased by increasing the distance of the recording drum from the lever. The vertical movement of the spot of light is converted into a horizontal movement through a second reflection in a suitably inclined mirror, M.

These curves enable us to obtain the absolute value of the movement executed by the tip of the leaflet. The abscissa of the curve represents the time, which is known from the speed

Fig. 8.



Optical lever for mechanical record.

of rotation of the drum. The absolute value of the ordinate, representing the distance travelled by the leaf, is found by moving the long arm of the lever through a given vertical distance, say one centimetre, and observing the displacement of the reflected spot of light on the recording drum.

Simultaneous Mechanical and Electrical Record.

In order to demonstrate the mutual relation of the two responses, it was necessary to take two records simultaneously on the same recording drum (fig. 9).

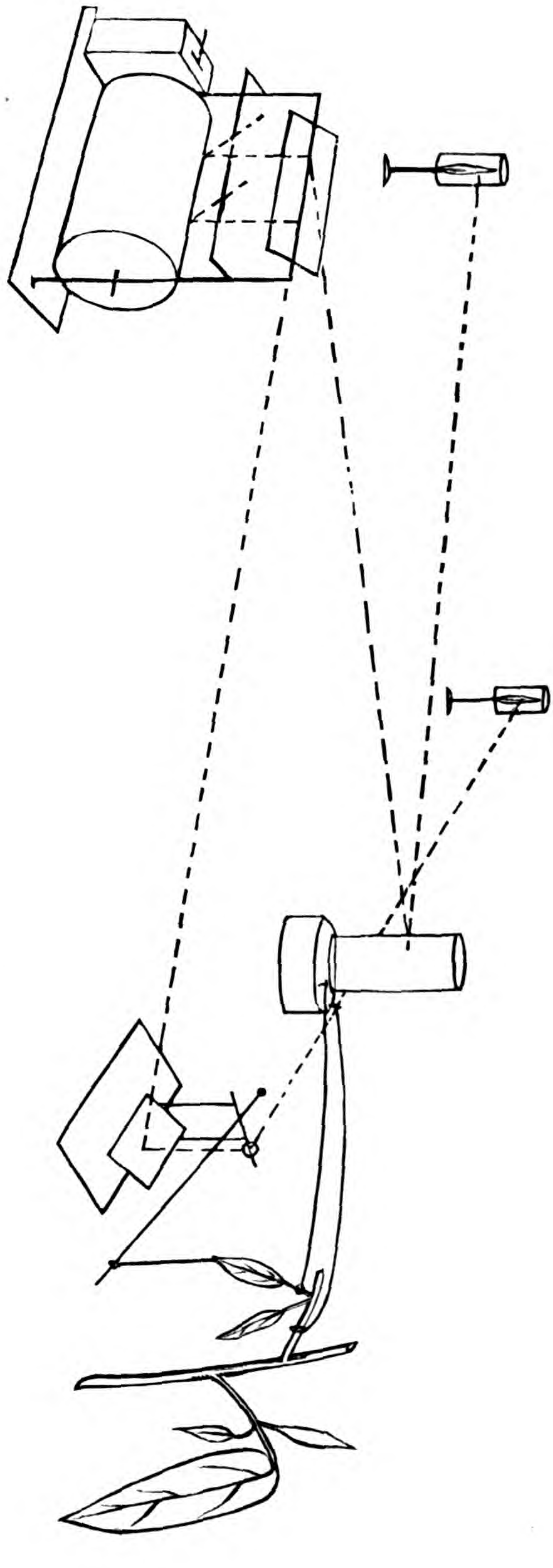
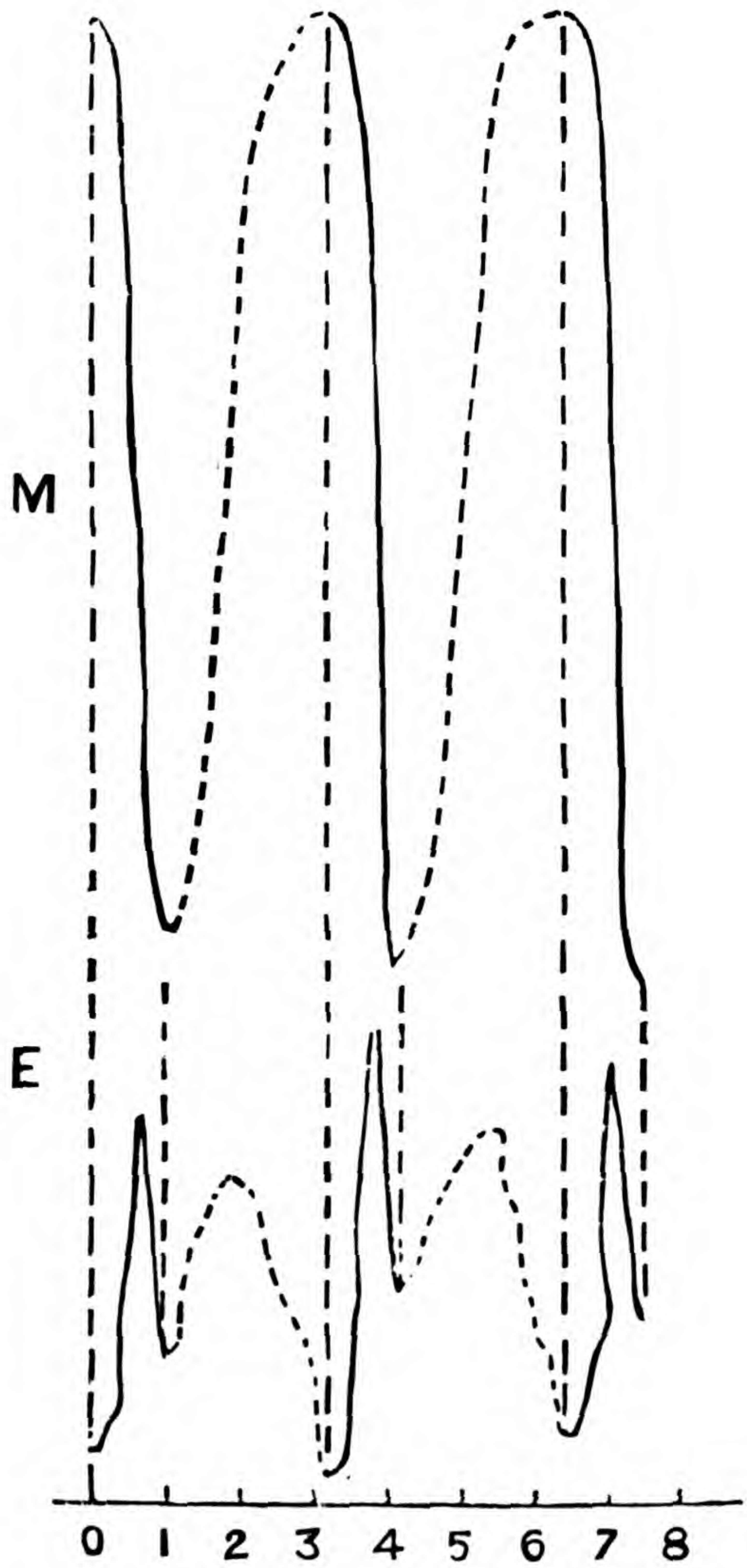


Fig. 9.

Arrangement for taking simultaneous mechanical and electrical record.

I give a record (fig. 10) thus obtained, which will be found to bear out fully the considerations which have been put forward to explain the double electric response corresponding to a single

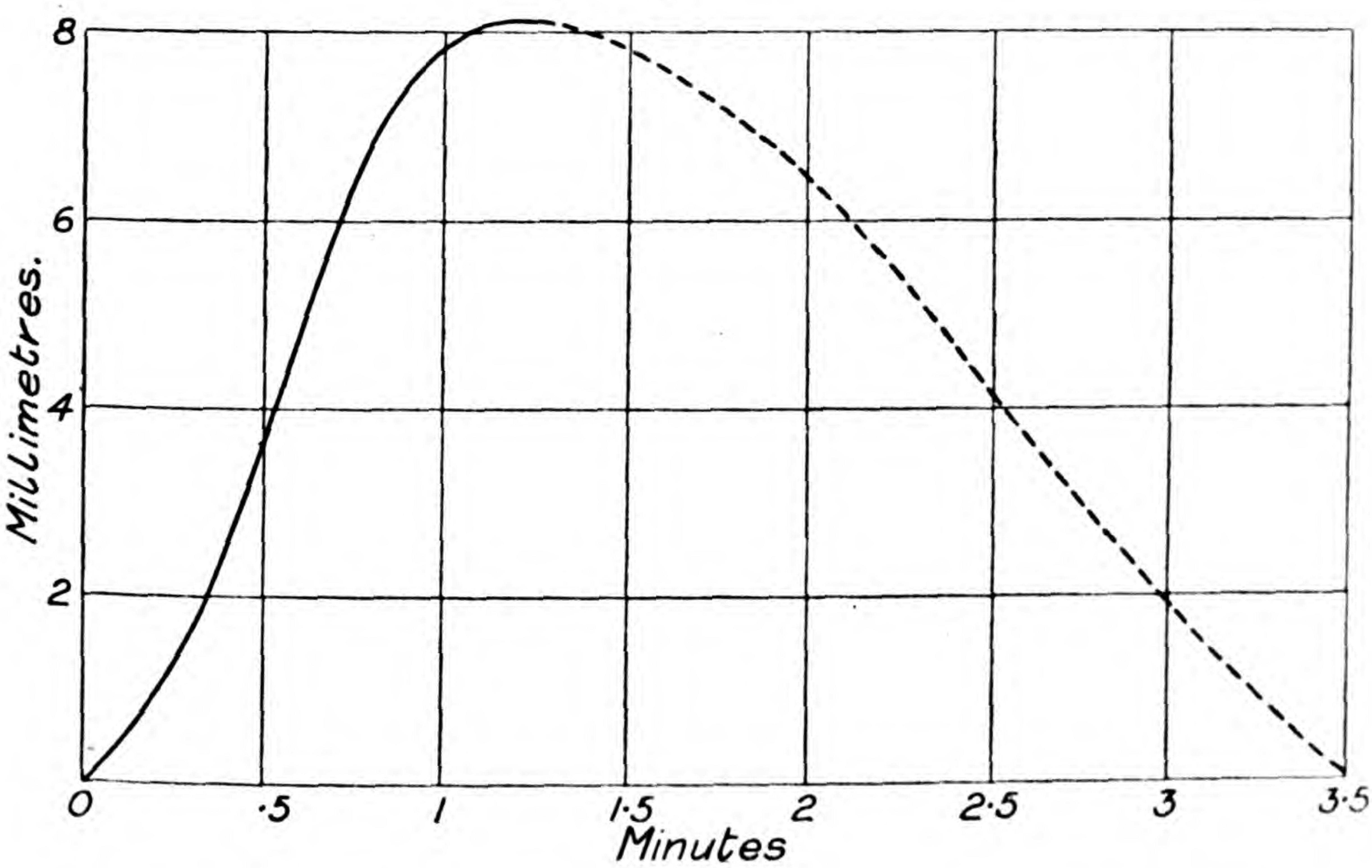
Fig. 10.



Simultaneous mechanical (M) and electrical (E) records. The curves in continuous line represent the descending movement of the leaflet and the corresponding electrical pulsation. The curves in dotted line similarly represent the ascending movement of the leaflet and the corresponding electrical pulsation.

mechanical response. It will be seen that after a period of quiescence, as the leaflet began to move downwards, it gave rise to the corresponding first or principal electric response. The movement downward ended in about a minute, and the principal response, with its recovery, was executed in this time. After a pause, the movement upwards now commenced, and the subsidiary electric response is seen to commence at the same moment as the upward movement. The upward movement of the leaflet ceased in a little more than two minutes, and the period of the secondary wave occupied the same time. (The secondary wave is therefore broader than the primary wave.) Thus we have the period of the principal wave coinciding with that of the downward mechanical movement of the leaflet, and the secondary wave with that of the upward movement.

Fig. 11.



Mechanical response curve. Here the rising portion of the curve, shown in continuous line, is traced by the leaflet during its descent, and the falling portion during its ascent.

We have still to account for the greater intensity of the principal electric response, which was shown to accompany the downward movement of the leaflet. I have already explained that it is the rate of mechanical movement which determines this intensity. In the present case, the greater amplitude of the principal wave would be accounted for if it can be shown that the downward motion of the leaflet is quicker than its motion upward. In the simultaneous record (fig. 10) a careful inspection will show that the descending part of the mechanical record which corresponds to the downward movement of the leaf is steeper than the ascending part of the curve corresponding to the upward movement of the leaf. But in a contracted curve these characteristics are not very evident. I therefore took a mechanical record on a fast-moving drum. This is reproduced in fig. 11. Here the ascending part of the curve represents the motion of the leaflet downwards. The leaflet, on commencing to move, soon attains an approximately uniform velocity. It will be seen from the curve that it travels a distance of 6·25 millimetres in 375 seconds, the velocity being 10 millimetres per minute. But during the ascent of the leaflet the velocity is very much reduced, when the velocity becomes approximately uniform. The leaflet only travels a distance of 6·25 millimetres in 86 seconds, or a velocity of 4·3 millimetres per minute.

The greater amplitude of the principal wave of electric response, which is the concomitant of the downward movement of the leaflet, is thus proved to be due to the greater velocity of motion of the leaflet during its period of descent.

———

On *Poa laxa* and *Poa stricta* of our British Floras.

By G. CLARIDGE DRUCE, M.A., F.L.S.

[Read 19th March, 1903.]

For some years past doubts have been expressed by many botanists, including Professor Hackel, as to the correct naming of the above grasses. The subject has for some time interested me, and I have paid three visits in different years to Lochnagar in order to see the plants growing in their native habitat. I have also, through the kindness of Professor Marshall Ward, had the privilege of examining the Poas in the late Professor Babington's Herbarium, in which are specimens of both the above plants, including the earliest known gathering of *Poa laxa* in Britain. Thanks to the officials of the British Museum, I have also seen the British specimens contained in the Herbarium there. I have had lent me by Mr. John Knox the specimens collected by George Don from Lochnagar; and Mr. F. J. Hanbury has kindly allowed me to consult the beautiful series contained in the Boswell-Syme Herbarium, which includes Syme's types of the third edition of 'English Botany'; and, lastly, thanks to our Secretary, Mr. Daydon Jackson, the Smithian Herbarium is now made easily accessible, and it is very interesting from its containing Mackay's original specimen of *Poa flexuosa*, as well as a specimen which had been one year in cultivation; and also Don's specimens called *flexuosa*, from Ben Nevis and Lochnagar.

My examination of these specimens and my field-work have led me to the following conclusions, which I hope the Fellows of this Society may not think I am too rash in putting before them.

Before venturing to give a decisive opinion as to the proper name to be assigned to Smith's *P. flexuosa*, I should like to visit Ben Nevis this year to study the plant, if I am fortunate enough to discover it, in the living state. This much, however, I can with some confidence assert, that it is not the *Poa flexuosa* of Wahlenberg's 'Flora Suecica,' n. 108, since that belongs to the *P. cenisia* group. Nor is it the *Poa laxa* of Willdenow, to which Sir W. Hooker was the first to refer it, in the 'Flora Scotica,' p. 34 (1821), where the E.B. plate for *flexuosa* is cited and Smith's description virtually adopted. Nor is it the *P. laxa* of Haenke, as Babington, in his first edition of the 'Manual of

British Botany,' p. 369 (1843), following Smith in the 'Engl. Flora,' i. p. 122 (1824), and Parnell in his 'Grasses of Scotland,' p. 83 (1842), calls it, although he says "he has not seen native specimens." The same erroneous reference will also be found in Richter's 'Plantæ Europææ,' p. 82 (1890), 'Index Kewensis,' iii. p. 572 (1894), and is still more recently given by Ascherson and Graebner in the 'Synopsis der Mitteleuropaïschen Flora,' p. 401 (1900).

Nor do I feel justified at present in placing it with the plant which Syme named *Poa stricta*, although its alliance is certainly rather with the *alpina* than with the *laxa* or *cenisia* group.

It differs from *alpina* in all the ligules being long and acute, by the very wavy panicle-branches, and by the conspicuously smaller spikelets. It was first described by Sir James E. Smith in 'Flora Britannica,' vol. i. p. 101 (1800), and was subsequently figured and described in the first edition of 'English Botany' under the tab. 1123, dated 1803, from specimens gathered by John Mackay on Ben Nevis, and his wild and cultivated plants are in the Smithian Herbarium; but I doubt the authenticity of the specimen in the Sowerby Herbarium at the British Museum, or, indeed, its identity with Smith's plant.

Having, therefore, somewhat cleared the ground by eliminating from the scope of our enquiry the plant named *Poa flexuosa* by Smith, which has been answerable for a considerable share in the confusion which surrounds the synonymy of the plants named *P. stricta* and *P. laxa*, I now propose to discuss the names I venture to designate them by, the characters which distinguish them, and their history as plants of Britain.

Poa alpina, *L.*, var. acutifolia.

Syn. *P. stricta*, Syme, 'E. B.' vol. xi. pp. 115–117, t. 1763, not of Lindeberg in 'Bot. Notiser,' 1855, p. 10, nor of D. Don, in Mem. Wern. Soc. iii. (1821) p. 298, which is a form of *P. pratensis*).

P. flexuosa, Knapp, 'Gram. Brit.' t. 51 (1804), pro parte; Don's 'Herb. Brit.' no. 6 (1804), pro parte; Parnell's 'Grasses of Scotland,' p. 83 (1842), pro parte; not of Wahlenberg, 'Flora Suecica.'

P. laxa, Bab. 'Man.' ed. ii. p. 389 (1847) (not of ed. i. p. 369 (1843)), pro parte; ed. iii. p. 397 *et seq.* (1851); not of Haenke, in Jirasek, 'Beob. Riesengeb.' (1791) p. 118.

P. laxa, Haenke, var. *laxa* proper, Hooker f. 'Student's Flora,' p. 443 (1870).

P. laxa, var. *vivipara*, Anderss. 'Gram. Scand.' ex Syme, E. B. xi. p. 116 in syn.

Exsicc. *P. alpina*, A. Croall, 'Plants of Braemar,' pro parte.

Fig. Syme, E. B. xi. t. 1763, sub nom. *P. stricta*.

Descr.—Rootstock shortly creeping or slightly cæspitose; plant flaccid; panicle in the young state scarcely exserted, very narrow, afterwards with long panicle-branches, the lower of which are deflexed, viviparous; leaves flat, tapering gradually to a point; the upper stem-leaf not very much shorter than the root-leaves, and situated above the middle of the stem; upper ligules long, acute. The leaf shape distinguishes it from typical *P. alpina*, and it is known from *Poa laxa* by the upper leaf being always above the middle of the stem, by the flat, not folded leaves, the shape of viviparous panicle, and by the hairs at the base of the florets being very short. In *P. laxa* var. *scotica* the panicle closes in fruit; in *P. alpina* var. *acutifolia* the viviparous panicle is widely open in the late autumn, but in the early condition it is very narrow and compact, whereas in the young state the panicle of *P. laxa* var. *scotica* is open.

Hab. Shady rock-ledges, and in the gully called "The Spout," Lochnagar, South Aberdeenshire, alt. 2600–3000 feet.

The earliest British specimens with which I am acquainted are those gathered by George Don, and issued by him in his 'Herb. Brit.' (cited above) in 1804. He sent them with other plants gathered on Ben Nevis to Knapp, who, in his 'Gramina Britannica,' sub t. 51, refers both gatherings to *P. flexuosa*, quoting Don as saying that on Ben Nevis it is usually, and on Lochnagar it is always viviparous.

Parnell, in his 'Grasses of Scotland,' p. 83, t. xxxviii. (1842), describes *P. laxa* from Ben Nevis at about 4300 feet as having the florets not webbed, the upper leaf flat and shorter than the sheath, and distinguishes it from *P. alpina* by the panicle being more slender and somewhat drooping, the root not tufted, upper leaf flat and taper-pointed, and the spikelets oblong-ovate. His variety *flexuosa* is mostly viviparous, with wavy panicle-branches and the leaves mostly short. The description of his *laxa* fits my plant, but the figure xxxviii. shows a plant which is not viviparous; whereas the figure of his var. *flexuosa* resembles closely my *acutifolia.* From his describing the florets as not webbed, we may assume that Parnell's plant is not identical with the *P. flexuosa* found by Mackay. His statement that it grows on Ben Nevis at an altitude of 4300 feet suggests some error, as I am unaware of any Alpine *Poa* reaching that height in Scotland. Probably both his species *laxa* and his variety *flexuosa* are forms of *P. alpina.*

In the second edition of the 'Manual,' p. 389 (1847), Prof. Babington gives as the habitats of *P. laxa* [my *acutifolia*] "Lochnagar, Prof. Balfour, and Ben Nevis, Dr. Parnell," altering the date from July to August. The specimens in his herbarium, dated Aug. 11, 1846, collected by J. H. Balfour, to which this doubtless refers, are practically identical with the var. *acutifolia,* except that they are not quite so viviparous and are even more slender; but I have seen such growing with *acutifolia,* under which I place them. In this edition a change is made in transferring the reference of *P. flexuosa,* Sm. E. B. t. 1123, with a query to *P. minor*, but this is also done erroneously.

In the first edition of Hooker's 'Student's Flora,' 1870, p. 443, Sir Joseph Hooker, under *P. laxa,* Haenke, gives the synonym of *P. flexuosa,* Sm., but, as we have seen, in error. He has a "var. *laxa* proper with flat leaves and flowering glumes not webbed," and a "var. *minor* (Gaudin), leaves keeled, curved; flowering glumes webbed, nerves more distinct"; and remarks of *P. laxa* that "it is often with difficulty distinguished from *alpina.*" This may be accounted for when, as I suggest, he is here speaking of two different plants specifically distinct, one of which, his *laxa* proper, being my *P. alpina* var. *acutifolia*, and his *P. minor* being a form of *Poa laxa*; and if we compare his description of *P. laxa* with that of *P. alpina,* we shall find that the chief contrasting features do not contrast, although in *P. laxa* the stem is said to be slightly compressed, while in *P. alpina* it is said to be terete, a character of small value in dried specimens, when the round culm grown in shade and moisture, after pressure, might show this character, while the same species grown in exposure might retain its terete appearance.

In distinguishing *P. alpina* from *P. flexuosa*, Smith laid stress on the latter having "webbed florets," while in *alpina* they were described as "not webbed." In the 'Student's Flora' *P. alpina* is described as having webbed florets, which is exactly at variance not only with Smith but with Syme. From the description given

I have little doubt that Hooker's *P. laxa* proper is my var. *acutifolia*.

In the third edition of 'English Botany,' vol. xi. pp. 115–117, Syme has given a very precise and accurate description of *P. alpina* var. *acutifolia* under the name of *P. stricta*, Lindeberg, for the first time renouncing the name of *Poa laxa*, with which it had, since the time of Sir W. Hooker's 'Flora Scotica' of 1821, been erroneously connected; but unfortunately Syme himself falls into the error of identifying it with the Scandinavian *Poa stricta*, which belongs to the *P. cenisia* group.

The specimens in Syme's Herbarium bear out his excellent description, and are identical with those collected by myself from the same locality. Mr. Hanbury's series are also the same thing, and a living plant which he brought home and grew for two successive years in a suburban garden shows that the leaves retain their flat tapering character, while the panicle-branches become even more elongate. They seem to me to be essentially distinct from Syme's *P. eu-laxa*.

In the seventh edition of the 'Manual' Prof. Babington uses the name *P. laxa* with the same description as in the third, but adds as a synonym "*P. stricta*, Syme 763" [*i. e.* t. 1763], omitting the Ben Nevis locality.

In the third edition of the 'Student's Flora' (1884), p. 493, Sir J. Hooker repeats the description given in the first edition, but characterizes the two forms as "*P. laxa* proper; leaves channelled, tip concave, panicle open in flower, closed in fruit. *P. flexuosa*, Sm.; *P. minor*, Gaud.," both synonyms being wrong; and "sub-sp. *P. stricta*, Lindb.; leaves flat to the tip, panicle open in flower, spreading in fruit"; this being the var. *acutifolia*.

In Professor Babington's Herbarium there are several sheets of specimens labelled *Poa laxa*, most of which are to be referred to my *acutifolia*, as, for instance, those already alluded to as collected by J. H. Balfour in 1846, and others gathered by the Rev. A. Ley on July 15, 1876, labelled by him *P. stricta*, Lindeb. These are, as the date suggests, immature, and are just those small rather narrow-leaved plants with scarcely exserted narrow panicle which is the early condition of my *acutifolia*. These differ so widely from the late autumnal state as to make it difficult to realize that they are the same. Fortunately, I have been able to gather plants in which both the fully-developed panicle and the early unopened one are present on the same individual.

Some of the other specimens labelled *P. laxa* should be placed under *P. alpina* rather than *P. acutifolia*, although in all cases the leaves are either gradually tapering or rather abruptly narrowed to a point, that is, are not conspicuously hooded. In the *P. alpina* sheet, consisting of A. Croall's 'Plants of Braemar,' no. 161, Lochnagar, Aug. 1854, two plants are inseparable from my *acutifolia*, but the centre specimen is a luxuriant and possibly cultivated specimen of *P. alpina*.

"The Spout," which has been referred to, is a narrow gully with an eastern exposure, by which one can with some difficulty ascend from the corrie near the Loch on the east side of Lochnagar to the summit of the mountain. I have visited this place three times at different seasons. The walls are of rather smooth rock, and are deep enough to give an amount of shade which can only be broken for a short time in the day, and that before the sun has much power. Although there is no permanent stream in the gully, there is considerable moisture, and there is always a movement of air up or down the rift, so that the predominating factors here are low temperature, nearly complete shade, nearly permanent moisture, and continual wind-currents: need we therefore be surprised that a grass like *P. alpina*, which has a considerable range of variability, should in such a situation produce some marked variation? The nearly complete shade, low temperature, and damp atmosphere necessarily lessen transpiration; therefore the normal plane surface of a leaf would tend to remain unaltered, and the leaves elongating would become narrower and more pointed in shape, while in a dry exposed situation the tendency would be for the leaves to shut up or enroll. In passing one may refer to the broad and blunt, and the narrow and pointed, forms of the leaves of *Poa pratensis*. The same factors of shade, low temperature, and moisture act, as do short seasons, in lessening the chance of the plant-cycle being completed in the year, moisture being inimical to pollination, especially in anemophilous species; so that "vivipary," or rather the reproduction of the plants by bulbils, which is less dependent on warmth and light, is induced, and this condition once set up is readily perpetuated: so we see that Mr. Hanbury's specimens remain in that condition, although removed to a lowland and more southern home; and this is also true of *Festuca ovina*. In the Spout the numerous specimens which occurs of *Deschampsia alpina* were all viviparous, and *D. cæspitosa*, *Festuca ovina* and *F. rubra* were also in that condition.

I found in this gully that when *acutifolia* grew in very complete shade the size of the panicle was much enlarged, owing to the lengthening of the panicle-branches; but when it grew on ledges more exposed to the sun and wind the panicle became more oblong from the shortening of its branches, and the leaves became shorter and broader, but they always remained acute and not hooded, and in all cases the upper leaf was well above the middle of the stem. In very shady situations the plant does not exhibit that compact mass of persistent leaf-sheaths which is so characteristic of *P. alpina*, but, as Syme says, when *P. alpina* is cultivated they often disappear; and it may be that the dense moss vegetation in which *acutifolia* often grows may be inimical to their presence, or may induce a more rapid decay.

Syme says he has also seen *P. stricta* [var. *acutifolia*] growing with *P. laxa* on the screes which are in full exposure, and that even there it remains viviparous. I was, however, unable to observe it in such situations; but the specimens noticed by Syme may have been carried down from the cliffs by the falling of rock-ledges or by storms of rain, or possibly were directly due to the falling of the bulbils from the rock above.

POA LAXA, *Haenke, in Jirasek, Beob. Riesengeb.* (1791) p. 118, var. SCOTICA.

P. minor, Bab. Man. ed. 2, p. 389 (1847), not of Gaudin.

P. flexuosa, Sm. ex Syme, xi. p. 116 in syn., not of Smith or Wahl.

P. eu-laxa, Syme, E. B. xi. p. 116, t. 1764.

P. laxa, var. *minor*, Hook. f. Stud. Fl. p. 414 (1870).

P. laxa proper, Hook. Stud. Fl. p. 492 (1884).

FIG. Syme, l. c., t. 1764.

Hab. Screes on the northern and eastern side of Lochnagar; north slopes of Cairntoul (*Syme*), alt. 2500–3000 feet.

I have made a careful study of this plant with a large series of Continental specimens, and have no hesitation in referring it to Haenke's species, and in this Professor Hackel fully concurs; but I think I see in the Scottish specimens certain characters which induce me to distinguish it by a varietal name, and in doing so there will be a great advantage in preventiug that troublesome confusion in synonymy which has arisen from the name *P. laxa* being used to designate three different British plants.

The description given by Syme leaves little to add, but I may say that the uppermost stem-leaf is usually placed well below the middle of the stem, and that, as varietal characters, I see that the lines of silvery hairs on the keel of the lower pales and on the lateral submarginal nerves are somewhat shorter, while the apex is not so acute in the Continental as in our British specimens, and to me the facies of the spikelet itself is somewhat different.

The history is as follows:—In the second edition of the 'Manual of British Botany,' p. 389 (1847), Babington describes "*Poa minor*, Gaudin, from Lochnagar, Prof. Balfour." He gives a queried reference to "*P. flexuosa*, Sm. 1123," and a locality "Ben Nevis, Sm."; but these references are incorrect. We find from his herbarium that Balfour's specimens queried by him as *P. laxa* have been altered to *P. minor* by Prof. Babington. Two of these are plants collected by Balfour in 1846, and two gathered by James Backhouse in 1850. Another specimen, I think of Balfour's gathering, is different, being only *P. alpina*. On another sheet there is a specimen from the same locality, labelled "*P. flexuosa*, Sm.?, J. Backhouse, Jun.," and two, gathered by J. T. Syme in 1851, labelled *P. minor* by Babington, but I think they are only shade-grown *P. alpina*. Another sheet contains four specimens of Prof. Balfour's gathering, two of which are *Poa minor*, but the other two are *P. alpina*, var. *acutifolia*. In the third edition of the 'Manual' there is no change in the description of *P. minor*, except that Ben Nevis is now given as a locality without inverted commas, and Smith as the authority for its occurrence is omitted.

In the third edition of 'English Botany,' vol. xi. p. 116, t. 1764, Syme treats this plant as a queried sub-species of *Poa laxa*, calling it *P. eu-laxa*, thus for the first time putting it in its true position. He gives an excellent description.

In the first edition of the 'Student's Flora' Sir J. Hooker puts it as a variety *minor* of *P. laxa*, but, as we have seen, incorrectly.

In the seventh edition of the 'Manual,' p. 423 (1874), Babington repeats the description given in the third edition, making a few verbal alterations, omitting the query after the reference to

"*P flexuosa*, Sm. E. B. 1123," but leaving out the Ben Nevis locality, which, it will be remembered, was the only one given by Smith for his *flexuosa*; and adds as a synonym *Poa laxa*, Fries, with a query.

In the third edition of the 'Student's Flora' Sir Joseph Hooker describes this plant as "*P. laxa* proper; leaves channelled, tips concave, panicle open in flower, closed in fruit. *P. flexuosa*, Sm., and *P. minor*, Gaud.," both synonyms being incorrect, as Gaudin's plant differs in its being even more lax than *P. laxa* var. *scotica*. *P. minor* has 4–6 flowered spikelets, and the florets are more closely connected with longer arachnoid hairs, and it has longer and narrower ligules.

We owe, therefore, the discovery of this plant to Prof. Balfour in 1846, and the publication of it under the name of *P. minor* in the 'Manual' of 1847.

Anyone who has studied these plants in nature will see that *P. laxa* and *P. alpina* var. *acutifolia* are specifically distinct. Syme himself doubted if they should be united under one super-species. We cannot identify the former with *P. minor*, Gaudin, nor has it any specific connection with Smith's Ben Nevis *flexuosa*, with which it has been confused. The habitat in which I have seen it growing is on the screes beneath the Spout of Lochnagar, S. Aberdeenshire. Sometimes it occurs in deep crevices between the larger stones in the screes, where, necessarily more sheltered, it becomes laxer and greener, and the outline of the plant is more irregular; but even in these abnormal instances the uppermost leaf is well below the middle of the stem, and the same densely cæspitose rootstock is found. The leaves in these abnormal instances are not so completely channelled, but the tips are hooded, while the panicles are beautifully flexuous, but do not tremble in the wind as Gaudin describes his *P. minor* doing, after the manner of *Briza*. It is also found, I believe, on the screes under the northern cliffs of Lochnagar. Syme also records it from the north slopes of Cairn Toul, which is, I suppose, near the Garachary; and there are specimens in the Boswell-Syme Herbarium identical with those from Lochnagar, but with the upper leaves higher on the stem; and Mr. Hanbury has also beautiful specimens from the same place. Syme also cites "Ben Nevis, Mr. John Mackay," but, as we have seen, erroneously.

The Botany of the Ceylon Patanas.—II.

By J. PARKIN, M.A., F.L.S., Trinity College, Cambridge; and H. H. W. PEARSON, M.A., F.L.S.

(With PLATES 11 & 12 and TABLE.)

[Read 19th March, 1903.]

CONTENTS.

I. INTRODUCTION.

IN a former paper * some account was given of the grass-lands, locally known as "Patanas," which cover a large part of the surface of the montane region of Ceylon. This paper was the outcome of investigations carried on by one of us *in situ* in 1897. In the opening paragraph the purpose of the research was thus stated: "to ascertain (i) the probable causes which have led to the development of these remarkable savannah-like

* Pearson, Journ. Linn. Soc., Bot. xxxiv. (1899) pp. 300–365, with Map.

expanses in an otherwise forest-covered country; and (ii) to what extent the vegetation of the patanas shows adaptations to the peculiar œcological factors under the influence of which it has been selected."

Owing to circumstances explained in the introduction *, the second part of the problem was only in part dealt with, its fuller treatment being reserved until an anatomical examination of such of the patana plants as were represented by spirit material could be made †. The results of that examination we now offer to the Society.

The conditions of soil and climate under which these plants live have already been discussed in some detail ‡. For the better comprehension of facts now to be stated, a brief summary of these conditions may be given. The patanas fall naturally into two groups which, owing to differences in elevation § and their situation with respect to the main mountain-ridge, present marked variations of soil and climate.

"*Wet*" *Patanas.*—Above 4500 feet the rainfall is copious, and fairly evenly distributed throughout the year. The soil is of a generally uniform character. It is thus described ||:—"An almost pure humus, black or coloured dark brown by the admixture of mineral substances; but apparently pebbles are always absent. It varies in consistency from a black mud to a powdery soil such as the wind will remove as dust, though this last condition is rarely seen, as it normally contains considerable quantities of water. The absence of earthworms is also remarkable, and is not without effect in contributing to the formation of a pure humus-soil. The reactions of the soil were not observed; attempts have, however, been made to use it for gardening purposes at the Hakgala Botanic Gardens, and it has been found to be too sour to be of any use."

In a soil of this character root-absorption is interfered with,

* Pearson, Journ. Linn. Soc., Bot. xxxiv. (1899) pp. 300, 301.

† Before the paper referred to was issued, my opportunities for carrying on laboratory work were so curtailed that the contemplated anatomical examination of my material became impracticable. My friend Mr. Parkin, who has had an opportunity of seeing the flora of the patanas, kindly consented to come to my assistance. This paper gives the result of his work, which, through the kindness of Professor Marshall Ward, was done in the University Botanical Laboratory, Cambridge.—H. H. W. Pearson.

‡ Pearson, *l. c.* § Pearson, *l. c.* pp. 301, 302. || Pearson, *l. c.* p. 320.

and the plants which it supports have to contend against xerophytic conditions. The absence of shade aggravates these conditions, the maximum air-temperature during the sunny portion of the day ranging between 120° and 138° F. *

But probably the most important factor in influencing the biological character of the plants of these patanas is the intense illumination to which they are subjected †.

"*Dry*" *Patanas.*—Below 4500 ft., the rainfall during eight months of the year (February to October) is small and the sky usually unclouded. There is a total absence of shade; the intensity of illumination is therefore very high and commonly continuous from sunrise to sunset. The maximum air-temperature during these eight months of low rainfall ranges from 156° F. (January) to 168° F. (August) ‡. For the greater part of the period a constant south-west wind, the S.W. monsoon, sweeps over the country, after discharging the greater part of its moisture on the slopes of the central ridge of the island which forms the western boundary of the area under consideration.

For two-thirds of the year, therefore, the plants have to withstand conditions which favour a constant and intense evaporation, while the paucity or absence of soil over the whole area prevents a natural storage of water accessible to the roots. At the same time, during the remaining four months of the year—the period of the north-east monsoon—copious rainfalls occur constantly.

The conditions prevailing on both "humus" and "dry" patanas would therefore lead us to expect in the plants composing their floras adaptations evolved to protect the aerial parts from the effects of intense insolation. Xerophytic characters are also likely to be prominent, though the conditions are not so extreme as to lead to the development of a flora of a very marked xerophytic type. Judging from the characters of the soil and climate of the two regions, the plants of the "dry" patanas might be expected to show a greater xerophytic tendency and a more marked protection against insolation than those of the "wet" patanas.

* Ceylon Administration Reports: Meteorology—Statistics for Hakgala, 1897.

† Pearson, Journ. Linn. Soc., Bot. xxxiv. (1899), see table on p. 332.

‡ Ceylon Administration Reports: Meteorology—Statistics for Badulla, 1897.

With a view to verifying these deductions, the subaerial parts of eighty species, all Dicotyledons except two, have now been submitted to anatomical examination. Of these, thirty-three were found only on the "dry" patanas, twenty-eight only on those above 4500 ft., that is to say "wet" patanas, while nineteen are common to both. The number of plants thus examined represent about two-fifths of the Dicotyledons of the whole patana flora.

The ordinary anatomical peculiarities of leaves subjected to strong insolation are by this time quite familiar to biologists. As Heinricher * and others have shown, sun-leaves frequently tend to assume an erect position and have a correspondingly isobilateral structure. The Table which follows shows, in a striking manner, a similar relation between the structure and position of erect and semi-erect leaves of certain of the patana plants—a point to which further reference will be made. A marked character of leaves exposed to strong sunlight is the great development of palisade-tissue usually at the expense of the looser spongy elements. Hence the relative thicknesses of these two constituents of the mesophyll is of interest. The leaf, as a whole, is thicker in sun- than in shade-plants. The development of intercellular spaces is usually greater in shade- than in sun-leaves. The epidermal cells, also their outer walls and cuticles, attain their greatest thickness in sun-leaves. The lateral walls of the epidermal cells are, as a rule, straight in sun-leaves and more or less wavy in shade-leaves. In dorsiventral sun-leaves the stomata are almost, if not entirely, confined to the lower surface.

Special attention has been paid to these characters, and the results are arranged in the form of a table, which includes exact measurements of the thickness of the epidermal, palisade, and spongy layers of the leaves. So far as we are aware, no representative portion of the flora of any biologically uniform area has previously been submitted to a systematic examination of this character; it is on this account the more desirable to place these measurements on record. Interesting comparisons will be possible when similar data for other areas are available.

* Heinricher, Pringsh. Jahrb. Bot. xv. (1884).

II. Table.*

	I.	II.	Upper Epidermis. III.	Upper Epidermis. IV.	
Actinodaphne stenophylla, Thw.	d	er	13·8	6·2	1
Allœophania decipiens, Thw.	w		21	1	2
Anaphalis brevifolia, *DC.*	w	ser	25·5	0·5	3
Anaphalis marcescens, *C. B. Clarke*	w	ser	19·3	8·7	4
Anaphalis oblonga, *DC.*	(w)d		22·5	4·5	5
Atylosia Candollei, *Wight & Arn.*	w		19	6	6
Atylosia rugosa, *Wight & Arn.*	w(d)	sm	18	3·5	7
Blumea crinita, Arn.	w		39	4	8
Blumea flexuosa, *C. B. Clarke*	w(d)		33·3	4·2	9
Bupleurum mucronatum, *Wight & Arn.*	w	ser	10	12	10
Canthium parviflorum, *Lam.*	d		18	7	11
Canthium Rheedii, *DC.*, var. minus, *Thw.*	d		26	7	12
Carallia integerrima, *DC.*	d	ser	21·3	7·2	13
Careya arborea, *Roxb.*	d		12	5	14
Cassia Kleinii, *Wight & Arn.*	d	sm	21	4	15
Cassia mimosoides, *Linn.*	w(d)	sm	15·3	2·5	16
Crotalaria albida, *Heyne*	(w)d	ser	18·2	3·8	17
Crotalaria rubiginosa, *Willd*	w	sm	39	3	18
Curculigo orchioides, *Gaertn.*	w(d)		50·7	2·3	19
Didymocarpus Humboldtiana, Gardn.	w		51·3	1·7	20
Dodonæa viscosa, *Linn.*	d	er	23	5	21
Embelia viridiflora, *Scheff.*	d		18	7	22
Emilia zeylanica, C. B. Clarke	w(d)	ser	70	10	23
Eugenia olivifolia, Duthie	d	er	22	14	24
Eugenia sp.	d		14·5	3·5	25
Eugenia sp.	d		17·7	5·3	26
Eurya acuminata, *DC.*, var. Wallichiana	d	ser	27·7	8	27
Eurya chinensis, *R. Br.*	w	ser	26·5	7	28
Eurya japonica, *Thunb.*, var. Thunbergii	w	ser	22·5	8	29
Evolvulus alsinoides, *Linn.*	d	er	21·5	3·5	30
Exacum zeylanicum, Roxb.	(w)d	ser	30	6	31
Flacourtia Ramontchi, *L'Hérit.*	d		21·5	3·5	32
Gaultheria fragrantissima, *Wall.*	w	ser	56·5	13·5	33
Geniosporum elongatum, *Benth.*	w(d)	er	41·2	3·8	34
Glochidion zeylanicum, *A. Juss.*	d	er	33·3	5·7	35
Gynura Pseudo-china, DC., var. *hispida*	(w)d		65·5	4·5	36
Hedyotis Lawsoniæ, Wight & Arn.	w	er	42	11	37
Hedyotis verticillaris, *Wight & Arn.*	w		14	7	38
Heptapleurum stellatum, *Gaertn.*	d		53·5	4·5	39
Hypericum mysorense, *Heyne*	w	ser	17·2	2·8	40

* For explanation see p. 438.

	Lower Epidermis.		Stomata.		Mesophyll.					
			u. s.	l. s.						
	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
1	8·5	1·5		500	146	dv	75	71	7·5	l
2	11·5	0·5		400	206	dv	100	106	5·5	fc
3	12·5	0·5		220	61	ib			1·5	fc
4	9·5	0·5		370	142	dv	55	87	4	fc
5	21·5	1·5	75	250	180	dv	50	130	3·5	fc
6	6·7	0·5		700	98	dv	53	45	5	vl
7	6·7	0·5		470	125	dv	54	71	7·5	vl
8	21	4		80	607	dv	85	522	2·5	l
9	14·5	3		80	140	dv	53	87	3	fl
10	6	16	345	345	152	grad	50	102	3·5	fc
11	10·8	7		230	247	dv	89	145	6·5	l
12	17	8		300	297	dv	95	200	7	fl
13	14	6		107	504	grad	168	336	3·5	vl
14	simi	lar *	vf	250	316	grad	70	246	4	l
15	simi	lar	330	330	103	dv	60	43	7·5	fl
16	simi	lar	400	400	103	dv	65	38	9	fc
17	17·3	4·7	275	275	140	grad			6	c
18	23	1·7		330	198	dv	70	128	4·5	fl
19	simi	lar	45	60	140	ib			1·5	c
20	31	1	vf	80	145	dv	50	95	2	fl
21	12	5		330	170	dv	90	80	7·5	l
22	16·5	8·5		170	380	dv	100	280	5·5	l
23	42	8	15	90	420	grad	123	297	3·5	fl
24	8·5	10·5		325	283	dv	100	183	8·5	fl
25	7·5	2·5		600	218	dv	50	168	7	fl
26	10·3	4·5		550	255	dv	99	156	8	fl
27	17·5	7		315	230	dv	90	140	3·5	fc
28	22	7		400	244	dv	90	154	3	sl
29	20·5	8		240	186	dv	48	138	4	fl
30	simi	lar	130	200	95	ib			2	c
31	18	7		200	249	grad	88	161	2·5	l
32	14·5	3·5		385	157	grad			3·5	c
33	14·5	7		350	238	grad			3·5	c
34	24·5	3·5	70	250	164	dv	85	79	4·5	vl
35	17·2	4·3		130	270	dv	103	167	11·5	vl
36	76·5	3·5	45	90	630	grad			2 ·	vl
37	14·5	3·5		370	144	dv	67	77	6·5	fc
38	11·5	6·5		375	207	grad			2	c
39	33	7		95	378	dv	169	209	6·5	l
40	16	2	375	375	147	ib			4	c

* Means that the measurements of the lower epidermis are the same as those of the upper epidermis.

	I.	II.	Upper Epidermis. III.	Upper Epidermis. IV.	
Jasminum angustifolium, *Vahl*	d		13·8	5·7	41
Justicia procumbens, *Linn.*	w		46	7	42
Knoxia platycarpa, Arn., var. *hirsuta*	(w)d	ser	43·8	11·2	43
Lagenophora Billardieri, *Cass.*	w(d)		31·7	3·8	44
Lasiosiphon eriocephalus, *Decne.*, var. zeylanicus.	d	er	34·2	4·3	45
Ligustrum Walkeri, *Decne.*...........................	d	ser	20	4·5	46
Litsea zeylanica, *Nees*	d	ser	11	7	47
Lobelia nicotianæfolia, *Heyne*........................	wd		31	3	48
Microglossa zeylanica, *Benth.*........................	(w)d		27·7	4·3	49
Mussænda frondosa, *Linn.*, var. zeylanica	d		20	1·5	50
Myrsine capitellata, *Wall.*, var. lanceolata	d	er	19·5	9	51
Oldenlandia Heynii, *G. Don*	d		68·7	14·3	52
Osyris arborea, *Wall.*	wd	er	17·5	7·5	53
Oxalis corniculata, *Linn.*.............................	w(d)	sm	42	1	54
Pedicularis zeylanica, *Benth.*	w		38	4	55
Phaseolus trinervis, *Heyne*	w	sm	28·5	3·5	56
Plectranthus nigrescens, Benth.	w		35·3	1·7	57
Polygala telephioides, *Willd.*	d	er	52·5	9·5	58
Polygonum chinense, *Linn.*	w		32·5	3·5	59
Pouzolzia Bennettiana, *Wight*	w		43·8	2·2	60
* Psidium Guyava, *Linn.*	d		39·5	3·5	61
Rhododendron arboreum, *Sm.*, var. nilagiricum.	w		35·8	7·2	62
Rhodomyrtus tomentosa, *Wight*	w	er	27	8·5	63
Rubus moluccanus, *Linn.*	w		17	4·5	64
Senecio ludens, *C. B. Clarke*	w		68	4	65
Senecio zeylanicus, *DC.*	w		49·5	8·5	66
Solanum indicum, *Linn.*.............................	w(d)		22·5	2	67
Sopubia trifida, *Ham.*	w(d)		32	3·5	68
Spiranthes australis, *Lindl.*..........................	w		44·5	5·5	69
Striga euphrasioides, *Benth.*	d	er	18	8·5	70
Striga lutea, *Lour.*	d	er	20·5	3·5	71
Swertia zeylanica, Walker	w	ser	30	8	72
Tephrosia tinctoria, *Pers.*	d	ser	22·6	5·4	73
Toddalia aculeata, *Pers.*	d		22·7	3·8	74
Vaccinium Leschenaultii, *Wight*, var. zeylanica.	d		40	5	75
Vernonia Wightiana, Arn.	w(d)		39	3·5	76
Viola Patrinii, *DC.*	w		63·7	6·3	77
Wendlandia Notoniana, *Wall.*	d		38·3	3·7	78
Woodfordia floribunda, *Salisb.*	d		27	9	79
Zornia diphylla, *Pers.*, var. Walkeri	d	sm	16·6	5·4	80

* Not indigenous but naturalized [Trimen, Flora of Ceylon, part ii. (1894) p. 167.]

	Lower Epidermis.		Stomata.		Mesophyll.					
			u. s.	l. s.						
	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
41	13	4·5		600	145	grad			2·5	c
42	20·7	4·3	vf	230	198	dv	85	113	7·5	vl
43	15	8		200	182	dv	92	90	7	fc
44	21·5	3·5	130	145	292	grad			3·5	fc
45	20·7	4·3		200	186	dv	85	101	8·5	vl
46	12	3·5		525	205	dv	85	120	6·5	fc
47	8·7	5·3		400	183	dv	113	70	7	vl
48	13·7	2·3	vf	245	128	dv	55	73	4	fc
49	16·7	4·3	66	230	177	grad			3	l
50	12	0·5		300	126	dv	61	64	4·5	vl
51	18	10·5		120	243	dv	98	145	7·5	sl
52	29	7		450	127	dv	63	64	5·5	l
53	simi	lar	240	280	373	ib			3	c
54	simi	lar	vf	110	64	dv	36	28	3	c
55	23·5	3·5		250	451	dv	275	176	5·5	fl
56	21·3	2·7	75	375	174	dv	110	64	6	vl
57	16·3	1·7		200	125	grad			3	c
58	43·5	9·5	100	120	310	grad			4	l
59	16·5	3·5	10	225	237	dv	80	157	3	fl
60	19·7	1·8		325	87	dv	46	41	5	fl
61	9·3	3·2	vf	1000	105	grad			4·5	c
62	9	1		525	254	dv	145	109	5·5	vl
63	7·5	7		500	210	grad			6·5	fc
64	10·5	0·5		300	136	dv	100	36	7	fc
65	20·5	2·5		210	412	grad			2·5	vl
66	24	4	25	125	474	grad			4	vl
67	13·5	0·5	50	300	176	dv	100	76	9	l
68	18	3·5		180	303	grad			2	sc
69	28	7	50	65	161	ib			1	l
70	simi	lar	150	200	242	ib			2	fc
71	simi	lar	285	285	332	ib			3	fc
72	simi	lar	70	155	539	grad			2·5	fl
73	14·5	3·5	150	250	144	grad			4	l
74	24	3·5		135	256	grad	64	192	9	vl
75	15·3	2·7		300	307	dv	142	165	5	l
76	13	1·5		300	112	dv	58	54	4·5	fc
77	44	5·5	40	110	170	grad			4	l
78	15	3		245	170	dv	110	60	6	fc
79	10·5	3·5		425	120	dv	64	56	9	fc
80	simi	lar	190	125	263	grad			3	fc

III. Explanation of Table.

The eighty plants whose leaves have been examined are arranged in alphabetical order. The endemic species are printed in italics. The measurements are given in μ (·001 mm.). The whole thickness of the leaf is not recorded, as this can be obtained by adding together that of the mesophyll and of the two epidermal layers. The measurements were made from sections of the alcoholic material mounted in water and in places where the vascular bundles (veins) were absent—such being usually the thinnest part of the leaf-lamina.

Column I. refers to the type of patana on which the plant grows. "w" means confined to "wet" patana, "d" to "dry," and "wd" common to both. Those of the third group were, with two exceptions, collected in one of the regions only—to express this the letter denoting the other patana is included in brackets; *e. g.* w(d) means that the plant is common to both, but the material for examination was only obtained from the "wet" patanas.

Column II. Letters "er" and "ser" refer respectively to the erect or semi-erect position of the leaf recorded in the field observations *. In the case of plants the leaves of which move into a profile position in bright sunlight, the fact is denoted by the letters "sm."

Columns III. *and* V. record the average depths of the upper and lower epidermal layers, exclusive of the thickness of the outer walls respectively.

Columns IV. *and* VI. record the average thickness of the outer walls of the upper and lower epidermal layers respectively.

Columns VII. *and* VIII. give the average number of stomata per square millimetre of leaf-area on the upper and lower surfaces respectively. When the space in column VII. is left blank it means that stomata were not observed on the upper surface. When "vf" occurs, it signifies that only an occasional stoma was seen—too few to average out to a square millimetre.

Column IX. gives the depth of the mesophyll.

Column X. its differentiation. "dv" stands for dorsiventral, "ib" for isobilateral or an approach to this type. "grad" denotes that the palisade (upper mesophyll) is not sharply

* Pearson, Journ. Linn. Soc., Bot. xxxiv. (1899) pp. 328–331.

marked off from the spongy (lower mesophyll), but that the one gradually passes into the other.

Columns XI. *and* XII. give the depth of the palisade and spongy tissues respectively. Blanks naturally occur in these columns when the mesophyll is isobilateral, or feebly differentiated.

Column XIII. represents the ratio of the length of the palisade-cell to its breadth ; *e. g.*, 6·5 means that the length of the cell in question is six and a half times its breadth. In the case of a two- or more-layered palisade the measurement was taken of the deepest layer, which is in nearly every case the uppermost.

Column XIV. Here the amount of intercellular space in the mesophyll is roughly indicated "l" signifies that the cells are loosely arranged and the intercellular space, therefore, considerable ; "c" compact, implies the converse ; "v," "s," and "f" stand for the qualifying adverbs "very," "slightly," and "fairly," respectively.

IV. General Summary of the Anatomical Characters of the Leaf.

Under this heading the data of the various columns of the table are discussed and summarized for the plants as a whole, as well as reference made to certain additional points in their leaf-anatomy not included in this table.

(1) *Depth of the Upper Epidermis* (*exclusive of the thickness of its outer wall*).

The average depth of the upper epidermis for the whole of the plants included in the table is about 30 μ *. A considerable number have a deep upper epidermis, at any rate relative to the whole thickness of the leaf, suggesting that it possesses a water-storing function. *Emilia zeylanica*, *Oldenlandia Heynei* (Pl. **11.** fig. 4), and *Senecio ludens* are extreme examples. It is perhaps of interest to compare the depth of the upper epidermis with that of the mesophyll. The average ratio for these plants is 1 : 7, *i. e.* the mesophyll has on the average seven times the thickness of the upper epidermis. Leaves in which the upper epidermis bears a large proportion to the whole thickness are very thin ones, such as those of *Oxalis corniculata* and *Pouzolzia Bennettiana*, in which the ratio is less than 1 : 2. Examples of the

* The numbers given for averages, &c. are approximate, decimals not being used to more than one place.

other extreme are *Careya arborea*, *Embelia viridiflora*, and *Osyris arborea*; in these cases the mesophyll is over twenty times as thick as the upper epidermis.

(2) *Thickness of the Outer Wall of the Upper Epidermis.*

The average is 5·5 μ. Only thirteen plants have a decidedly thin outer wall—below 3·5 μ—and this is connected with a hairy upper surface in all but three instances, viz., *Cassia mimusoides*, *Hypericum mysorense*, and *Oxalis corniculata*, which have glabrous leaves. Twenty-one plants have the outer wall between 7 and 10·5 μ, and in six others it is more than 10·5 μ. About the thickest outer wall—14·3 μ—is exhibited by *Oldenlandia Heynei* (Pl. **11**. fig. 4).

A glabrous upper surface is the rule. About a quarter of these plants have a hairy one, and of these only two are anomalous in having this associated with a thick outer wall. These are *Knoxia platycarpa* var. *hirsuta* and *Woodfordia floribunda*, neither of which, however, is very hairy on the upper surface. The average thickness of the outer wall in leaves with glabrous upper epidermis is 6·3 μ, and with hairy upper epidermis 3·6 μ.

As a rule the cuticle is quite distinct. Often half, or even more, of the whole thickness of the wall is cuticularized (Pl. **12**. figs. 1 & 2). Exact measurements of the two constituents of the wall have, however, not been made. In two or three cases the cuticularized portion penetrates the side-walls, e. g. *Gaultheria fragrantissima* and *Rhodomyrtus tomentosa*. In the first instance (Pl. **12**. fig. 5) the pegs of cuticularized cellulose, as shown in section, reach to nearly the base of the side-walls; in the second (Pl. **12**. fig. 4) rather more than halfway. Some thick outer walls have, however, only a relatively narrow cuticularized part, e. g., *Bupleurum mucronatum* (Pl. **11**. fig. 1), *Oldenlandia Heynei* (Pl. **11**. fig. 4), and *Hedyotis Lawsoniæ* (Pl. **11**. fig. 2).

(3) *Depth of the Lower Epidermis (exclusive of the thickness of its outer wall).*

The lower epidermis shows as a rule, as one might expect, shallower cells with thinner outer walls. Sometimes, however, it is nearly or quite similar to the upper epidermis, and this likeness, as the table shows, is usually associated with an erect or semi-erect attitude of the leaf.

The average depth of the lower epidermis is 18·5 μ, not much more than half that of the upper. In no case does it exceed at all appreciably that of the upper. *Gynura Pseudo-china* is remarkable in having both epidermal layers very deep; in fact, according to the table, the lower is slightly the deeper when the thickness of the outer wall is excluded.

(4) *Thickness of the Outer Wall of the Lower Epidermis.*

The average is 4·4 μ, about 1 μ less than that of the upper epidermis. When the walls are similar or nearly so in thickness, the two surfaces are alike in character, either both glabrous or both hairy. *Rhodomyrtus tomentosa* is an exception—the upper surface is smooth, while the lower is covered with fine tomentum, yet the outer walls of the two epidermal layers do not differ much in thickness; this, however, is an erect leaf. In a few instances the lower wall may actually be thicker than the upper. This is evident in *Bupleurum mucronatum* (Pl. **11.** fig. 1) and *Heptapleurum stellatum*.

The relation between the hairiness and the thickness of the wall is shown rather more strikingly than in the case of the upper epidermis. Thirty-six of these plants have a hairy lower surface with an average thickness of wall of 2·6 μ; and forty-six a glabrous surface with thickness of 5·8 μ. A correspondence between the thickness of the cuticle and the presence or absence of hairs has been observed by Kearney * in the plants of the "Dismal Swamp" region of Virginia.

Two features of the epidermal cells not included in the table have been observed in detail, viz.:—the convexity of the outer wall, and the waviness of the lateral walls as seen in the surface view.

(5) *Convexity of the Outer Wall of the Upper Epidermal Cells.*

The outer walls are frequently convex (Pl. **11.** figs. 2 & 4 and Pl. **12.** fig. 4); the surface in consequence is not level, but consists of a series of slight bulges, each corresponding to a single epidermal cell. Forty-five of these plants have more or less these arched walls, and the remainder, thirty-seven, have straight or nearly straight ones. This feature has been compared with the thickness of the outer wall on the one hand, and with the depth of the epidermal cell on the other.

	Leaves with straight walls.	*With arched walls.*
Average thickness of outer wall ..	6·8 μ	4·6 μ
Average depth of cell............	30 μ	32 μ

* Kearney, Contr. from the U.S. Nat. Herb. v. no. 6 (1901), p. 389.

Thus the arched wall seems to be associated with a thinner outer wall and a rather deeper cell. A comparison may perhaps be drawn between these arched outer walls and the furrowed or wrinkled cuticles which are frequently found in the glabrous leaves of insolated plants. With regard to the latter, it has been suggested * that the irregularities of the surface effect the dispersion of some of the light falling on the leaf, and so constitute a means of protection against excessive illumination. Some of the light-rays would undoubtedly undergo total reflection from the curved surfaces of these epidermal cell-walls, and it seems not unreasonable to ascribe to them a similar function.

(6) *Waviness of the Lateral Epidermal Walls.*

In shade-leaves the lateral walls of the lower epidermis are usually more wavy than those of the upper. Of the plants in question nineteen only have the side-walls of the upper epidermal cells sinuous, while in forty-four, rather more than half, this character is shown by the cells of the lower surface. A comparison has been made between wavy and straight walls with regard to the depth of the epidermal cell and the thickness of the outer wall, including both surfaces of the leaf.

Depth of cell—average for leaves with				straight lateral walls			$25 \cdot 7\ \mu$.
	"	"	"	wavy	"	"	$23 \cdot 4\ \mu$.
Thickness of outer wall	"	"	"	straight	"	"	$5 \cdot 5\ \mu$.
	"	"	"	wavy	"	"	$4 \cdot 2\ \mu$.

Considering that a straight lateral wall is a characteristic of sun-leaves, it might be expected that this would be accompanied by a thicker outer wall and perhaps by a deeper epidermis, as this often has a water-storing function; the above numbers bear this out to some extent. Perhaps the thinner the side-wall, the greater is the inclination to be wavy. Exact measurements, however, have not been made to ascertain how this idea is supported, on the whole, by this series of plants. In some instances it is certainly not the case. *Anaphalis oblonga* and *Blumea flexuosa*, for example, have thick, yet wavy upper epidermal lateral walls. Hairiness does not seem to influence directly this sinuosity. Haberlandt † considers the wavy side-wall to be a help in withstanding strains and bendings, as well

* Kearney, Contr. U.S. Herb. v. n. 6 (1901), p. 389.

† Haberlandt, Phys. Pflanz.-Anat. (1896) pp. 103 & 105.

as favouring water-storage by permitting a greater expansion of the cell.

(7) *Stomata.*

The occurrence of stomata on the upper surface is fairly common. Thirty-two plants have them thus situated. In six of these they are very scarce, less than one per sq. mm. In eleven they are fairly numerous, but only half as many, or less than on the lower surface. In fifteen they are equally distributed, or nearly so, on both surfaces, and in these with one exception, *Lagenophora Billardieri*, the leaf is either erect or semi-erect, or shows sun-movements. In one case, *Zornia diphylla*, a papilionaceous plant with leaf-movements, the number on the upper surface is actually larger than on the lower. *Anaphalis oblonga*, *Gynura Pseudo-china*, *Lagenophora Billardieri*, *Microglossa zeylanica*, *Senecio zeylanicus*, and *Viola Patrinii*, the leaves of which have stomata fairly numerous on the upper surface and yet are not erect nor possessed of movements, do not show xerophytic characters, at any rate in their mesophyll; they may be considered mesophytes and all, save one, are Composites.

The number of stomata per square millimetre varies greatly for different species. Practically, nothing is known of the conditions which govern this variation. It is perhaps not so much their number as the size of the aperture which is to be taken into account. The average number per sq. mm. of the lower surface for this group of plants is 284, a figure somewhat larger than an average given by Weiss* for a miscellaneous collection of plants. *Psidium Guyava* is very remarkable in having as many as 1000 per sq. mm. Two species of *Eugenia* and *Rhodomyrtus tomentosa* belonging to the same natural order, also *Jasminum angustifolium*, *Ligustrum Walkeri*, *Rhododendron arboreum*, *Actinodaphne stenophylla*, and *Atylosia Candollei*, have large numbers. If both surfaces are taken into account together, which is perhaps the legitimate plan, then *Cassia mimosoides* stands next to *Psidium Guyava* as having the second largest number, viz. 800; *Hypericum mysorense* follows close with 750. *Bupleurum mucronatum*, *Cassia Kleinii*, *Crotalaria albida*, *Osyris arborea*, and *Striga lutea* have numbers above 500.

* Weiss, Anat. der Pflanzen (1878), p. 392.

The stomata are in some cases sunk, but no very remarkable examples have been noticed. Sunken stomata occur in fifteen of these plants. On the other hand, twenty-seven have them slightly raised or projecting, while the remaining thirty-seven have them about level with the surface of the leaf. The best examples of sunken stomata are those of *Bupleurum mucronatum* (Pl. **11**. fig. 1), *Heptapleurum stellatum* (Pl. **11**. figs. 8 & 9), and *Hypericum mysorense* (Pl. **11**. fig. 3). Cases of raised stomata are shown in figures 3 (Pl. **12**) and 6 (Pl. **11**) for *Atylosia rugosa* and *Didymocarpus Humboldtiana* respectively. The sinking of the stomata is usually associated with a glabrous surface, and the raising with a hairy one; there are a few exceptions in both cases. *Crotalaria rubiginosa*, *Gynura Pseudo-china*, *Lasiosiphon eriocephalus*, *Litsea zeylanica*, and *Tephrosia tinctoria* have a hairy undersurface and stomata slightly sunk, while *Dodonæa viscosa* *, *Hedyotis verticillaris*, *Senecio zeylanicus*, *Sopubia trifida*, *Striga lutea*, and *Viola Patrinii* are glabrous and have stomata somewhat raised.

(8) *Mesophyll.*

There is a considerable tendency to depart from the typical dorsiventral structure, which is distinctly marked in only 25 per cent of the plants examined. The upper mesophyll often passes into the lower by gradations without a distinct line separating the palisade from the looser spongy elements. In several cases the structure is almost homogeneous, with the cells only slightly elongated at right angles to the surface. This type of mesophyll, here referred to as isobilateral, is usually associated with an erect position of the leaf. That form of isobilateralism with a well differentiated row of palisade-cells beneath each epidermis hardly occurs. *Evolvulus alsinoides* (Pl. **11**. fig. 5), *Hypericum mysorense* (Pl. **11**. fig. 3), *Striga lutea*, and *Tephrosia tinctoria*—all with erect leaves—have a feeble lower palisade-layer.

The average thickness of the mesophyll for the whole group of plants is about 230 μ. *Blumea crinita* and *Gynura Pseudo-china* are noticeable in having the thickest leaves, the depth of the mesophyll in both cases being over 600 μ. It is in this respect that the leaf of *Blumea crinita* principally differs from that of *B. flexuosa*.

A double palisade-layer is not very common; examples where

* The leaf of this plant is viscid and covered with minute scales.

a second row is pronounced are furnished by the leaves of *Dodonæa viscosa*, *Heptapleurum stellatum* (Pl. **11.** fig. 8), *Rubus moluccanus*, and *Rhododendron arboreum*—the last has even a third row of palisade-cells.

In some cases the mesophyll is more or less irregularly palisade throughout, the cells usually decreasing somewhat in length from the upper to the lower surface. The leaves of *Crotalaria albida*, *Flacourtia Ramontchi*, *Polygala telephioides*, *Psidium Guyava* (Pl. **11.** fig. 7), *Rhodomyrtus tomentosa*, *Tephrosia tinctoria*, and *Zornia diphylla* show this in varying degrees.

In order to gauge the palisade nature of the upper mesophyll, the length of its average cell should be compared with its breadth. This has been done, and the results inserted in Column XIII. of the Table. The measurements have been taken of the uppermost palisade row where two occur, and of the average cell where the palisade ones are somewhat irregular in length and breadth. The average figure for the column is 5, *i. e.*, the length of the palisade-cell is on the average five times its breadth. The most marked palisade-layer is seen in *Glochidion zeylanicum*, where the length of the individual cell is eleven times its width. Haberlandt * remarks that palisade-cells vary from being scarcely longer than broad to having a length 10–12 times their breadth.

From the figures in Columns XI. and XII. the relative proportions of palisade and spongy tissues can be calculated. On an average the spongy is one and a half times as deep as the palisade; only those plants, fifty-two in all, which have these layers fairly well marked off one from another are taken into account. *Blumea crinita* has the largest proportion of spongy tissue, viz., six times the depth of the palisade.

As regards the development of intercellular space in the spongy tissue or in the mesophyll as a whole, about 40 per cent. have very little, *i. e.* the mesophyll is compact.

V. The Anatomical Characters of the Leaf of the "Wet" and "Dry" Patana Plants compared.

Having briefly summarized the anatomical characters of the leaves as a whole, we now proceed to compare the plants of the "wet" patanas with those of the "dry" patanas. As previously mentioned, twenty-eight belong to the "wet," thirty-three to the

* Haberlandt, Phys. Pflanz.-Anat. (1896) p. 228.

"dry" patanas, and nineteen are common to both. We have thought it advisable to reduce these three groups to two by distributing the plants of the last-mentioned amongst the first two, according as the material for examination was collected in the wet or dry region, since in only two cases were specimens gathered and preserved in spirit from both kinds of patana. These are *Lobelia nicotianæfolia* and *Osyris arborea*. Consequently in this section of the paper each of these plants is counted as two, one belonging to the wet region and the other to the dry. This brings the total number of plants for comparison to eighty-two, of which forty-two are considered as "wet" patana and forty as "dry" patana plants, thus nearly equalizing the two groups. In the Table the figures for *Lobelia nicotianæfolia* and *Osyris arborea* are the mean of the two sets of calculations. Estimations similar to those given below have been made for the three categories separately, but it seems superfluous to record them here, for in no case are they contradictory; *e. g.*, the average depth of the epidermis of the wet patana plant is greater than that of the dry patana plant when the species are divided into the three classes, and it still remains greater when they are reduced to two classes; such holds good for the other averages.

(1) *Depth of the Upper Epidermis* (*exclusive of the thickness of its outer wall*).

Average depth for w.p.* .. 33·4 μ.
" " d.p. .. 26·0 μ.

The w.p. has therefore on the whole a deeper upper epidermis than the d.p.—a result hardly to be expected in the light of a water-storing function for the upper epidermis. A factor, discussed below, which must be taken into account, is that the arching of the outer wall is commoner amongst w.ps. This has already been shown to be associated with a deeper epidermal cell. Therefore, other things being equal, the tendency would be for the w.p. to have a deeper cell than the d.p. The difference, however, appears too great to be fully explained in this manner.

The ratio of the depth of the upper epidermis to the thickness of the mesophyll for w.p. is as 1 : 6·5; for the d.p. as 1 : 8; so the w.p. has a relatively as well as an absolutely deeper upper epidermis.

* w.p. is short for "wet" patana plant, and d.p. for "dry" patana plant.

(2) *Thickness of the Outer Wall of the Upper Epidermis.*

Average for the w.p. .... 5 μ.

" " d.p. .... 6 μ.

So the d.p. has an appreciably thicker outer wall—a result to be anticipated. But this difference may be accounted for directly apart from any influence of climate or soil; for a hirsute covering is about twice as common amongst w.ps. as amongst d.ps.; and this has been seen to be associated with a thinner outer wall as a rule. About 30 per cent. of the w.ps. and 15 per cent. of the d.ps. have a hairy upper surface. Further, there are amongst the w.ps. quite as many with markedly thick walls as amongst the d.ps., *e. g.* fourteen plants of each have an outer wall 7 μ or more in thickness, and three of each above 10·5 μ. Consequently we are forced to the conclusion that in this particular the two sets of plants are very similar.

(3) *Depth of the Lower Epidermis (exclusive of the thickness of its outer wall).*

Average for w.p. .... 20·6 μ.

" " d.p...... 16·6 μ.

As in the case of the upper epidermis, so here the w.p. has a deeper cell than the d.p. The arching of the lower epidermal wall has not been strictly observed to say whether this influences the depth of the cell, as in the case of the upper surface. But if it does, it can hardly account for so great a dissimilarity in depth between the two classes of patana plants.

(4) *Thickness of the Outer Wall of the Lower Epidermis.*

Average for w.p.......... 3·7 μ.

" " d.p. .... 5·1 μ.

The thinner outer wall of the w.p. can be explained in the same way as for the upper epidermis. A hairy under surface is about twice as common amongst the w.ps.

w.p...	24 plants,	*i. e.* 57	p.c. with hairy lower surface.
d.p. ..	12 "	30	" " "

(5) *Convexity of the Outer Wall of the Upper Epidermal Cell.*

Of the w.ps. twenty-eight out of forty-two, *i. e.* over 66 per cent., have been considered to have arched walls, nineteen of which have this feature pronounced.

Of the d.ps., seventeen out of forty, *i. e.* 42·5 per cent., have arched walls, six of which have this feature pronounced.

Thus, whatever may be its significance, it is commoner amongst the w.ps. Although usually accompanied by a thin outer wall, it is not always so—to wit, *Oldenlandia Heynei* (Pl. **11**. fig. 4).

The supposed function of the convexity in concentrating light-rays can hardly hold here, for it is difficult to imagine the plants of either region requiring more light—rather the reverse.

(6) *Waviness of the Lateral Epidermal Walls.*

Upper surface.

Out of 42 w.ps., 33 have straight walls, 9 wavy.
„ 40 d.ps., 30 „ „ 10 „

Lower surface.

Out of 42 w.ps., 16 have straight walls, 26 wavy.
„ 40 d.ps., 22 „ „ 18 „

Sinuous lateral walls in the upper epidermis are then about as common in one class of plants as in the other, but in the lower epidermis they are decidedly commoner amongst the w.ps.

(7) *Stomata.*

w.p., lower surface, average number per sq. mm. 264.
d.p., „ „ „ „ „ 305.

This difference is about the same if both surfaces are taken into consideration, notwithstanding that the w.ps. have stomata more often on the upper surface than the d.ps.

w.p., both surfaces together, average number per sq. mm. 309.
d.p., „ „ „ „ „ „ 356.

Sixteen w.ps. have stomata fairly numerous on the upper surface; the leaves of all except six are either erect or semi-erect, or with movement.

Eleven d.ps. have them on the upper surface; of which all, except two, have erect or semi-erect, or motile leaves.

Sun-leaves are stated to have more stomata than shade-leaves *. On the other hand, Warming † states, quoting authors, that the drier the situation the fewer the stomata. The first statement, however, refers to the leaves of the same species according as it grows in the shade or in the sun, while the second has to do with xerophytes collectively compared with other types of plant associations.

* Dufour, Bull. Soc. Bot. France, xxxiii. (1886) pp. 92–95; also Ann. Sc. Nat., Bot. sér. 7, v. (1887) p. 311.

† Warming, Oekologische Pflanzengeographie, ed. Knoblauch. (1896) p. 193.

The two plants, *Lobelia nicotianæfolia* and *Osyris arborea*, of which leaves from both patanas have been investigated, bear out the first statement. The stomata in both cases were found more numerous per unit area on the dry patana plants. One explanation forthcoming is that the leaves of a given species are apt to be smaller in area in the light than in the shade, and taking the number of stomata per each leaf as equal, then the sun-leaves will have more to the square millimetre.

As regards the position of the stomata with respect to the general leaf-surface:—

Out of	42 w.ps.,	14 with stomata level,	21 raised,	and 7 sunk.
„	40 d.ps.,	26 „ „	6 „	8 „

Thus sunken stomata are about as common in one region as in the other, showing again that xerophytic characters are about as marked amongst one group as the other.

The larger number of raised stomata amongst the w.ps. is probably due to the greater frequency of a hairy leaf-surface.

(8) *Mesophyll.*

Average thickness for w.p. . . . . 234 μ.
„ „ „ d.p. . . . . 225 μ.

The difference here is too slight to be taken into account. Yet the dissimilarity might have been expected to be the reverse of what it is, since sun-leaves are thicker than shade-leaves.

Proportion of spongy tissue to palisade, w.p. 1 : 1·5, d.p. 1 : 6.

No appreciable disagreement, both sets of leaves calculating out to about the same ratio, viz.:—the spongy tissue being about one and a half times as deep as the palisade.

There is a greater inclination amongst the d.ps. to have a two-layered palisade.

d.p., 32 p.c. have a two-layered palisade.
w.p., 21 p.c. „ „ „

Ratio of the length of the palisade-cell to its breadth.

Average for w.p. . . . . 4·3.
„ „ d. p. . . . . 5·5.

Thus the palisade character is more pronounced amongst the d.ps., as might be expected. This still remains the case if the erect and semi-erect leaves are omitted from both groups; the ratio then is for w.p. 4·5, for d.p. 5·8.

Intercellular space.

w.p.	with a loose mesophyll	24, *i.e.* 57 p.c.;	compact	11, *i.e.* 43 p.c.
d.p.,	,, ,,	26, *i.e.* 65 p.c.;	,,	14, *i.e.* 35 p.c.

A result hardly to have been anticipated that the d.ps. should have on the whole a looser mesophyll—more intercellular space—than the w.ps. This may be partly explained by the fact that there are more typically dorsiventral leaves amongst the d.ps., and that a marked palisade-layer may allow a looser spongy tissue beneath.

VI. Remarks on the Structure of Erect and Semi-erect Leaves.

Erect Leaves.—Twenty-seven species of Dicotyledons are recorded * as possessing leaves which have a permanently erect position. Fourteen of these have been anatomically examined and are included in the Table. Five—viz.: *Polygala telephioides*, *Evolvulus alsinoides* (Pl. **11.** fig. 5), *Striga lutea*, *S. euphrasioides*, and *Osyris arborea* (Pl. **12.** fig. 2)—are isobilateral in structure. Two others, *Geniosporum elongatum* and *Rhodomyrtus tomentosa*, approach the isobilateral structure; the former in distribution of stomata, feeble differentiation of mesophyll, and the depth of the cells and thickness of the outer walls of the upper and lower epidermis; the latter only in the undifferentiated character of the mesophyll. The remaining seven—viz.: *Dodonæa viscosa*, *Eugenia olivifolia*, *Actinodaphne stenophylla*, *Glochidion zeylanicum*, *Hedyotis Lawsoniæ*, *Lasiosiphon eriocephalus*, and *Myrsin ecapitellata*—are distinctly dorsiventral in structure, though erect in habit.

Semi-erect Leaves.—Of the twenty-five species with semi-erect † leaves sixteen have been studied in the Laboratory, and in these the correspondence between structure and recorded position is more marked than in the case of the "erect" leaves. Five species—*Hypericum mysorense* (Pl. **11.** fig. 3), *Crotalaria albida*, *Tephrosia tinctoria*, *Bupleurum mucronatum* (Pl. **11.** fig. 1), and *Swertia zeylanica*—have leaves more or less isobilateral in structure. Those of *Emilia zeylanica* are almost as strongly isobilateral, but the upper epidermal cells are rather deeper than those of the lower, and by far the larger proportion of the stomata are found on the under surface. In *Exacum zeylanicum* and *Carallia*

* Pearson, Journ. Linn. Soc., Bot. xxxiv. (1899) p. 327.

† Pearson, *loc. cit.* p. 328.

integerrima the stomata are confined to the lower surface of the leaf, which in other respects shows only feeble dorsiventrality.

Both varieties of *Eurya japonica* as well as *E. acuminata* show a great similarity in the structural characters of the cells of the upper and lower epidermis. In the leaves of *Anaphalis marcescens*, *A. brevifolia*, and *Gaultheria fragrantissima* the tendency to an isobilateral structure is found only in the mesophyll. The three remaining species with semi-erect leaves—viz., *Ligustrum Walkeri*, *Knoxia platycarpa* var. *hirsuta*, and *Litsea zeylanica*—appear to be typically dorsiventral in structure.

Thus of the thirty plants with erect or semi-erect leaves microscopically examined, ten have practically an isobilateral structure, ten others are isobilateral to some extent either in their epidermis or mesophyll, while the remaining ten are dorsiventral. An astonishing fact is that most of the dorsiventral ones are confined to the "dry" patanas: one only, *Hedyotis Lawsoniæ*, is restricted to the "wet" patanas, but shows an inclination towards isobilateralism in its mesophyll; *Knoxia platycarpa* is common to both and possesses a well differentiated mesophyll, but the material was collected from the dry patanas. More remarkable still, these eight remaining dry-patana plants with erect or semi-erect leaves—viz., *Actinodaphne stenophylla*, *Dodonæa viscosa*, *Eugenia olivifolia*, *Glochidion zeylanicum*, *Lasiosiphon eriocephalus*, *Ligustrum Walkeri*, *Litsea zeylanica*, and *Myrsine capitellatum*—are some of the most striking examples of dorsiventrality occurring amongst the whole group of plants anatomically investigated. Not only have they a marked palisade, but also a loose spongy tissue. The only feature in which the lower surface shows, as a rule, a similarity to the upper, is in the thickness of the outer epidermal wall. All these eight plants are shrubs or small trees. Can these plants have only recently taken to the erect habit and their structure not yet become modified?

The leaves of the two Monocotyledons, *Curculigo orchioides* and *Spiranthes australis*, may be said to have an isobilateral structure; their mesophyll is practically homogeneous throughout and composed of cells hardly elongated at all. Since their leaves grow vertically or inclined to the vertical, they may be reckoned amongst the erect or semi-erect.

To be consistent, let us see what plants other than those belonging to the erect or semi-erect categories have leaves approaching the isobilateral type.

Lagenophora Billardieri, *Gynura Pseudo-china*, and, to a less extent, *Viola Patrinii* and *Microglossa zeylanica* come near isobilateralism in having both epidermal layers similar, stomata numerous on the upper surface, and a feebly differentiated mesophyll, which, however, is not compact but loose. In fact, except for a fairly thick outer epidermal wall, these plants are of a decidedly mesophytic character. From their habitats a mesophytic structure might be expected in the cases of *Lagenophora* and *Viola*, but hardly in those of *Gynura* and *Microglossa*, for the one grows on rocks and the other is common on the dry patanas.

The two species of *Blumea*, *Hedyotis verticillaris* (Pl. **12**. fig. 1), *Polygonum chinense*, *Senecio ludens*, *S. zeylanicus*, and *Vernonia Wightiana* have leaves with feebly differentiated mesophyll, but thickened outer upper epidermal walls; these all belong to the "wet" patanas, and with two exceptions are Composites. *Flacourtia Ramontchi* and *Jasminum angustifolium*, both of the "dry" patanas, have feebly differentiated but compact mesophylls; leaves inclined to the vertical might have been expected in these two species.

Zornia diphylla has almost an isobilateral structure, both in its epidermis and mesophyll, in connection with which it is of interest to note that its leaflets move into a profile position in bright sunlight. None of the other plants examined, possessing this power of movement, show such a correlated structure in their leaflets. *Cassia Kleinii* and *C. mimosoides* have their epidermal layers similar, with stomata equally distributed on both surfaces, but their mesophyll has a dorsiventral differentiation. The four others, *Atylosia rugosa* (Pl. **12**. fig. 3), *Crotalaria rubiginosa*, *Phaseolus trinervius*, and *Oxalis corniculata*, have practically dorsiventral leaves. It would be interesting to extend these observations to see whether such a profile position assumed in bright sunlight may have tended to modify the dorsiventrality of such leaves. The above examinations merely suggest the idea.

VII. Special Points in the Anatomy of the Leaf bearing on Xerophytism.

Under this heading are enumerated certain leaf-structures in some of these plants, such as a double-layered epidermis, mucilage-cells, &c., which are generally regarded as protections against excessive transpiration; also instances of chloroplasts occurring in the epidermal cells—usually looked upon as a decidedly mesophytic character.

(1) **A Double-layered Upper Epidermis or Hypoderm* occurs in *Glochidion zeylanicum*, *Heptapleurum stellatum*, *Psidium Guyava*, *Rhododendron arboreum*, *Vernonia Wightiana*, and *Exacum zeylanicum*.

Glochidion zeylanicum. The upper epidermis is not uniformly two-layered, but only double in places. This fact does not seem to have been recorded for the genus.

Heptapleurum stellatum. The upper epidermis is 2–3 cells deep, as a rule two; the second layer is deeper than the first. The genus is mentioned by Solereder † as possessing a hypoderm.

Psidium Guyava (Pl. **11**. fig. 7). The upper epidermis consists of 3–4 narrow layers of cells. Bokorny ‡ has noted a hypoderm in the species *P. araca* and *P. incanescens*.

Rhododendron arboreum. The upper epidermis is composed of two layers of about equal depth. This instance is recorded by Solereder.

Vernonia Wightiana. The epidermis is divided in places only.

Exacum zeylanicum. Below the uppermost layer of cells (epidermis) is one composed of large, rather rounded cells with very few chloroplasts; it appears to have been differentiated from the mesophyll, and probably functions as an aqueous layer.

(2) *Peculiar Lateral Walls in the Epidermis of* Hypericum mysorense.—Some of the lateral walls of both epidermal layers

* In none of these examples, except *Exacum zeylanicum*, has it been definitely proved whether the second layer of cells may have been derived from the originally single epidermal layer or from the mesophyll. Immature leaves in various stages were not to hand to settle this point. Most likely all but *Exacum* are epidermal in origin.

† Solereder, Syst. Anat. der Dicotyledonen, 1899, p. 482.

‡ Bokorny, Flora, 1882, pp. 35–45 & p. 387; also Solereder, *l. c.* p. 398.

of the leaf have a much swollen appearance. In surface view they appear lenticular in shape (Pl. **12.** fig. 7): in section they present the form of pegs, being thickest next the outer wall and diminishing gradually towards the basal one (Pl. **12.** fig. 6). Treatment with Schultze's solution or iodine and sulphuric acid shows that the cuticularized part of the outer wall is continued down these side-walls for some distance in the form of wedges (Pl. **12.** fig. 6, *cp.*); but no cuticularized core is revealed in the ordinary thin lateral walls.

An examination of young leaves makes it evident that these peculiar walls are interpolated after the general cellular formation of the epidermis. In fact, they may be regarded as belonging to the same category as those walls which are inserted so as to render an epidermis two-layered; only in the first case the additional walls are radial, while in the second case they are tangential. The original cell is usually well defined, as it is bounded by the ordinary thin lateral walls; it may remain single or be divided into two or more compartments by the formation of these special walls (Pl. **12.** fig. 7). The latter result is best seen in the epidermis overlying the vascular bundles (veins). They, no doubt, serve to strengthen the leaf, and may perhaps to some extent help to lessen transpiration. This peculiarity does not seem to have been noticed previously in the genus.

The leaf of this plant is also interesting as possessing an isobilateral structure. Till quite recently all species of the Hypericaceæ * examined possessed dorsiventral leaves with stomata only on the lower surface. Kearney †, in a paper published lately, mentions two other species of the genus, viz. *Hypericum virgatum*, Lam., and *H. pilosum*, Walt., as having isobilateral leaves. In both these species, growing in an exposed situation, the leaves are erect and, as in *H. mysorense*, the stomata are found on the ventral as well as on the dorsal surface, the epidermal cells of both surfaces present similar characters, and a second palisade-layer is found contiguous with the lower epidermis.

(3) *Mucilaginous Cells in the Epidermis.*—The presence of mucilaginous cells in the epidermis is a common character of

* Solereder, Syst. Anat. Dicot. (1899) pp. 134–135.

† Kearney, Contr. from U.S. Nat. Herb. vol. v. (1901) pp. 495, 496.

plants of dry climates. The mucilage is not held in the lumen of the cell, but in the inner (basal) wall. This is enormously thickened, and composed principally of mucilage. It often presents a stratified appearance due to unaltered bands of cellulose. Such a wall can act as a water-absorbent and storer. In some cases all the epidermal cells may be thus modified, while in others specialized mucilaginous cells are scattered about.

Several of the patana plants examined have such sacs. Their names are given below.

Crotalaria albida (Pl. **12**. fig. 9). The mucilage-cells are very numerous in both epidermal layers. Perhaps one out of every three cells has its inner wall mucilaginous. These cells, especially those of the upper epidermis, are very deep, penetrating a long way into the mesophyll, the extra depth being wholly due to the thickness of the inner wall.

Crotalaria rubiginosa. The mucilage-cells are much less numerous than in the preceding species and are, moreover, confined to the upper surface. This plant is also in other respects less xerophytic than *C. albida*. Neither is mentioned by Solereder as exhibiting this feature.

Zornia diphylla. The mucilage-cells are numerous in both epidermal layers.

Polygonum chinense (Pl. **12**. fig. 8). The mucilage-cells are confined to the upper epidermis and are not very numerous. The genus is mentioned by Solereder as showing this feature.

Lasiosiphon eriocephalus. The presence here of a mucilaginous epidermis is recorded by Solereder. The cells occur only on the dorsal surface and are numerous but not deep.

Myrsine capitellatum. The mucilage-cells occur plentifully in both epidermal layers, but more so in the lower than upper.

Eurya acuminata and the two varieties of *E. japonica*. The inner walls of both epidermal layers are uniformly somewhat thickened and mucilaginous—the mucilage is thus in these three instances not restricted to special cells.

(4) *Chloroplasts in the Lower Epidermis.*—What appear to be chloroplasts exist in the lower epidermis of the leaves of *Didymocarpus Humboldtiana* (Pl. **11**. fig. 6, *ch.*) and *Pedicularis zeylanica*. Since fresh material of these plants has not been examined, it cannot be stated with absolute certainty from an investigation of the spirit-specimens that these bodies contained

chlorophyll, although their likeness to the plastids of the mesophyll render it highly probable. Solereder * mentions species of the order Scrophulariaceæ, but not Gesneraceæ, to which *Didymocarpus* belongs, as having chloroplasts in their epidermis. Neither of the above plants shows marked xerophytic characters in the leaf. In fact, *Didymocarpus Humboldtiana* is decidedly mesophytic in structure; it grows on wet boulders. *Pedicularis zeylanica* has its outer epidermal walls somewhat thickened and possesses fairly well differentiated palisade-cells.

VIII. Additional Points of Anatomical and Physiological Interest.

In this division of the paper are included certain features of interest bought to light during the microscopic examination of these plants, which, however, have hardly any œcological bearing, but which, we think, are worth recording. Several of them require further investigation.

(1) *Tannin Idioblasts in the Mesophyll.*—Distributed in the mesophyll of several of these plants are special sacs, which in the alcoholic material are coloured brown and which are usually larger than the ordinary chlorophyll-cells. They may have a scattered arrangement, or be located chiefly in the palisade-tissue, or form a more or less definite layer in the middle of the leaf, or be aggregated mainly round the fibrovascular bundles. Solereder † refers to such cells as tannin idioblasts, and mentions them as being of common occurrence in the Sapindaceæ, Papilionaceæ, Mimoseæ, and Rubiaceæ. The brown coloration possibly arises from the action of an oxidase on the tannin substance, changing it into a phlobaphene or some kindred body on the death of the cell.

Their occurrence has been noticed in the mesophyll of the following patana plants:—

Papilionaceæ.—*Atylosia rugosa* (Pl. **12.** fig. 3, *ts.*), *Tephrosia tinctoria.*

Rubiaceæ.—*Canthium parviflorum, C. Rheedii, Hedyotis Lawsoniæ* (Pl. **11.** fig. 2, *ts.*), *Knoxia platycarpa* var. *hirsuta, Mussænda frondosa* (Pl. **11.** fig. 10, *ts.*).

Polygonaceæ.—*Polygonum chinense.*

* Solereder, Syst. Anat. Dicot. (1899) p. 907, for list of natural orders with chloroplasts in epidermis.

† olereder, *l. c.* p. 924.

It is interesting to note that the other species of both *Atylosia* and *Hedyotis*, viz., *A. Candollei* and *H. verticillaris* respectively, do not possess these sacs.

(2) *Thick-walled Spongy Tissue in the Leaf of* Mussænda frondosa.—This leaf is remarkable in having relatively very thick-walled spongy mesophyll-cells (Pl. **11**. fig. 10, *tw.*). These walls hardly seem to be mucilaginous in nature, for they neither swell in water nor stain with corallin-soda. Again, they do not appear to be composed of ordinary cellulose, as neither Schultze's solution nor iodine and sulphuric acid stains them the characteristic blue colour, but they remain for the most part unchanged.

(3) *Crystals.*—Notes have been made of the crystalline contents of these plants, but very few of these need be recorded.

Exacum zeylanicum has single crystals of calcium oxalate in its leaf. This is noteworthy, since it is asserted by Solereder * that no crystals have been observed in the order Gentianaceæ.

The leaves and stems of this plant also show in the spirit-material crystalline spheroidal masses, which to the naked eye appear as white specks dotted all over the specimens. These are insoluble in hot and cold water and in dilute mineral acids, but soluble in potash and concentrated sulphuric acid with yellow coloration. The substance is probably a glucoside, and may be akin to hesperidin. In the living tissue it is most likely in solution, the precipitation being caused by the alcohol.

Raphides, as is well known, occur frequently in the Rubiaceæ, but attention does not seem to have been called to the fact as to whether they may be imbedded in mucilage or not. Of the raphide-containing species, *Knoxia platycarpa* var. *hirsuta* and *Hedyotis Lawsoniæ* have mucilage as well, while *Hedyotis verticillaris*, *Allæophania decipiens*, and *Oldenlandia Heynei* are wanting in this substance. The raphide-mucilage may be of value in retaining water, and so be considered a xerophytic character.

(4) *Reserve Carbohydrates.*—As might be expected, sphero-crystals of *inulin* were found in the spirit-preserved roots, and sometimes in the lower part of the stems of the following Compositæ, viz.:—*Vernonia Wightiana*, *Lagenophora Billardieri*, *Microglossa zeylanica*, *Blumea flexuosa*, *B. crinita*, *Anaphalis marcescens*, and *A. oblonga*, and also of *Lobelia nicotianiæfolia*. Reserve starch in all these cases was absent.

* Solereder, Syst. Anat. Dicot. (1899) p. 291.

Curculigo orchioides (N.O. Amaryllidaceæ).—This perennial herb has an erect fleshy rootstock and stout tuberous roots. In our collected material the rootstock had a largely developed cortex full of small starch-grains. The root-tubers, on the other hand, contained no starch, and the cells seem to lack contents generally. Possibly they may have had reserve carbohydrate, which has been exhausted, or they may function as water-reservoirs, while the rootstock serves as a food-reservoir. Examinations of the plant at various times of the year would soon elucidate this point. Our material was collected in the middle of October from the Hakgala patanas.

Pedicularis zeylanica and *Spiranthes australis* (an orchid) are peculiar in having starch-grains in their reserve-organs staining not blue, but red-brown with iodine.

The large tuberous roots of *Pedicularis zeylanica* were nearly depleted of their starch; what remained was located in the outer part and stained red with iodine, suggesting the idea that the altered nature of the grains was merely prior to their complete dissolution. However, the plentiful starch-grains of young roots stained similarly, looking as if "red" starch is the form in which the reserve-carbohydrate is deposited in this plant.

A few cases of reserve "red" starch are known *, such as in the endosperm of *Sorghum vulgare* var. *glutinosum*, in the rootstock of a few orchids, and in the tuber of *Isopyrum biternatum* †. Transitory "red" starch is of commoner occurrence.

(5) *Cortical Bundles in the Stem of* Glochidion zeylanicum.—Besides the main stele, this plant often has in its internodes two small lateral steles traversing the cortex opposite one another and running in two longitudinal swellings, one on each side of the stem (Pl. **12**. fig. 10). These are similar in structure to the main stele.

This character is not very constant. Sometimes one only of the lateral steles is continuous throughout the internode, the other joining the central stele part of the way up; or, again, both may fuse with the main stele before the node above is reached. Further, in one internode three subsidiary steles occurred, two on

* A. Meyer, Ber. d. Deut. Bot. Ges. 1886, p. 337; Shimoyama, "Beiträge zur Kenntniss des japanischen Klebreisses," Inaug.-Dissert., Strassburg, 1886; Zimmermann, Bot. Microtechnique, 1893, p. 228.

† Macdougal, Minnesota Bot. Studies, no. 9, pt. viii., April 1896.

one side and one on the other. All these variations were noticed in the few twigs at our disposal for examination.

In the nodal region the lateral stele gives out a branch which joins the petiolar fibrovascular bundle just about where this latter passes into the stem stele. An offshoot from this branch goes to the stipule.

No mention of this peculiarity for the genus is to be found in Solereder's work. It resembles to some extent the stem-structure of certain lianas *.

(6) *Stipular Glands and Root-swellings of* Hedyotis verticillaris.—This interesting plant, so different in habit † from the rest of the Rubiaceæ, has very conspicuously stalked glands on its large stipules. These belong most likely to the type found in the genus *Coprosma* of the same order, a short account of which was given before the Linnean Society by Gardiner ‡ in 1883.

Each gland is papillate in shape, and consists of a core of parenchyma covered by an epithelium (Pl. **12**. fig. 11). No tracheids were observed to penetrate the tissue of the gland. Their function is unknown. An absorptive one has been suggested, since they are immersed in the water which collects in the concavities formed by the rosette of leaves.

The roots in the material collected of this plant often showed swellings; in these the central stele was considerably broken up. In one case the fibrovascular tissue seemed to consist of a ring of isolated bundles. These thickenings may be caused by external injury or disease, and not be a normal feature of the plant.

IX. Summary.

To recapitulate some of the more important facts and conclusions gleaned from an anatomical investigation of these 80 plants :—

(1) The leaves of the "dry" patana plants examined do not show more marked xerophytic characters than do those of the "wet" patanas. In fact the two sets of plants are very similar in this respect. Chief points of difference are :

(*a*) "Wet" patana plants have deeper upper and lower epidermal layers.

* Schenck, Anat. d. Lianas, 1893, p. 142.

† Pearson, Journ. Linn. Soc., Bot. xxxiv. (1899) pp. 331 and 343.

‡ Gardiner, Linnean Soc. meeting Dec. 20th, 1883 (never published); also Note in Bot. Centralbl. 1884, ii.

(*b*) "Wet" patana plants are more hairy, which may explain their rather thinner outer epidermal cells and the more frequent occurrence of raised stomata.

(*c*) Arched epidermal cells and wavy lateral epidermal walls are somewhat commoner amongst the "wet" patana plants.

(*d*) Stomata are rather more numerous amongst the "dry" patana plants.

(*e*) The ratio of the length of the palisade-cell to its breadth is rather greater amongst the "dry" patana plants and a double-layered palisade is commoner.

(*f*) "Wet" patana plants have on the whole a more compact mesophyll, *i. e.* less intercellular space.

(2) Many of the erect and semi-erect leaves show an isobilateral structure or a tendency thereto, but there are some striking exceptions among the "dry" patana plants.

(3) A double-layered upper epidermis or hypoderm occurs in six plants.

(4) Peculiar additional lateral epidermal walls are present in the leaf of *Hypericum mysorense*.

(5) Eight species have cells in the epidermis of the leaf with inner (basal) walls much thickened and mucilaginous.

(6) The spongy cells of the mesophyll of *Mussænda frondosa* have relatively very thick walls which are not true cellulose, and hardly appear to be mucilaginous.

(7) The tuberous roots of *Pedicularis zeylanica* and *Spiranthes australis* contain "red" starch—two new examples of this comparatively rare reserve carbohydrate.

(8) The stem of *Glochidion zeylanicum* has often two additional steles (cortical bundles) traversing longitudinal swellings on opposite sides of the internode.

(9) Attention is called to the conspicuous glands borne on the large stipules of *Hedyotis verticillaris*.

X. Concluding Remarks.

In a former paper it was stated that "the flora of the patanas as a whole is composed of plants which, generally speaking, present characters which tend to reduce transpiration and to protect delicate parts from the injurious effects of intense illumination"*. This view, the result of field observations, is sufficiently borne out by the anatomical characters, herein recorded, of those plants which have been available for examination. The conditions prevailing over the patanas situated below 4500 ft. appeared to be much more favourable to the existence of a pronounced xerophytic flora than those which dominate the open country at higher elevations. It was therefore confidently expected that those anatomical peculiarities which usually characterize plants of insolated areas would be more strongly developed in the members of the "dry" patana flora than in those from the "wet" patanas. That this is not the case is abundantly evident from the facts recorded above. This conclusion is of considerable interest and by no means easy of explanation.

It does not seem likely that the unfavourable nature of the climatic conditions of the "dry" patanas has been overestimated. It is rather probable that some factor in the climate of the wet patanas tending to the evolution of xerophytic characters has been overlooked or its influence undervalued. All the material of "wet" patana plants examined was obtained from the patanas lying along the Hakgala valley, which, as already pointed out*, trends east and west and falls rapidly to the east. Throughout the prevalence of the south-west monsoon, this valley is swept by powerful winds from the west, whose dwarfing effect upon the arborescent vegetation on the upper southern slopes has already been alluded to †. Thus, although the air is never dry in any ordinary sense of the word, it is almost constantly changing and probably rarely approaches a state of saturation, at any rate in the lower portion of the valley. We are inclined to regard this as a factor of importance in the development of the xerophytic character of the flora, which, compared with that of the drier patanas, is certainly more marked than would be anticipated.

In this connection sufficient importance has perhaps not been ascribed to the lowering of the functional activity of the roots of "wet" patana plants by the humic acids in the soil ‡. This to some extent renders them incapable of absorbing the moisture in the soil which under other circumstances would be sufficient to support a flora of a mesophytic type.

* Pearson, Journ. Linn. Soc., Bot. xxxiv. (1899) p. 323.

† Pearson, *l. c.* p. 332. ‡ Pearson, *l. c.* p. 324.

EXPLANATION OF THE PLATES.

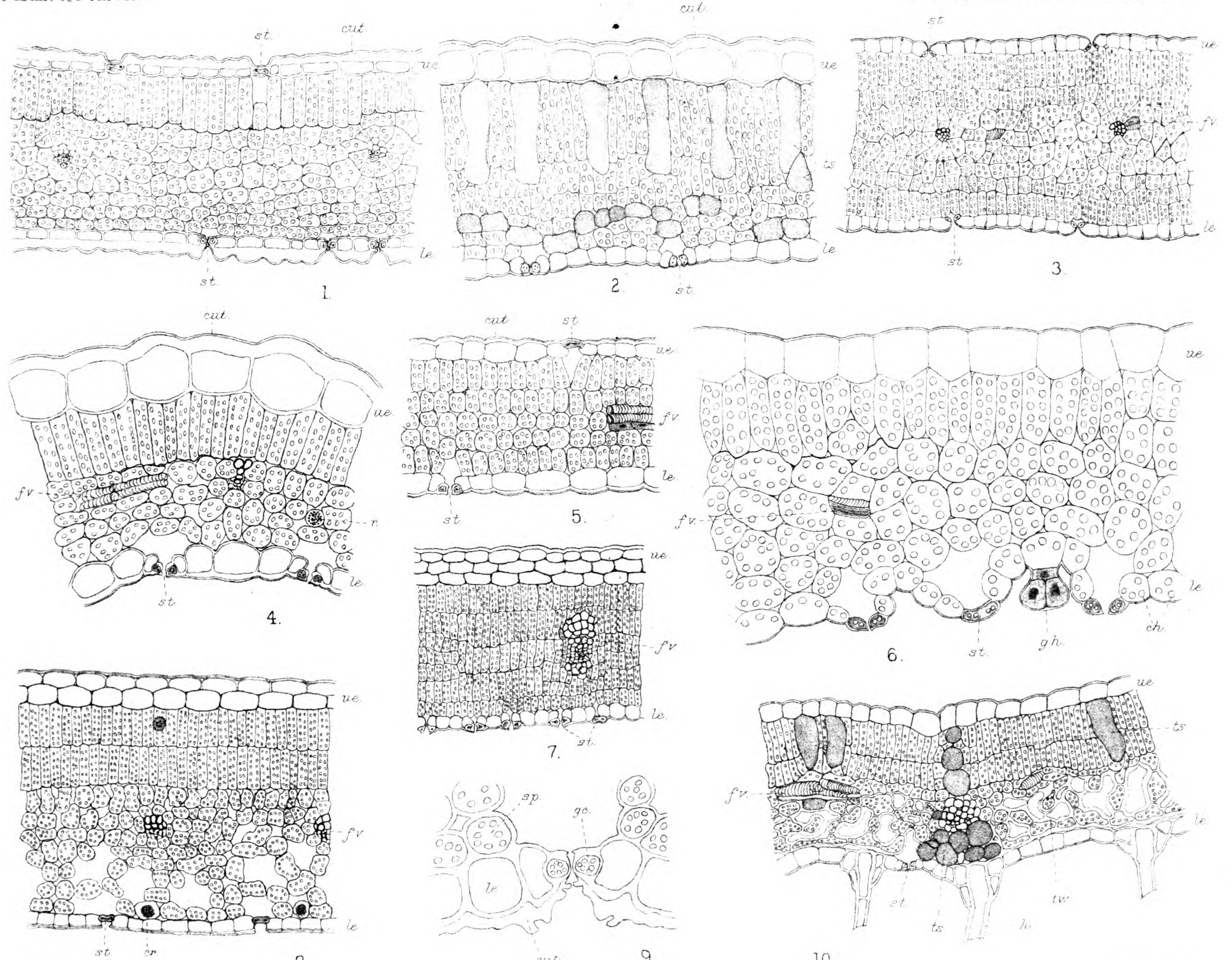
u.e., upper epidermis; *l.e.*, lower epidermis; *st.*, stoma; *cut.*, cuticularized part of the outer epidermal wall; *fv.*, fibrovascular tissue.

PLATE 11.

Fig. 1. *Bupleurum mucronatum.* Section of leaf. × 200.
Fig. 2. *Hedyotis Lawsoniæ.* Section of leaf. × 200.
t.s., tannin-sacs (shaded).
Fig. 3. *Hypericum mysorense.* Section of leaf. × 200.
Fig. 4. *Oldenlandia Heynii.* Section of leaf. × 200.
r., raphide-cell in section.
Fig. 5. *Evolvulus alsinoides.* Section of leaf. × 200.
Fig. 6. *Didymocarpus Humboldtiana.* Section of leaf. × 200.
gh., glandular hair; *ch.*, chloroplasts in lower epidermis.
Fig. 7. *Psidium Guyava.* Section of leaf. × 200.
Fig. 8. *Heptapleurum stellatum.* Section of leaf. × 100.
cr., cluster crystals of calcium oxalate.
Fig. 9. *Heptapleurum stellatum.* Section of stoma. × 400.
g.c., guard-cell; *l.e.*, lower epidermal cell; *cut.*, cuticularized part of outer wall of epidermis; *sp.*, spongy mesophyll-cells.
Fig. 10. *Mussænda frondosa.* Section of leaf. × 200.
t.s., tannin-sacs (shaded); *tw.*, thickened wall of spongy cell.

PLATE 12.

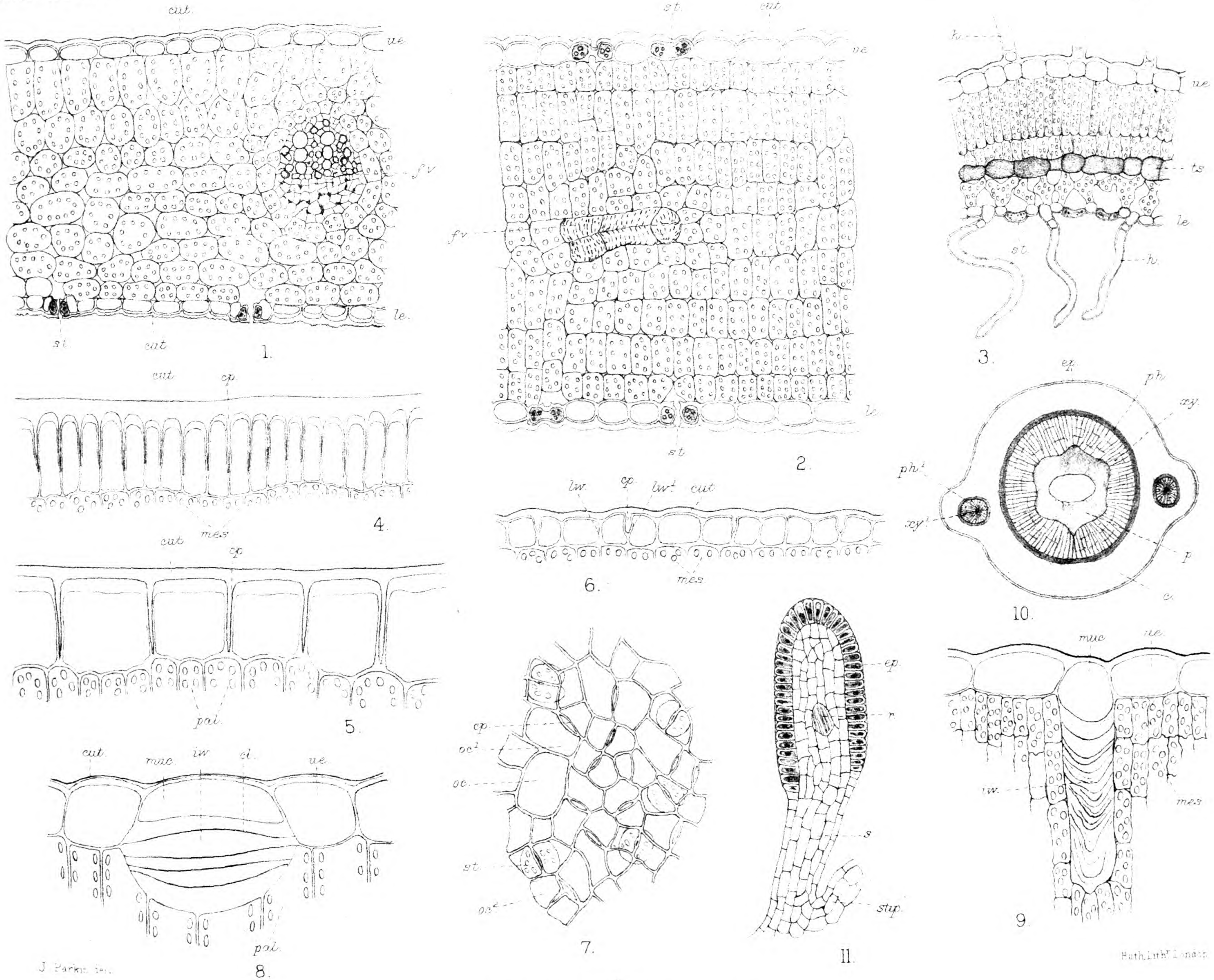
Fig. 1. *Hedyotis verticillaris.* Section of leaf. × 200.
Fig. 2. *Osyris arborea.* Section of leaf. × 200.
Fig. 3. *Atylosia rugosa.* Section of leaf. × 200.
t.s., layer of tannin-sacs (shaded); *h.*, 3-celled hairs, only basal parts of them shown on upper surface.
Fig. 4. *Rhodomyrtus tomentosa.* Section of upper epidermis. × 400.
cut., cuticularized part of outer wall; *cp.*, cuticularized prolongation into side-walls; *mes.*, commencement of mesophyll.
Fig. 5. *Gaultheria fragrantissima.* Section of upper epidermis. × 400.
cut., cuticularized part of outer wall; *cp.*, cuticularized prolongation into side-walls; *pal.*, upper parts of palisade-cells.
Fig. 6. *Hypericum mysorense.* Section of upper epidermis. × 400.
cut., cuticularized part of outer wall; *lw.*, ordinary lateral wall; $lw._1$, special lateral wall with cuticularized prolongation, *cp.*; *mes.*, commencement of mesophyll.
Fig. 7. *Hypericum mysorense.* Surface view of upper epidermis. × 400.
st., stomata faintly shown, being sunk somewhat; *oc.*, original epidermal cell undivided, $oc._1$, divided into two cells by special wall, $oc._2$, divided into three cells by two special walls at right angles to one another; *cp.*, cuticularized core of special lateral walls.
Fig. 8. *Polygonum chinense.* Section of upper epidermis, showing mucilage-cell. × 400.
muc., lumen of mucilage-cell; *i.w.*, thick inner wall containing the



J. Parkin del.

Huth, Lith. London.

PLANTS OF THE CEYLON PATANAS.



J. Parkin del.

Huth, lith.r London.

PLANTS OF THE CEYLON PATANAS.

mucilage and traversed by bands of cellulose, *cl.*; *u.e.*, ordinary epidermal cell; *pal.*, commencement of palisade-cells.

Fig. 9. *Crotalaria albida.* Section of upper epidermis, showing very deep mucilage-cells. × 400.

muc., lumen of cell; *iw.*, inner wall of great thickness containing the mucilage with stratified appearance due to bands of unaltered cellulose; *mes.*, mesophyll; *ue.*, ordinary epidermal cell.

Fig. 10. *Glochidion zeylanicum.* Diagram of transverse section of the middle part of internode of stem. × 20.

ep., epidermis; *c.*, cortex; *p.*, pith with central cavity (unshaded).
ph. and *xy.*, phloem and xylem, respectively, of main stele.
$ph._1$ and $xy._1$, „ „ „ of lateral steles.

Fig. 11. *Hedyotis verticillaris.* Longitudinal section of stipular gland. × 100.

ep., epithelial layer of gland; *s.*, stalk of gland; *stip.*, main tissue of stipule; *r.*, raphide-cell.

On the Synanthy in the Genus *Lonicera*.

By E. A. Newell Arber, M.A., F.G.S., Trinity College, Cambridge; University Demonstrator in Palæobotany. (Communicated by A. C. Seward, Esq., F.R.S., F.L.S.)

[Read 4th December, 1902.]

The morphological character known as synanthy, or the union of two or more members of an inflorescence, is in nature by no means rare, although it can hardly be said to be of common occurrence. It is exhibited normally in plants belonging to many widely separated orders. Among these, the genus *Lonicera*, belonging to the Caprifoliaceæ, is remarkable both for the number of species which possess this character and for the different ways in which the synanthy is effected.

The genus has recently been divided into three groups as follows *:—

i. *Caprifolium*, DC.
ii. *Nintooa*, Sweet.
iii. *Xylosteum*, DC.†

* Fritsch (1891). The numbers in brackets after the authors' names refer to the date of the memoir, which will be found quoted in the bibliography at the end of this memoir.

† This section was originally founded by Tournefort in 1700 as *Xylosteon*, and this reading has been followed by De Candolle and others. I have, however, adopted here, on the authority of Bentham and Hooker (1873), p. 11, the form *Xylosteum*.

These are separated by the characters of the leaves, inflorescences, and flowers, as well as by the habit. The subgenus *Caprifolium*, which includes the two British climbing Honeysuckles, *L. Caprifolium*, L., and *L. Periclymenum*, L., is easily distinguished from the two other groups by the compound inflorescence, formed of closely compressed 3-flowered dichasia. No synanthy occurs in this group. In the two other subgenera, the inflorescence consists of a simple 2-flowered dichasium, in which the terminal flower is suppressed. The *Nintooa* group includes climbing shrubs, and, so far as is known, synanthy does not occur in any of its species.

The third subgenus, *Xylosteum*, is distinguished by the fact that none of its members are climbers. Usually the habit is that of an erect shrub. In many of the species included in this group, synanthy occurs between the two flowers of the cyme or the two fruits. This group is by far the largest, containing upwards of 70 species *. The great majority of these belong to Eastern Asia, occurring especially in China, the Himalayas, and in other parts of India. A few species belong to North America. Several are European, occurring especially as alpines in the mountains of Southern and Eastern Europe. A single representative of the group, *L. Xylosteum*, L., is a naturalized or possibly indigenous British plant.

The union of the flowers and fruits in certain species of *Lonicera* is well known, and has for many years been used as a character of systematic importance. The main facts relating to the morphology of the flowers and fruits have also been described by various authors, and may be found scattered throughout the systematic literature dealing with this group. At the same time, so far as I am aware, no one has yet undertaken a comparative morphological study of the synanthy in this genus. As little attention appears to have been paid recently to this subject, a comprehensive study of the *Xylosteum* section, from the point of view of the synanthy, may be of interest as a contribution to the morphology of floral structures.

The work has been carried out on the following lines:—Examination of the various stages in the flowers and fruits has been made in the case of a number of species of which material could be obtained. In this way I have worked out, independently

* Fritsch (1891), p. 166.

of previous observers, a series of types to which I believe all or nearly all the species showing synanthy may be referred. I have also examined the whole of the rich collection of dried material in the Kew Herbarium, which I have been able to compare with the types previously dissected. In a few cases, owing to the material being insufficient, or to difficulties inherent to the inspection of dried and mounted specimens, I have not been able to arrive at definite conclusions.

The fresh material for the work was partly collected in Switzerland, and partly obtained from the Botanic Garden at Cambridge. I am indebted to the courtesy of the Director of the Royal Botanic Gardens, Kew, for the material of certain species, and also for permission to work in the Kew Herbarium. I am also indebted to the Keeper of the Herbarium for help during the examination of the dried material.

True Synanthy.

There are two distinct types of synanthy exhibited in the genus. The first, and by far the most common, is one in which the union is effected by the floral organs. This I may distinguish as true synanthy, as opposed to the second type, which is due to the intervention of extra-floral organs, the bracteoles. As will be seen presently, a false synanthy may arise as a corollary to the union of the four bracteoles of the inflorescence into a bracteolar sheath enveloping the ovaries. In true synanthy, the union is effected by the coalescence of the receptacular walls of the two inferior ovaries *.

This coalescence may be partial or complete. We may thus distinguish two types of true synanthy, that of *L. Xylosteum*, L., which is incomplete, and *L. alpigena*, L., in which the union is complete.

Type of *L. Xylosteum*, L.

In a large number of species belonging to the *Xylosteum* group there is no synanthy. Occasionally, however, in some of these very slight union may apparently take place at the base of the

* The walls of inferior ovaries were formerly regarded as almost entirely receptacular. It has been pointed out, however [Goebel (1900), p. 54], that there are good grounds for the belief that the carpels take some share in their formation. I therefore use the term receptacular walls, without implying that the walls are entirely of receptacular origin.

ovaries, e. g., *L. ciliata*, Mühl.*; while in others the two flowers are always free. Such instances as *L. ciliata* form a gradation to the type of *L. Xylosteum*, in which the ovaries are united for rather less than half their length. This union takes place only in one plane, which is the median plane of the inflorescence. In this region, the parenchymatous tissues of the walls of the two inferior ovaries, or of the pericarps of the two berries, are in organic continuity. The fruits are united to a less extent comparatively than the flowers, and thus the two spherical red berries are nearly distinct.

In this species the bracteoles are very small and inconspicuous, and free from one another. In others, however, such as *L. nigra*, L., which possesses the same degree and type of synanthy, they are much larger, and sheath the lower portion of the ovaries. In all the flowers of *L. nigra* which I have examined, the bracteoles are united in pairs on one side, but free laterally. In others the four bracteoles may all be free †. The bracteoles do not, however, increase in size proportionately to the berries, and the fruits of *L. nigra* are similar to those of *L. Xylosteum*.

The following species possess the same type and degree of synanthy as *L. Xylosteum*.

Type of *Lonicera Xylosteum*, L.

L. bracteolaris, Boiss. & Buhse ‡.
L. cærulescens, Dipp. §
L. decipiens, Hook. f. & Thoms.
L. floribunda, Boiss. & Buhse.
L. fragrantissima, Lindl. & Paxt.
L. hellenica, Orph.
L. leiophylla, A. Kern.
L. Maximowiczii, Maxim.
L. nigra, L.
L. phyllocarpa, Maxim. ||
L. Standishii, Hook.
L. Tatarinowii, Maxim. ||

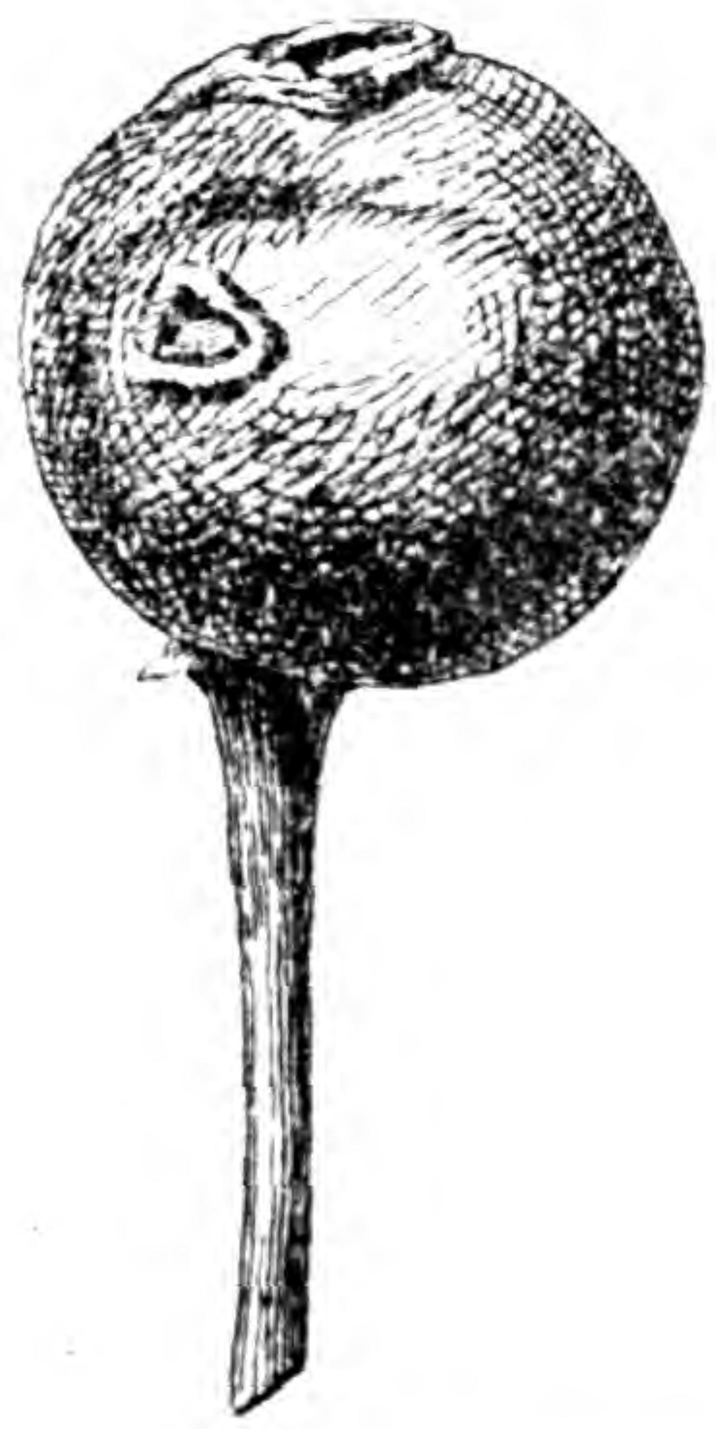
* Dippel (1889), p. 252.
† Koehne (1893), p. 548.
‡ Boissier (1875), p. 9.
§ Dippel (1889), p. 233. I have not seen this species.
|| On the authority of Maximowicz (1859), p. 138.

Type of *L. alpigena*, L.

Species in which the synanthy is complete are somewhat more numerous than those in which the union is only partial, but all gradations may be found between the type of *L. Xylosteum* and that of *L. alpigena.* In both cases, as a rule, the degree of synanthy is constant in the species, but here again exceptions occur. Thus *L. alpigena*, which in Europe has a single berry-like fruit, resulting from the complete union of the two ovaries, occurs also in India, where the two berries are always free *. These variations may possibly have some bearing on the question of the adaptation presented by such a false berry as that of *L. alpigena.*

In *L. alpigena*, at least in European examples, the coalescence is complete in the median plane throughout the entire, or nearly the entire, length of the ovaries. As Vidal † has already pointed out, this union is effected by the parenchymatous tissues of the receptacular walls or pericarps, which are in organic continuity.

Fig. 1.



L. alpigena, L.—The pseudocarp resulting from the complete union of the two berries. The scars of the two calyx-rings are seen towards the apex of the fruit. ×3.

The synanthy is even more marked in the fruit than in the flowers, for as the pseudocarp ripens it becomes globose, and the distinction between the two ovaries, from which it originates, is lost (fig. 1). This particular kind of pseudocarp may be termed a false berry.

* Hooker (1882), vol. ii. p. 16.

† Vidal (1897), p. 14.

In *Lonicera alpigena* the bracteoles are small, while in *L. oblongifolia*, Hook., and *L. microphylla*, Will., they are usually absent altogether. In other species possessing the same type of synanthy they form by their union a well-developed bracteolar sheath, which may be quite two-thirds as long as the ovaries, *e. g. L. angustifolia*, Wall.*

In the following species the synanthy is complete or nearly complete both in the flowers and fruits:—

Type of *Lonicera alpigena*, L.

L. angustifolia, Wall.
L. calcarata, Hemsl.†
L. caucasica, Pall.‡
L. Chamissoi, Bunge.
L. conjugalis, Kell.
L. discolor, Lindl.
L. Glehni, F. Schmidt.
L. glutinosa, Vis.
L. Kesselringi, Regel §.
L. microphylla, Willd.
L. oblongifolia, Hook.
L. orientalis, Lam. ||
L. parvifolia, Edgew.
L. Schmitziana, Dipp.¶
L. szechuanica, Batal.
L. tangutica, Maxim.
L. tomentella, Hook. f. & Thoms.

False Synanthy.

In many species of *Lonicera* the bracteoles are well developed and more or less completely united into a sheath, by the fusion of the four bracteoles of the cyme in the median and lateral planes. This bracteolar sheath may completely envelop the ovaries, especially in species in which the bracteoles are all united. In this case the external appearance of the flowers and

* Koehne (1893), p. 543.
† Hemsley (1901), pl. 2632.
‡ Jaubert & Spach (1842), tab. 72, p. 135.
§ Koehne (1893), p. 548. I have not seen this species.
|| Jaubert & Spach (1842), tab. 71, p. 134.
¶ Koehne (1893), p. 548. I have not seen this species.

the young fruits is apt to be misleading. In *L. iberica*, Bieb. (*cf.* fig. 2), the two corollas appear superficially to spring from a single inferior ovary, whereas the two ovaries are really free from one another, though closely enwrapped by the bracteolar sheath. This sheath has, in fact, been mistaken for completely fused ovaries. C. Koch* was apparently the first to discover that, in *L. iberica* and *L. chlamydophora*, C. Koch, the two ovaries are free. Again, Boissier † states that, in the case of *L. cærulea*, there are no bracteoles; although in other species he recognized the existence of a bracteolar sheath. As we shall see, bracteoles play a very important part in this species. Other authors, notably Jaubert and Spach ‡, Dippel §, and especially Koehne ||, have called attention to the fusion of the bracteoles into a sheath enveloping the ovaries.

In the great majority of species in which a completely fused sheath is present, the two ovaries are entirely free from one another and there is no synanthy. A few exceptions occur, such as those which exhibit true synanthy, as already mentioned. In one species, *L. cærulea*, the presence of a bracteolar sheath has given rise to a form of synanthy which is distinct from that above described.

Before, however, proceeding to discuss the condition of affairs in this interesting species, it may perhaps be well to point out how different species of *Lonicera* exhibit different stages in the formation of a complete bracteolar sheath such as that of *L. iberica*. In *L. nigra* we have in some forms a very incomplete sheath, which, in the flowering stage, does not cover more than half the length of the ovaries. In *L. involucrata*, Banks, a North American species with large leaf-like bracts, the two free ovaries are completely covered by large bracteoles, which are united in pairs medially, but remain free laterally. Other species similar in this respect to *L. involucrata* are *L. Maacki*, Maxim., *L. arborea*, Boiss., *L. flavescens*, Dipp.¶, and *L. spinosa*, Jacq.**

In *L. iberica*, as already stated, the four bracteoles are completely fused. Other species with a complete bracteolar sheath, and with the ovaries free from one another and from the

* C. Koch (1851), p. 478.
† Boissier (1875), p. 9.
‡ Jaubert & Spach (1842), p. 137.
§ Dippel (1889), p. 254, &c.
|| Koehne (1893), p. 545, &c.
¶ Koehne (1893), fig. 313 *c–f*.
** Koehne (1893), fig. 313 *a–c*.

bracteolar sheath, are *L. Aucheri*, Jaub. & Spach *, *L. gynochlamydea*, Hemsl.†, *L. hypoleuca*, Decne., *L. quinquelocularis*, Hardw., and *L. Ferdinandi*, Franch. ‡

The function of the bracteolar sheath is, no doubt, to afford protection to the young fruits. In all the above-mentioned species the fruits as they mature either grow out of the sheath, usually splitting it laterally (*L. iberica*), or where the bracteoles are free laterally the sheath becomes reflexed (*L. involucrata*).

In at least two other species, *L. ligustrina*, Wall., and *L. pileata*, Oliver, additional protective coverings to the ovaries and young fruits are found. The flowers of *L. ligustrina*, Wall., an East-Indian species which Koehne § has figured, possess in addition to the bracteolar sheath a further and still outer integument, which is developed from the region of the calyx-tube, and which grows downwards, overlapping the bracteolar sheath. When the fruits are ripe they project beyond the bracteolar sheath, as in *L. iberica*, and bear at the apices the withered remains of the upper integument. The two fruits, as also the two ovaries, are quite free from one another and from the bracteolar and upper sheaths. In *L. pileata* the upper and outer envelope is also present ||, and probably also in *L. vesicaria*, Komar ¶. I have not, however, seen this latter species.

Type of *L. cærulea*, L.

In those species which possess a more or less well-developed bracteolar sheath, we have seen that the two ovaries and the two fruits are entirely free from one another. We have also traced the fate of the bracteolar sheath when the fruits mature. We are now in a position to understand the origin of the false synanthy in the isolated type, *L. cærulea*, L., a common European alpine, and a species of great morphological interest. A completely fused bracteolar sheath is present in this species surrounding the two ovaries (fig. 2). The ovaries are, as in *L. iberica*, quite free from one another, although externally they appear to be completely fused.

* Jaubert & Spach (1842), tab. 73, p. 137.

† Forbes & Hemsley (1888), p. 362.

‡ Also ? *L. minuta*, Batal., *vide* Batalin (1892), p. 170.

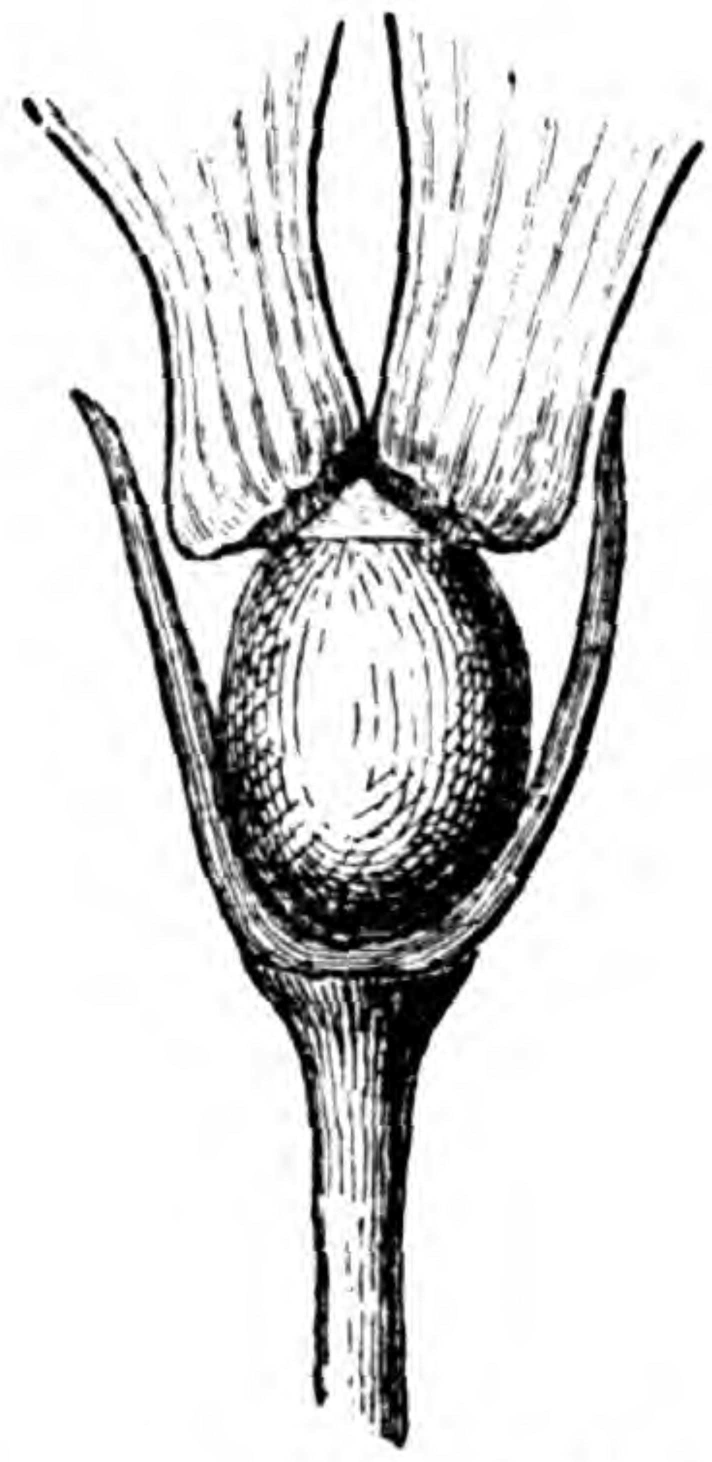
§ Koehne (1891), p. 167, fig. 57 *f–j*.

|| Figured by Oliver (1887), pl. 1585.

¶ Komarov (1901), p. 427.

The two ovaries are, however, united with the bracteolar sheath in certain planes. The condition of affairs is best explained by means of the diagrammatic sketches in fig. 3.

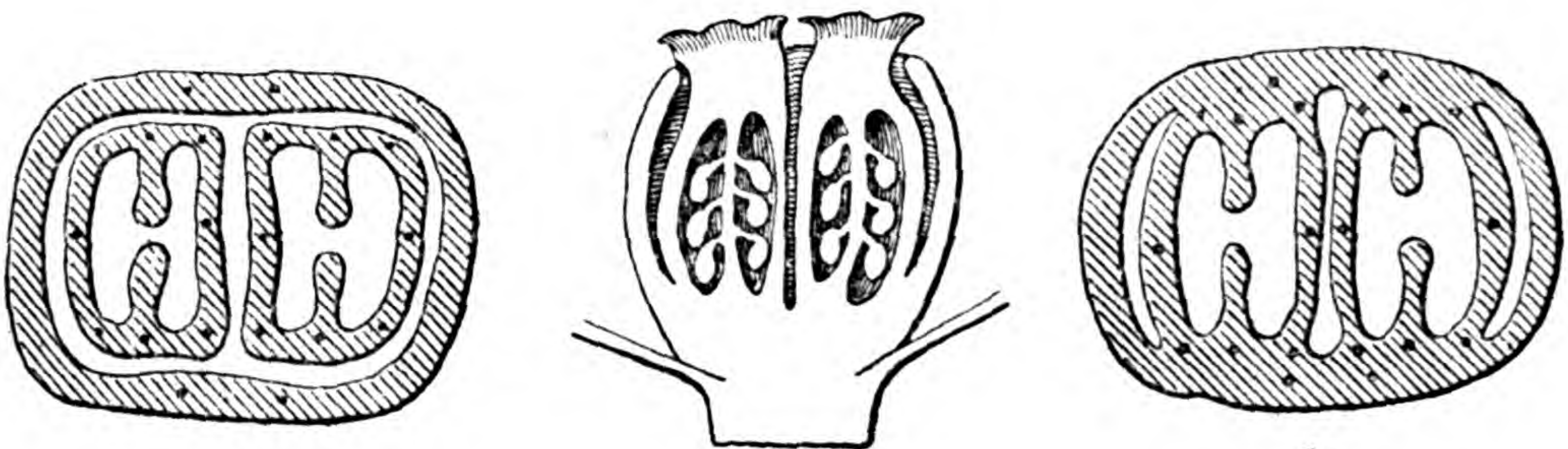
Fig. 2.



Lonicera cærulea, L.—Lower portion of the inflorescence, showing the bracteolar sheath investing the two gynæcea.

Fig. 3, *a*, shows the two free ovaries surrounded by the bracteolar sheath, to which, in their upper portion, they are

Fig. 3.



Lonicera cærulea, L.—(*a*) Diagram of a transverse section through the upper portion of the ovaries; (*b*) transverse section through the lower portion of the ovaries; (*c*) diagram of a longitudinal section through the lower portion of the inflorescence in the plane of the bracts.

not united. At a lower level, figs. *b*, *c*, they are united in the median plane of the inflorescence with the sheath, but remain free laterally. The longitudinal section* in the plane of the

* A similar diagram of Koehne's (1891), fig. 57 *e*, is not quite correctly drawn, at least as regards the specimens which I have examined.

bracts, fig. 3 *c*, shows that the two ovaries are not united with one another.

The result of this fusion is that, as the fruit matures, the growth of the bracteolar sheath keeps pace with the growth of the true berries which it encloses, and contributes to the pericarp in addition to the walls of the two ovaries. The pseudocarp which results is not very dissimilar in appearance, except in colour and size, to that of *L. alpigena* (fig. 1), although it is morphologically quite distinct. We see, therefore, that the presence of a bracteolar sheath may give rise to a false synanthy in which the union is effected by organs external to the flowers themselves.

Conclusions.

We have seen that two different types of synanthy occur in the *Xylosteum* section of the genus *Lonicera*. True synanthy is effected by the partial or complete fusion of the receptacular walls of the inferior ovaries or fruits, and the bracteoles play no part in its formation. Where the synanthy is complete, the resulting fruit is a false berry, in which the pericarp is formed from the walls of the two ovaries. Dr. Masters * states that this type of synanthy occurs in *Pomax* and *Opercularia* among Rubiaceæ, in *Eucalyptus Lehmanni* among Myrtaceæ, and in *Lycopersicum esculentum* (Solanaceæ). He terms this particular form of synanthy (in which "the pistils of different flowers may coalesce more or less without much alteration in the other parts of the flowers, as happens normally in many Caprifoliaceæ") *Syncarpy*. This is a most inappropriate and misleading term in this connection. If some such term is really necessary, we might perhaps coin a word such as *Syngyny*, or speak of these as cases of *Syngynæcea*.

It has been shown, as has already been pointed out by various authors, that in many species the gynæcea are enveloped by a bracteolar sheath, and that, as a rule, there is no synanthy in such cases. The object of the fusion of the bracteoles into a sheath is no doubt to protect the young fruits. Their function would thus seem to be very similar to that of the bracteoles in *Castanea* and *Fagus*. As a rule, this sheath plays no part in the formation of the pericarp of the fruit.

In one species, however, the presence of a bracteolar sheath

* Masters (1869), pp. 38 and 45.

may give rise to a false synanthy. So far as I am aware, this occurs only in the case of *L. cærulea*, though it is not improbable that other species may eventually be found which possess this character. The false synanthy in *L. cærulea* is effected by the union of the two gynæcea in certain planes with the bracteolar sheath, the gynæcea themselves remaining quite free from one another. The fruit in this species is a pseudocarp and a false berry, in which the bracteoles as well as the ovarian walls contribute to the pericarp.

There can be little doubt that there is some special biological significance expressed in the false berries of *L. alpigena* and *L. cærulea*, and that these forms of synanthy, although morphologically distinct, are both adaptations to some particular conditions of the plants' environment. What these conditions are, in the case of these two species, are questions which can hardly be answered without a special study of the subject. It would seem possible, however, that the adaptations have some connection with the alpine conditions under which these species thrive.

Bibliography.

BATALIN, A. (1892).—" Notæ de Plantis Asiaticis." Act. Hort. Petropol. xii., 1892.

BENTHAM, G., & J. D. HOOKER (1873).—' Genera Plantarum,' vol. ii., 1873.

BOISSIER, E. (1875).—' Flora Orientalis,' vol. iii., 1875.

DIPPEL, L. (1889).—' Handbuch der Laubholzkunde,' part i., 1889.

FORBES, F. B., & W. B. HEMSLEY (1888).—" An Enumeration of all Plants known from China," &c. Journ. Linn. Soc., Bot. vol. xxiii., 1888.

FRITSCH, K. (1891).—In Engler and Prantl's ' Die natürlichen Pflanzenfamilien,' Theil iv. Abth. 4, p. 156, 1891.

GOEBEL, K. (1900).—' Organography of Plants' (English Edition), 1900.

HEMSLEY, W. B. (1901).—" *Lonicera calcarata*," in Hooker's ' Icones Plantarum,' ser. 4, vol. vii. t. 2632.

HOOKER, J. D. (1882).—' The Flora of British India,' vol. ii., 1882.

JAUBERT, H. F., & E. SPACH (1842).—' Illustrationes Plantarum Orientalium,' vol. i., 1842–3.

Koch, C. (1851).—"Beiträge zur Flora des Orients." Linnæa, Bd. viii., 1851.

Koch, C. (1872).—'Dendrologie,' Bd. ii., 1872.

Komarov, V. L. (1901).—"Species novæ Floræ Asiæ Orientalis." Act. Hort. Petropol. xviii. (3), 1901.

Koehne, E. (1891).—In Engler and Prantl's 'Die natürlichen Pflanzenfamilien,' Theil iv. Abth. 4, fig. 57, 1891.

Koehne, E. (1893).—'Deutsche Dendrologie,' 1893.

Masters, M. (1869).—'Vegetable Teratology,' Ray Society, 1869.

Maximowicz, C. J. (1859).—"Primitiæ Floræ Amurensis." Mém. Savans Étrang. St. Pétersb. ix., 1859, p. 1.

Oliver, D. (1887).—"*Lonicera pileata*," in Hooker's 'Icones Plantarum,' ser. 3, vol. vi., t. 1585, 1866–7.

Vidal, L. (1897).—Annales de l'Université de Grenoble, 4[me] trimestre, 1897.

List of Marine Algæ collected at the Maldive and Laccadive Islands by J. S. GARDINER, Esq., M.A. By ETHEL S. BARTON (Mrs. Antony Gepp). (Communicated by A. GEPP, M.A., F.L.S.)

[Read 2nd April, 1903.]

(PLATE 13.)

THERE appears to be no record of the marine algæ of these islands, neither are there any specimens from them in the British Museum Herbarium. This list includes one new species, but all the rest recorded here, with two exceptions, are already known from the Indian Ocean. One of the plants is especially interesting as enabling a doubtful species to be elucidated, and another provides material for the drawing-up of a diagnosis of a plant hitherto undescribed and known only in Herbaria. All the Minikoi specimens were collected on July 26th, 1899.

In thanking Mr. J. Stanley Gardiner for allowing me to work out this collection, I would draw attention to his interesting notes on the habitats of the species, incorporated below almost verbatim. As a general observation, he states that "Algæ on tropical coral-reefs in *oceanic* areas never form more than low growths. Most of the reef-surface is bare, or towards the edge covered with nullipores (*Lithothamnion*). However, the latter area, where the waves break, is richer than the reef-flat, but too dangerous for proper collecting." Ordinarily, algæ are not found on shoals in the lagoon, the whole being covered with growing corals.

CHLOROPHYCEÆ.

1. ULVA sp.

Minikoi, Laccadive Islands. From sand-flat of lagoon near lighthouse. Sterile and fragmentary.

2. CAULERPA FREYCINETII, *Agh.*, forma TYPICA, *Web. v. Bosse.*

Minikoi, Laccadive Islands. On shoal in centre of lagoon.

Geogr. Distr. Warm Atlantic, Indian Ocean, Pacific.

3. HALIMEDA TUNA, *Lamx.*, forma PLATYDISCA, *Bart.*

Suvadiva Atoll, Maldive Islands. From muddy sand at 43 fathoms.

Geogr. Distr. Mediterranean, Atlantic, Indian Ocean, Pacific.

4. HALIMEDA OPUNTIA, *Lamx.*, forma TYPICA, *Bart.*

Minikoi, Laccadive Islands; from shoal in centre of lagoon. Rare everywhere on the Minikoi reef; but small masses may be found by searching under stones or in protected situations of the inner part of the reef, near the beach or boulder zone. In lagoon, not found in currents, but very luxuriant in moderately still water where it can find any stones to fix itself upon. Addu Atoll, Maldive Islands; at 25 fathoms; hard bottom outside atoll. Suvadiva Atoll; from fine mud at 45 fathoms.

Forma TRILOBA, *Bart.*

Suvadiva Atoll, Maldive Islands. From muddy sand at 43 fathoms.

Geogr. Distr. Atlantic, Indian Ocean, Pacific. Tropical.

5. H. INCRASSATA, *Lamx.*, form between f. *typica* and f. *Lamourouxii*.

Addu Atoll, Maldive Islands. 25 fathoms; hard bottom outside atoll.

Geogr. Distr. Atlantic, Indian Ocean, Pacific. Tropical.

6. VALONIA CONFERVOIDES, *Harv.*

Minikoi, Laccadive Islands. Forming with *Gracilaria crassa* a feltwork found very commonly towards the edge of the reef, almost up to the inner ends of the fissures, and abundant in the strong outrushing currents and on the buttresses, a few yards in from their edges.

Geogr. Distr. Warm Atlantic, Indian Ocean, Pacific, Australia.

PHÆOPHYCEÆ.

7. SARGASSUM DUPLICATUM, *Agh.*

Minikoi, Laccadive Islands. With *Turbinaria ornata* and *Gelidium rigidum.* Very common all over the reef right round the atoll. Not found in lagoon. Occurs only in parts where there is no sand; and never uncovered at low tide. Not found near the outer edge of the reef, the whole bottom being covered with incrusting *Lithothamnion*; nor in the fissures, apparently not being able to live in the very strong currents formed by the outrushing waters after each breaker.

Geogr. Distr. Indian Ocean, South Pacific.

8. Turbinaria decurrens, *Bory.*

Minikoi, Laccadive Islands. From sand-flat of lagoon near lighthouse.

Geogr. Distr. From the Red Sea, through the Indian Ocean, to China and Australia.

9. T. ornata, *J. Agh.*

Minikoi, Laccadive Islands. With *Sargassum duplicatum* and *Gelidium rigidum.*

Geogr. Distr. Indian Ocean, Pacific, New Zealand.

10. Haliseris delicatula, *Agh.*

Suvadiva Atoll, Maldive Islands. From muddy sand at 43 fathoms.

Geogr. Distr. Warm Atlantic, Indian Ocean, Pacific, Cape of Good Hope.

11. Dictyota Bartayresiana, *Lamx.*

Addu Atoll, Maldive Islands. In passage, 25 fathoms; hard bottom.

Geogr. Distr. Warm Atlantic, Indian Ocean, Australia.

12. Ralfsia verrucosa, *Aresch.* Sterile.

Minikoi, Laccadive Islands. This is the commonest growth by the sides of the fissures, where it sometimes forms masses several yards across. Colour black-green.

Geogr. Distr. Baltic, Mediterranean, Atlantic, Pacific, Cape of Good Hope.

13. R. ceylanica, *Harv.* (Pl. **13.** figs. 1–4.)

Minikoi, Laccadive Islands. From outer reef near edge, close to the south of the atoll.

Geogr. Distr. Indian Ocean.

This species has apparently never been described, though an authentic specimen of it is preserved in the British Museum Herbarium. With this specimen I have compared the Laccadive plant, and find it identical. I can find no fruit on either specimen, and am therefore able to give here a diagnosis of the sterile plant only.

Ralfsia ceylanica, Harvey, in Herb. Mus. Brit. Crusta mediocriter tenui, 25 mm. vel plus lata; tota pagina inferiore filis articulatis moniliformibus numerosis ad matricem calcaream arcte adhærenti; (sectione transversali) e stratis horizontalibus pluribus (10 vel plus) cellularum composita; unius strati infra medium positi cellulis maximis rectangulis protoplasma intense coloratum continentibus; stratis cæteris dimidio tenuioribus, paginam superiorem versus cellulis partitione verticali plus et plus subdivisis; pilis vel numerosis congestis ex areolis superficialibus, vel parvis ex cryptostomatibus minutis ortis; sporangiis nullis.

The absence of fruit makes it impossible to be sure of the exact position of this alga, which differs in certain details from other species of *Ralfsia*. In surface view the uppermost layer is seen to consist of small cells, arranged in long, continuous bands, separated by a very thin, translucent line. Each band is divided transversely into rows of from 2–4 cells (Pl. **13.** fig. 2). The moniliform rhizoids form a thick mass below the flat thallus (Pl. **13.** figs. 3 & 4), and the cells of the thallus arise in vertical lines from the very base. About the middle of the thallus, as seen in transverse section, is a single horizontal row of large, rectangular, deeply-coloured cells, and the cells of the 2 or 3 adjacent horizontal layers on each side correspond in width with these large cells, but are about half the depth (Pl. **13.** fig. 3). The uppermost layers are composed of small cells, and from these arise here and there patches of hairs. Small fascicles of hairs often arise from minute cryptostomata situated in the same superficial or uppermost layer.

14. Liebmannia Laccadivarum, n. sp.; fronde inferne lateraliter parce ramosa, ramis simpliciusculis tenuibus cylindraceis, sæpe flexuosis, sensim attenuatis, adscendentibus, 2 mm., rarius 3 mm., lata. Sporangia unilocularia hucusque ignota. Sporangia plurilocularia lanceolata, 55–75 μ long. × 15 μ lat., e cellulis filorum periphericorum inflatis basalibus orta, in pedicellis simplicibus vel furcatis terminalia. Fila peripherica longissima flexuosa, inferne semi-moniliformia cellulis basalibus pluribus unilateraliter inflatis, superne longe cylindracea. (Pl. **13.** figs. 5–8.)

Hab. Minikoi, Laccadive Islands. Found only on the upper (*i. e.* inner) terrace of the reef to the east of the island. Rooted in sand. On July 26th, 1899, it was timed as being exposed to the air for 4½ hours at low tide.

This plant resembles *L. Harveyana*, J. Agh., in its manner of branching, but is much more slender. A transverse section of the two plants shows at once the difference in structure. In *L. Harveyana* the peripheral filaments are grouped in fascicles, in *L. Laccadivarum* each filament grows out independently from the thallus, and is markedly larger in every way than those of *L. Harveyana.* The basal cells of the filaments are swollen on one side and resemble the paraphyses of *Splachnidium.* From this portion of the filaments arise the short simple or forked branches which terminate in the plurilocular sporangia. Above the swollen cells comes the growing part of the filament, composed of short cylindrical cells with dense contents, and above these are the long hyaline cells which are pushed out indefinitely to form the long hair.

I gratefully acknowledge Mr. Batters's kind help in determining the genus to which this species belongs.

15. Hydroclathrus cancellatus, *Bory.*

Minikoi, Laccadive Islands. From sand-flat of lagoon near lighthouse.

Geogr. Distr. Indian Ocean.

16. Colpomenia sinuosa, *Derb. et Sol.*

Minikoi, Laccadive Islands. Found only attached to, and sheltered by, overhanging massive upstanding blocks of the reef-flat, never where there is much sand being washed to and fro; often exposed for 2–3 hours to the air at low tide. In one place growing with a purple sponge.

Geogr. Distr. Mediterranean, Warm Atlantic, Indian Ocean, Pacific, Falklands, Tasmania.

17. Ectocarpus simpliciusculus, *Agh.*, var. vitiensis, *Asken.*

Minikoi, Laccadive Islands. From sand-flat of lagoon near lighthouse. Growing among portions of *Ectocarpus spongiosus*, Dickie.

Geogr. Distr. English Channel and Mediterranean for the species. The variety is recorded from the Friendly Islands and the coast of Queensland.

18. E. spongiosus, *Dickie.* (Pl. 13. figs. 9–13.)

Minikoi, Laccadive Islands. From sand-flat of lagoon near lighthouse. Also on the upper (*i. e.* inner) terrace of the reef to the east of the island. Rooted in sand. Exposed to the air for 4½ hours at low tide (26/7/99).

Geogr. Distr. Indian Ocean.

The position of this species has hitherto been regarded as obscure, since all that was known of it was the short description given by Dickie ("On the Algæ of Mauritius," Journ. Linn. Soc., Bot. vol. xiv. 1875, p. 191). "*Ectocarpus spongiosus*, n. sp.—Filis decomposito-ramosis, in funiculos obtusos densissime implexis; ramulis brevibus, alternis, bifidis vel trifidis. Propagula? The joints are about as long as broad, those of the ramuli a half longer than broad. The plant is dark brown, very sponge-like in habit."

Specimens of the plant are included in the present collection from the Laccadive Islands, and it is now possible to add further details as to the structure and to figure the fruits. Portions of the original material collected by Pike at Mauritius are preserved both in the British Museum and Kew Herbaria, and an examination of these specimens shows that plurilocular sporangia are present, but were overlooked by Dickie. They correspond closely with those of the material now obtained from the Laccadive Islands. They are terminal on a stalk of 1 cell, and are about 40–50 μ long and about 40 μ broad. They appear to be divided into 6 or 8 loculi; but as the sporangia of the Laccadive material are not quite mature, it has not been possible to figure one with all the walls of the loculi complete. In several instances a new sporangium has clearly grown up through the stalk-cell of an old one, as is seen by the collar of old tissue round the new stalk-cell.

Both in Dickie's description and the pencil sketch which accompanies his type specimen of *E. spongiosus* in the British Museum, the branches are said to be bifid or trifid; but though there are traces of this in the material itself, it is neither a conspicuous nor a characteristic feature. The ends of the branches are very often curled right round on themselves, and this is also very marked in the Laccadive material.

In the British Museum there is a 'Challenger' specimen from the Admiralty Islands named by Dickie *Ectocarpus sordidus*, Harv., but upon examination it proves to be a good example of *E. spongiosus* in fruit. A sterile plant of *E. spongiosus* is included among the algæ collected by the 'Investigator' at Sail Rock, Cheduba Straits, off the Burmah coasts.

FLORIDEÆ.

19. GALAXAURA RUGOSA, *Lamx.*

Minikoi, Laccadive Islands. A very brilliant pink-coloured alga, common on outer part of reef-flat near south-east point of reef, but extremely local elsewhere.

Geogr. Distr. Warm Atlantic, Indian Ocean, Pacific.

20. GELIDIUM RIGIDUM, *J. Agh.*

Minikoi, Laccadive Islands. From sand-flat of lagoon near lighthouse. Also growing with *Turbinaria ornata* and *Sargassum duplicatum*, and forming as it were a basis for them.

Geogr. Distr. Warm Atlantic, Indian Ocean, Pacific.

21. GRACILARIA CRASSA, *Harv.*

Minikoi, Laccadive Islands. With *Valonia confervoides*.

Geogr. Distr. Indian Ocean.

22. LAURENCIA sp.

Minikoi, Laccadive Islands. From sand-flat of lagoon near lighthouse. Also with *Corallina* sp.

23. SPYRIDIA ACULEATA, *J. Agh.*

Minikoi, Laccadive Is. This plant has the outward appearance of *S. insignis*, which is an Indian Ocean species, but the ramelli are long and uncorticated, and form a dense covering to the branches. They are hooked at the ends, and in every way more closely resemble the ramelli of *S. aculeata* than those of *S. insignis*. I have therefore called this plant *S. aculeata*, J. Agh., though it does not represent the typical form of the species. Among the Schousboean algæ in the British Museum Herbarium there is a specimen of *S. aculeata* which is denser than the other plants, and more nearly resembles the Minikoi specimen. In Minikoi it grows principally on the reef where it passes into the beach, but is not found generally opposite the boulder zone. It is often exposed for 3–4 hours at low tide (for more than 4 hours on July 26th, 1899). It may occur on the reef-flat, but never does so commonly; and it never roots itself in sand.

Geogr. Distr. Mediterranean, Atlantic, Red Sea.

24. HALYMENIA FORMOSA, *Harv.* With tetraspores.

Minikoi, Laccadive Islands. From sand-flat of lagoon near lighthouse.

Geogr. Distr. Indian Ocean, Pacific.

25. Halymenia sp.

Minikoi, Laccadive Islands. A fairly common red-brown alga with brilliant orange tips. It occurs sparingly everywhere on the reef-flat; prefers the parts of the reef where the tide rushes out, not the fissures.

26. Peyssonellia rubra, *J. Agh.*

Suvadiva Atoll, Maldive Islands. In fine mud at 45 fathoms.

Geogr. Distr. Mediterranean, Atlantic, Indian Ocean, Pacific.

27. Corallina sp.

Minikoi, Laccadive Islands. Beneath the breakers beyond the edge of the reef. With *Laurencia* sp.

EXPLANATION OF PLATE 13.

Fig. 1. *Ralfsia ceylanica*, Harv. Nat. size.
2. ,, ,, Small portion seen in surface view. × 178.
3. ,, ,, Transverse section of thallus showing vertical arrangement of cells, with middle row of large rectangular cells and basal rhizoids. × 178.
4. ,, ,, Single rhizoid. × 178.
5. *Liebmannia Laccadivarum*, n. sp. Nat. size.
6. ,, ,, Transverse section of thallus, showing hairs, paraphyses, and plurilocular sporangia. × 30.
7. ,, ,, Hair, showing swollen basal cells. × 178.
8. ,, ,, Plurilocular sporangium. × 472.
9. *Ectocarpus spongiosus*, Dickie. Nat. size.
10. ,, ,, Vegetative filament, showing spare branching and curled ends to branches. × 83.
11. ,, ,, Curled end of branch. × 178.
12. ,, ,, Plurilocular sporangium, drawn from type in Herb. Mus. Brit. (Mauritius, *Pike*). × 472.
13. ,, ,, Plurilocular sporangium, drawn from Laccadive Islands material, showing collar round pedicel cell. × 472.

Barton & Highley del.

Highley lith & imp.

MALDIVE & LACCADIVE ALGÆ.

Descriptions of New Chinese Plants, chiefly by STEPHEN TROYTE DUNN, B.A., F.L.S., with an Introductory Note by CHARLES HENRY WRIGHT, A.L.S. (Contributed by permission of the Director of the Royal Botanic Gardens, Kew.)

[Read 18th June, 1903.]

A LARGE collection of plants made by Dr. A. Henry in Yunnan, and presented by him to Kew in 1900, was (together with Chinese plants from other sources) in process of determination by Mr. S. T. Dunn, F.L.S., when he was appointed Superintendent of the Botanic and Afforestation Department, Hongkong. The following paper contains Mr. Dunn's descriptions of the species in these collections which he regarded as new; but as some of them were originally drawn up with a view to publication elsewhere, they have been amended so far as was necessary to make them conform to one plan. It had been intended that Mr. W. Botting Hemsley, F.R.S., should write an introduction to this paper, but the pressure of other work has prevented this intention being realized.

Some of the species call for special mention. Of *Magnolia Henryi*, Dunn, only a single tree was seen, and that in such bad condition as to suggest the idea that it was a sole survivor. *Bombax tenebrosum*, Dunn, was also only met with as a solitary tree, but Dr. Henry was able, by sending back collectors at various seasons, to obtain specimens of both flowers and fruit. Its white petals are 4½ in. long by nearly 1 in. broad, and are densely pubescent on the back.

A fourth species is added to *Euchresta*, Benn. Of those previously known, one extends from Khasia, Java, and the Philippines to Formosa and the Luchu Archipelago, while the others are confined to Japan and China respectively.

Two new species of *Cryptotæniopsis* are here described, bringing the number now known up to nine. This genus (originally proposed by Franchet as a subgenus of *Carum*) is one of the few Umbelliferæ in which the secondary branching of the inflorescence is cymose instead of umbellate. A similar structure occurs in *Pternopetalum*, Franch., which differs in having the fruit much laterally compressed and winged.

In the Journal of the Linnean Society, Botany, xxiii. (1886–88) pp. 449–458, thirty-five species of *Senecio* are recorded from

China; since then 83 new species have been described from that region, chiefly by Franchet, while the present collections add 11 more and bring the total number known from China up to 129. In the 'Flora of British India' 63 species are enumerated, of which 43 occur in the northern part of that area, 3 extending into China, and 2 into the higher regions of Tibet. This genus is remarkable for the diversity in habit of the various species. *S. Dryas* has about twelve long-petiolate radical leaves, in shape and texture much resembling those of the common ivy; the long scape bears a solitary capitulum. *S. fibrillosum*, Dunn, also has most of the leaves radical, but the scape bears many capitula in a raceme. In *S. dididymantha*, Dunn, and *S. Hoi*, Dunn, the numerous capitula are arranged in much-branched panicles, and the latter species is a climber. *S. glumaceus*, Dunn, has 1-flowered capitula.

Ninety-two species of *Saussurea* occur in China and 39 in British India, of which 9 extend into the higher regions of Tibet, where 3 endemic species exist, as well as 3 common to other regions.

Rhabdothamnopsis, Hemsl., is a new genus of Cyrtandraceæ, resembling somewhat the New Zealand *Rhabdothamnus Solandri*, A. Cunn., in habit. It is allied to *Bœa* and *Streptocarpus*, from both of which it differs in being a small, erect shrub with solitary flowers in the axils of the leaves.

Two new species of *Æschynanthus* are here described by Mr. Hemsley, one of which adds a second species to the section *Microtrichium*, characterized by the short solitary hair at each end of the seed.—C. H. Wright.

Magnolia Henryi, *Dunn*; M. pterocarpæ, *Roxb.*, habitu similis, fructu longe divergens.

Arbor 20–25-pedalis, præter pilos paucos adpressos infra folia juniora omnino glabra, ramulis luteis. *Folia* coriacea, siccitate fortiter utrinque reticulata, obovato-oblonga, 8–26 poll. longa, acuminata, ad basin acutam angusta, nervis primariis 20–40, subter prominentibus. *Florum* alabastra ovoidea, spatha glabra voluta; pedunculi 4–5 poll. longi, arcuati. *Sepala* 3, coriacea, oblonga, 2–2½ poll. longa. *Petala* 5, alba, sepalis similia. *Ovariorum* spica stamina excedens. *Fructus* maturus cylindricus, 4–5 poll. longus, 1–1½ poll. diam. *Carpella* ovoidea, rugosa, breviter rostrata.

Yunnan: at 4000 ft. in the forest near Szemao, *A. Henry*, 12782, 12782 A.

Dr. Henry tells me that he saw only one tree on the edge of a ravine in the forest 8 miles south of Szemao, and that this was in a wretched condition, only producing one or two flowers at a time, so that three visits had to be made to collect enough material.

Alphonsea mollis, *Dunn*; ab *A. lutea*, Hook. f. & Thoms. ovariis paucis, et specie indumenti differt.

Arbor 20-pedalis. *Ramuli* dense tomentosi. *Folia* subsessilia, ovato-oblonga, obtuse acuminata, basi rotundata, 3–5 poll. longa, supra sine costis glabra, ibi et subter mollissime tomentosa (siccitate fulva). *Flores* in nodis oppositifoliis solitarii vel bini; pedicelli 6–9 lin. longi, tomentosi, bracteolati. *Sepala* parva, triangularia. *Petala* exteriora apice recurva, extus tomentosa, intus glabrescentia, luteo-albida, interiora similia paulo breviora. *Ovaria* 3, tomentosa, stylo depresso. *Fructus* ignotus.

Yunnan: at 4000 ft. in the Yulo forests south of Szemao, *A. Henry*, 12923.

Cyclea polypetala, *Dunn*; petalis ab omnibus *Cycleis* aliis distinguenda.

Frutex alte scandens, caulibus sulcatis, hirsutis, tarde glabrescentibus, fuscis, pallescentibus. *Folia* subcoriacea, supra glabra, subter molliter hirsuta, venis prominentibus, cordata, vel sæpius subpeltata, breviter vel longe acuminata, $3\frac{1}{2}$–$7\frac{1}{2}$ poll. longa. *Paniculæ* solum in planta infima juxta humum enatæ (*A. Henry*). *Flores* masculi (feminei ignoti) virides (*A. Henry*), laxe paniculati, 1 lin. longi. *Petala* cylindrica, libera. *Drupæ* albidæ (*A. Henry*), globosæ, 2 lin. diam., in paniculis pyramidalibus densis, $2\frac{1}{2}$–$3\frac{1}{2}$ poll. longis dispositæ.

Yunnan: at 4000–5000 ft. in the Szemao forests, *A. Henry*, 12072, 12072 A, 12072 B, 12072 C.

Polygala floribunda, *Dunn*; a *P. arillata*, Ham., sepalis brevioribus, cristæque exsertione distincta.

Frutex 2–4-pedalis, glaber. *Folia* breviter petiolata, tenuia, lanceolata vel lanceolato-linearia, 5–8 poll. longa, acuminata, basi cuneata. *Flores* racemosi, 8–9 lin. longi, rosei vel purpurascentes, racemis densis terminalibus solitariis vel sæpius paniculas formantibus. *Sepala* valde inæqualia, alis et carina 5–6-plo superata. *Carinæ* crista laciniata, laciniis acutis. *Capsula* alata, orbicularis, retusa, 4 lin. longa. *Semina* nigra, pilis albis tecta, exalbuminosa.

YUNNAN: in grassy parts of the mountains on the edges of the forest at 6000–7000 ft. near Mengtze, *A. Henry*, 10511 A, 10511 B, 10511 C, 11079; *Hancock*, 79.

Polygala globulifera, *Dunn*; P. arillatæ, *Ham.*, accedens, sed foliis, cristis seminibusque diversa.

Frutex 6–8-pedalis, ramulis glabris vel pubescentibus. *Folia* membranacea, pilis minimis raris tecta, obovata, breviter acuminata, basi rotundata vel acuta, 4–9 poll. longa, petiolis brevibus. *Racemi* terminales vel foliis oppositi et eis multo breviores. *Flores* flavi, 8–9 lin. longi; pedicellis 4–6 lin. longis. *Sepalum* posterius 4 lin. longum, saccatum, ceteris 2 lin. longis, ovatis. *Alæ* 6–7 lin. longæ. *Crista* haud laciniata, plicata et convoluta, globulum formans. *Capsula* rubra, 6 lin. diam., late alata, pericarpio membranaceo, reticulato. *Semina* 3 lin. diam., omnino glabra, arillo ad dimidium obtecta.

YUNNAN: at 4000–6000 ft. in the forests south and south-east of Szemao, *A. Henry*, 12805, 12805 A.

Polygala saxicola, *Dunn*; in § *Chamæbuxo* habitu cæspito racemisque pedunculatis distincta.

Herba vel suffrutex humilis, multicaulis, 2–4 poll. alta. *Folia* breviter petiolata, conferta, tenuia, supra inter nervos sparse lanata, subter puberula, obovata vel oblonga, 1–2 poll. longa, brevissime acuminata vel apiculata, basi cuneata vel rotundata. *Flores* racemosi, 4 lin. longi, rosei vel albi; racemi densi, solitarii vel 2–3-aggregati, foliis breviores. *Sepala* inæqualia, cum petalis decidua; alæ quam cetera 3-plo longiores. *Petala* æqualia. *Carinæ* crista obtuse laciniata. *Capsula* alata, rotundata, retusa, $2\frac{1}{2}$ lin. longa. *Semina* arillata, nigra, pilis minutis albis tecta; albumen tenue.

YUNNAN: on damp shady rocks in woods near the Red River, *Hancock*, 469. On exposed dry rocks on the mountain-ridges at 6000–8000 ft. near Mengtze, *A. Henry*, 9169.

Bombax tenebrosum, *Dunn*; B. insigni, *Wall.*, floribus accedit, recedit foliis opacis pubescentibus, nervisque primariis approximatis.

Arbor 20-pedalis. *Foliorum* petioli pubescentes, 5–8 poll. longi, foliola sæpius excedentes; foliola 7–9, ovato-lanceolata, 5–7 poll. longa, acuminata, basi angustata; petioluli $\frac{1}{2}$ poll. longi; nervi primarii approximati, regulares. *Flores* 5–5$\frac{1}{2}$ poll. longi. *Calyx* 1$\frac{1}{2}$ poll. longus, lignosus, exterius pubescens, breviter et irregulariter lobatus. *Petala* fusco-rubra, lineari-oblonga, erecta; staminibus albis, sesqui-longiora. *Ovarium* conicum, pubescens, stylo rubro. *Fructus* immaturus 5-angulatus, glabrescens.

YUNNAN: in a very dry part of the forest west of Szemao, at 5000 ft., *A. Henry*, 12666.

Only one tree of this species was seen by Dr. Henry himself, and that only in bud, but its remarkable appearance induced him to send back collectors later in the season to secure flowers and fruit.

Hiptage minor, *Dunn*; H. arboreæ, *Kurz*, affinis, habitu longe distincta.

Frutex erectus, 2–3-pedalis vel rarius subscandens, glaber præter caules novissimos et inflorescentiam, cortice rimosa. *Folia* breviter petiolata, coriacea, glabra, ovato-lanceolata, 1$\frac{1}{2}$–3 poll. longa, acuminata, basi cuneata, venis utrinque prominentibus. *Racemi* axillares et terminales, foliis multo longiores. *Flores* fragrantes, pedicello 1–2-plo longiores, 5 lin. diam., pedicellis circiter medio articulatis, bibracteolatis, bracteolis deciduis. *Sepala* cum pedicello pedunculoque adpressa, tenuiter sericea, petalis 5-plo breviora, orbiculata. *Petala* alba, laminis rotundatis, fimbriatis. *Stamina* majora petalis paullo breviora. *Ovarium* pubescens. *Fructus* ex 1–3 carpellis trialatis factus, alis $\frac{1}{2}$–1 poll. longis tenuibus.

YUNNAN: covering rocks at 4500–4600 ft. at the base of the Mengtze mountains, *Hancock*, 421; *A. Henry*, 10792, 10792 A, 10792 B.

Indigofera scabrida, *Dunn*; a speciebus proximis indumento glanduloso distincta.

Frutex sesquipedalis, fere ubique glandulis rubris stipitatis nonnunquam densissime tecta. *Folia* pinnata, 2–4 poll. longa, stipulis linearibus, 2–3 lin. longis; foliola 7–9, subcoriacea, utrinque pilis brevibus appressis pubescentia, in margine subtusque in venis glandulosa, elliptica, $\frac{1}{2}$–1 poll. longa, apiculata. *Racemi* folia tandem longe excedentes, laxiflori; bracteæ lineares, 2 lin. longæ. *Flores* 4 lin. longi. *Calycis* dentes tubum excedentes. *Corolla* rubra, calycem ter longior, vexillo pubescente. *Ovarium* pubescens. *Legumen* glabrescens, ascendens, lineare, rectum, $\frac{3}{4}$–$1\frac{1}{4}$ poll. longum, acuminatum. *Semina* 6–8.

YUNNAN: in exposed grassy parts of the Mengtze mountains, at 4600-6000 ft., *A. Henry*, 9686, 9686 A, 9686 B; *Ducloux*, 533.

Lespedeza lanceolata, *Dunn*; L. cystisoides, *Benth.*, habitu huic proximat sed inflorescentia racemosa recedit.

Frutex, ramulis junioribus sparse appresse pilosis. *Folia* trifoliolata; petiol isubalati, 3–6 lin. longi; stipulæ lanceolatæ, membranaceæ, striatæ, persistentes, superiores longe acuminatæ, internodiis longiores; foliola chartacea, supra glabra, subter sparse sericea, lanceolata, 1–$1\frac{1}{2}$ poll. longa, apice basique acuta, stipellata, nervis lateralibus simplicibus, subter prominentibus, supra impressis. *Flores* albi, subumbellati, 3 lin. longi; pedunculi axillares, petiolis breviores; pedicelli calyce breviores; bracteæ parvæ, persistentes. *Calyx* sericeus, corollæ dimidium vix accedens, lobis 4, anguste triangularibus, tubum paulo longioribus. *Carina* obtusa, vix curvata, vexillum æquans, alis longior. *Stamen* vexillare liberum. *Legumen* reticulatum, glabrum, obovatum, apice rotundatum, basi cuneatum, 3–4 lin. longum.

HAINAN: Nam-Fom-See, *Ford*, 372.

Lespedeza latifolia, *Dunn*; a *L. velutina*, Dunn, foliis latioribus, calycis dentibus brevibus carinisque acutis differt.

Frutex 10-pedalis, caulibus petiolisque velutino-pubescentibus. *Folia* trifoliolata; petioli 1–2 poll. longi, internodiis longiores; stipulæ parvæ, triangulares, pubescentes; foliola coriacea, supra velutino-viridia, subter molliter cinerascentia, elliptica, $1\frac{1}{2}$–4 poll. longa, $\frac{3}{4}$–$2\frac{1}{2}$ poll. lata, apice rotundata vel retusa, mucronulata, basi rotundata vel obscure cordata. *Flores* purpurei, racemosi, breviter pedicellati, 5 lin. longi; racemi pauci in paniculam terminalem conferti; bracteæ lineares, sericeæ, caducæ. *Calyx* sericeus, corolla 3-plo brevior, lobis triangularibus, tubum æquantibus. *Carina* acuta, abrupte incurvata, vexillum alasque æquans. *Stamen* vexillare, liberum. *Ovarium* sericeum.

YUNNAN: Milê district, *A. Henry*, 9899.

Apios gracillima, *Dunn*; in genere inflorescentia distincta.

Herba volubilis, gracillima; caulis præter pilos in nodis paucos glaber. *Folia* pinnata, 5–7-foliolata, glabra vel in pulvinis pubescentia; foliola membranacea, utrinque obsolete reticulata, oblongo-linearia, $\frac{3}{4}$–1$\frac{3}{4}$ poll. longa, apice obtusa, mucronulata, basi rotundata. Flores in apicibus pedunculorum axillarium, foliis multo breviorum, bini, 6–7 lin. longi; bracteolæ minutæ. *Calycis* dentes laterales acuminati, deflexi, apicem lobi posterioris triangularis fere accidentes. *Corolla* purpurea; vexillum orbiculare, striatum, brevissime unguiculatum; carinæ apex abrupte incurvatus. *Ovarium* pubescens.

YUNNAN: Mengtze, at 6000 ft., *A. Henry*, 9828.

Spatholobus pulcher, *Dunn*; a *S. ferrugineo*, Benth., indumento, floribusque majoribus recedit.

Frutex alte scandens (*A. Henry*). *Caules* tomento tenui rubro tecti, teretes, robusti, lenticellos paucos inconspicuos ferentes. *Folia* trifoliolata, petiolos bis superantia; foliola coriacea, supra glabra, subter præcipue in nerviis hirsuta, ovata, apice sæpissime rotundata rare retusa vel breviter et obtuse acuminata, basi angustata, 3$\frac{1}{2}$–6 poll. longa, stipellis subulatis, persistentibus, 3 lin. longis. Flores in paniculis magnis terminalibus axillaribusque congesti, 4–5 lin. longi. *Calyx* pedicellum bis superans et cum illo olivaceo-velutinus, dentibus lanceolatis acutis tubum æquantibus. *Corolla* alba (*A. Henry*), calycem bis excedens. *Legumen* 2$\frac{1}{2}$–3$\frac{1}{2}$ poll. longum, reticulatum, molle præcipue ad margines.

YUNNAN: Szemao forests, 5000 ft., *A. Henry*, 12780.

Spatholobus suberectus, *Dunn*; species *S. Roxburghii*, Benth., affinis, dentibus calycinis floccisque sub foliolis distincta.

Frutex nunc erectus sexpedalis late extensus nunc alte scandens (*A. Henry*). *Caulis* tenuiter pubescens, lenticellis sparsis. *Folia* trifoliolata, petiolis sublongiora; foliola subcoriacea, pilos paucos breves et floccos in nerviorum axillis majoribus ferentes, ovata, acuminata, basi sæpe angustata, 4–8 poll. longa; stipellæ persistentes subulatæ, 2 lin. longæ. *Flores* nodosi, in paniculis magnis aphyllis terminalibus et axillaribus dispositi, 3–4 lin. longi. *Calyx* pedicello æqualis vel major, cum eo et pedunculo tenuiter griseo-pubescens; dentes tubo breviores, tribus inferioribus triangularibus obtusi, superiore latio truncato. *Corolla* alba (*A. Henry*), calyce bis longior. *Legumen* ignotum.

YUNNAN: Szemao, 4500–5000 ft., *A. Henry*, 11977, 11977 A, 11977 B, 13698.

In its occasional independence of support, when it forms a large bush, it differs from all previously known *Spatholobi*. In other respects it resembles *S. Roxburghii*, Benth., from which it can be distinguished by its different calyx-teeth and by the tufts in the vein-axils of its leaves.

Spatholobus varians, *Dunn*; species *S. purpureo*, Benth., affinis, nervis ascendentibus, stipellisque magnis divergens.

Frutex alte scandens (*A. Henry*), caulibus foliisque pilis adpressis sericeis deciduis, et pubescentia obscura adpressa persistente tectis. *Folia* trifoliolata, petiolis fere bis longiora; foliola subcoriacea, reticulata, nitentia, ovata vel obovata, basi sæpius cuneata, apice obtusa, apiculata vel breviter acuminata, 3½–9 poll. longa; nervi ascendentes intraque marginem procurrentes; stipellæ persistentes, 3–6 lin. longæ. *Paniculæ* axillares et terminales, laxæ. *Flores* 4–5 lin. longi. *Calyx* pedicello vix longior et cum eo pubescens; dentes tubo breviores, acuti vel obtusi. *Corolla* purpurea (*A. Henry*), calyce 3-plo longior. *Legumen* sericeum, 2½–3½ lin. longum.

YUNNAN: Szemao, mountain-forests, 5000 ft., *A. Henry*, 11771, 11771 A, 11771 C, 11771 D; Yulo Mountains, *A. Henry*, 11771 B.

Similar to *S. acuminatus*, Benth., which differs chiefly in its smaller stipels and its leaf-venation. The abundant material sent home by the collector under the above numbers was found to vary so much in the shape and size of its leaves and in the character of the calyx, that it seemed at first as if several species were present. A further examination, however, showed that the variations sometimes occurred on one and the same specimen.

Dolichos Lagopus, *Dunn*; inter species asiaticas leguminibus hispidis distinguitur.

Caules super frutices scandens (*A. Henry*), petiolique pilis brevibus luteis dense tecti. *Folia* trifoliolata, petiolis 1½–4-plo longiora; foliola subcoriacea, utrinque molliter hirsuta, ovata vel rhomboidea, acuminata, 2½–4½ poll. longa. *Racemi* axillares, petiolis breviores, vel extra-axillares sessiles. *Flores* conferti, 6–8 lin. longi. *Calyx* pedicello multo brevior, et cum eo pedunculoque griseo- vel luteo-hirsutus, dentibus tubus longioribus, lineari-lanceolatis superiore breviter bifido. *Corolla* purpurea (*A. Henry*), calyce vix longior. *Stamen* vexillare, basi appendiculatum. *Stylus* filiformis; stigma terminale, annulo pilorum brevium cinctum. *Legumen* lineare, hispidum, fulvum, apice griseo.

YUNNAN: Manpan, Red River, *A. Henry*, 11220; Szemao woods, 4500 ft., *A. Henry*, 12378.

Atylosia trichodon, *Dunn*; species *A. rostratæ*, Baker, carina rostrata floribusque striatis appropinquat, aliter longe distans.

Caulis scandens (*A. Henry*), petioli et folia puberuli. *Folia* trifoliolata, petiolos unifarie hirsutos circiter duplo excedentia; stipulæ lanceolatæ, 4–5 lin. longæ; foliola papyracea, ovata, longe acuminata, $1\frac{1}{2}$–3 poll. longa. *Racemi* axillares folia multoties excedentes, folia pauca parva et nonnunquam ramulum in parte inferiore ferentes. *Flores* per paria laxe dispositi, 5–7 lin. longi. *Calyx* pedicello subæqualis, et cum eo et pedunculis pilos fulvos longiores in pube exhibens; dentes tubo longiores; superior lanceolatus breviter bifidus, ceteri in acumina longa subiter angustati. *Corolla* calyce vix longior, vexillo luteo striato rubro (*A. Henry*). *Legumen* lineare, acuminatum, molliter pubescens.

YUNNAN: Szemao mountains, 5000 ft., *A. Henry*, 12474.

Rynchosia lutea, *Dunn*; R. sericeam, *Spreng.*, simulans, floribus magnis flavis differt.

Herba volubilis, caule striato puberulo. *Folia* trifoliolata, petiolis inclusis 4–8 poll. longa; foliola membranacea, præter nervis pubescentibus glabra, oblata, obtuse acuminata, 2–4 poll. longa; nervi utrinque prominentes; stipulæ parvæ, caducissimæ. *Flores* flavi (*A. Henry*), racemosi, 8–9 lin. longi; racemi laxi, foliis anthesi prima nunc sesquilongiores nunc breviores; bracteæ caducæ. *Calycis* sparse hirsuti dentes laterales tubo æquantes, superioribus paulo breviores, infimus tubo duplo superans. *Vexillum* orbiculatum, breviter appendiculatum. *Carina* incurvata, vexillo paullo brevior, alis longior. *Stamen* vexillare liberum. *Ovarium* 2-ovulatum. *Legumen* velutinum, virescens, 1–$1\frac{1}{4}$ poll. longum, inter semina contractum. *Semina* strophioli veri egentia, cærulescentia, nitida, 3 lin. diam.

YUNNAN: Mengtze, in woods and on rocky mountains, 4600–5700 ft., *A. Henry*, 9994, 9105 A.

Like several other species of this genus it has spherical seeds of a fine deep blue colour.

Euchresta tubulosa, *Dunn*; calyce cylindrico elongato inter species ceteras nota.

Suffrutex pedalis, ubique præter foliorum paginas superiores floresque puberula. *Folia* imparipinnata, bijuga, 3–4 poll. longa, petiolo bipollicari; foliola subtus pallida, papyracea, ovato-lanceolata, 2–3 poll. longa, utrinque acuta, omnia sessilia. *Racemi* 1–2, terminales, densiflori, prima anthesi 1½–2 poll. longi, pedunculis bipollicaribus. *Flores* 10 lin. longi, albi, præter calyces glabri. *Calyx* tubulosus; tubus infra petalorum staminumque insertionem 5 lin. longus, supra 2–3 lin. longus, sinuato-dentatus. *Vexillum* oblongum, retusum. *Ovarium* biovulatum, stipite 6 lin. longo. *Legumen* ignotum.

HUPEH: Nanto, *E. H. Wilson*, 1175.

Ormosia striata, *Dunn*; species *O. gracili*, Prain, magis accedens; inflorescentia simpliciter racemosa divergens.

Arbor 20–30-pedalis (*A. Henry*), præter alabastra calycumque paginas internas omnino glaber; ramulis pallidis; alabastris aurantiaco-tomentosis. *Folia* pinnata, 3–4-juga; foliola chartacea, ovato-lanceolata vel oblonga, 2–6 poll. longa, acuminata, ultimo obtusa, obscure reticulata. *Racemi* approximati in foliorum superiorum axillis, foliis breviores. *Flores* 5–6 lin. longi, racemorum in partibus superioribus bini collecti. *Calyx* amplus interne pubescens, dentibus ovatis obtusis, tubum æquantibus. *Corolla* lutescens (*A. Henry*), calyce 3-plo longior, vexillo striato. *Ovarium* stipitatum, 2–4-ovulatum. *Legumen* ovoideum, rostro obliquo, basi vel apice attenuatum secundum positionem ovulorum sterilium, 1–1½ poll. longum; valvæ lignosæ. *Semina* 1–2, rubra, ovata, 6 lin. longa.

YUNNAN: Szemao forests, 4000–5000 ft., *A. Henry*, 11886, 12843, 12979, 12979 A, 12979 B.

Cæsalpinia Morsei, *Dunn*; C. Bonducellæ, *L.*, affinis, sed floribus multo majoribus distinguenda.

Frutex subscandens. *Rami* 20–35-pedales, cum foliorum rachidibus, pedunculisque aculeis parvis sæpe uncatis armati, brunneo-pubescentes. *Folia* bipinnata, ambitu ovata, 1–2-pedalia, alterna; pinnæ circiter 16, aculeis parvis fortiter uncatis præcipue inter foliola provisæ; foliola elliptica, 1–1½ poll. longa, utrinque rotundata, apice apiculata, supra subglabra, subter puberula, in paribus 6–12 disposita. *Flores* sæpius racemosi, racemis terminalibus, multifloribus, circiter 1 poll. longi; bracteæ magnæ, ovatæ, deciduæ; pedicelli floribus æquales. *Calyx* mollis, tubo brevi, lobis oblongis rotundatis. *Corolla* pubescens, calyce sesquilongior, albida præter carinam rubro notatum. *Staminum* filamenta lanuginosa. *Legumen* immaturum oblongum, 3–4 poll. longum, aculeis rectis ad ½ poll. longis dense armatum.

YUNNAN: Szemao, North-west mountains, at 5000 ft., *Henry*, 10739; KWANGSI: Lungchow in hedges, *Morse*, 303; TONKIN, in woods, *Balansa*, 2145.

Albizzia bracteata, *Dunn*; A. glomerifloræ, *Kurz*, affinis foliis distincta.

Arbor 12–20-pedalis (*A. Henry*), ramulis foliisque puberulis, inflorescentia pubescente. *Folia* bipinnata, 8–15 poll. longa, glandulis magnis juxta petiolorum bases provisa; pinnæ 2–6, 3–6-jugæ; folia subsessilia, papyracea, ovato-rhomboidea, 1–3 poll. longa, apiculata, venis utrinque prominulis. *Flores* in racemis condensatis longe pedunculatis solitariis fasciculatisve dispositi; glomerulæ corymbas terminales axillaresque formantes; bracteæ cochleariformes, post anthesin deciduæ. *Calyx* pubescens. *Corolla* alba (*A. Henry*), calyce bis longior, staminibus 4-plo superata, extus pubescens. *Legumen* lineare, 4–13 poll. longum, planum, præcipue super semina reticulatum, fortiter marginata, basi cuneata, apice rotundata. *Semina* 4–9, brunnea, discoidea, 4 lin. diam.

YUNNAN: by streams in the Mengtze plain, *W. Hancock*, 304; Mengtze, Szemao, *A. Henry*, 9997, 9997 D, 9997 E.

Pygeum Henryi, *Dunn*; inter species alias *P. stipulaceo*, King, affinis, sed stipulis obscuris et calyce intus glabro differt.

Arbor 15–30-pedalis (*A. Henry*), ramulis ferrugineo-pubescentibus, tarde glabris, lenticellatis. *Folia* alterna, breviter petiolata, stipulis obscuris, coriacea, infra et in venis supra ferrugineo-pubescentia, tarde subglabra, oblongo-lanceolata, 5–9 poll. longa, lente acuminata vel acuta, basi rotundata, auriculas duas parvas infra cavas ferentia vel breviter cuneata, margine integro, involuto, venis subter prominentibus. *Flores* albi (*A. Henry*), brevipedunculati (rarius sessiles) in racemis (rarius spicis) in axillis foliorum veteriorum sæpe jam dejectorum, 3–4 lin. diam. *Calyx* 10-dentatus, dentibus parvis acutis, extus cum pedunculis fulvo-pubescens, intus glaber. *Petala* obsoleta. *Stamina* 10, alterna basi bulbosa. *Ovarium* pubescens, cum stylo 2 lin. longum. *Drupa* crustacea, ovoidea, 4 lin. longa. *Semen* 1, cotyledones semi-globosi.

YUNNAN: Szemao, forests, 4500–5000 ft., *A. Henry*, 12313, 12313 A, B, 12708.

Cratægus Henryi, *Dunn*; C. pinnatifidæ, *Bunge*, affinis, foliis indivisis differt.

Arbor 10–20-pedalis (*A. Henry*), fere undique glabra, ramulis pallidis vel rubris, inermibus. *Folia* graciliter petiolata, coriacea, subter secus rhachin sparse pilosa, cetera glabra, lanceolata vel ovata, $1\frac{1}{2}$–3 poll. longa, apice basique subacuta, crenato-serrulata, parte inferiore sæpe integra; petioli 3–8 lin. longi. *Flores* albi (*A. Henry*), glabri, vel circa stylos pubescentes, 7–8 lin. diam., corymbis sessilibus subumbellatis circiter 15-floris dispositi; pedicelli floribus vix longiores; bracteæ lineares, denticulatæ, caducæ. *Calycis* lobi ovati, acuminati, tubo et petalis dimidio breviores, persistentes. *Petala* orbicularia, 2–4 lin. lata, staminibus paullo longiora. *Ovarium* omnino inferum, apice nonnunquam pubescens; styli 3, liberi. *Drupa* rubra, globosa, 7 lin. diam., 5-lobata; pyrenæ 5, vix separabiles, dorso teretes.

YUNNAN: Mengtze, 5000 ft., *A. Henry*, 9426.

This fine Hawthorn is remarkable for its large red fruit and toothed, not lobed, leaves.

CRYPTOTÆNIOPSIS, *Dunn*, *in Hook. Ic. Pl.* t. 2737.

1. **C. vulgaris**, *Dunn, in Hook. Ic. Pl.* t. 2737.—Ind. or.; China.

[Boissieu (Bull. Herb. Boiss. 2me sér. ii. (1902) p. 806) has erroneously referred this species to *Pternopetalum Davidi*, Franch. (Nouv. Arch. Mus Par. 2me sér. viii. (1885) p. 246, t. 8. fig. B). In the former the ovaries are nearly twice as long as broad, and the mericarps subterete with obscure ridges; in the latter, on the other hand, the ovary is shorter than broad, and the mericarps much laterally compressed with 5 conspicuous denticulate ridges or wings; the leaflets, also, are of different shapes.—*C. H. W.*]

2. **C. botrychioides**, *Dunn*; C. vulgari, *Dunn*, foliorum segmentis latis affinis, segmentorum numero incisioneque distincta.

Herba perennis, glabra, 6–18 poll. alta; rhizoma obliquum, 1–2-caule, radicibus fusiformibus. *Caules* simplices. *Folia* radicalia minora simpliciter ternata foliolis ovatis, majora et floralia in tres partes infra pinnatas apice caudatas pinnatifidas divisa; foliola membranacea, $\frac{1}{2}$–$2\frac{1}{2}$ poll. longa, crenato-serrata, serraturis apiculatis; folia floralia sessilia, ceterorum petioli 1–3 poll. longi, breviter sed late vaginantes. *Umbellæ* 1–2, terminales, 6–30-radiatæ; radii sub anthesi 1–4 lin. longi, fructiferi pollicares; bracteæ involucrales 1 vel 0. *Flores* 2 lin. diam. *Calycis* dentes ovario paullo breviores, lineares. *Petala* late obovata, biloba, acumine inflexo. *Fructus* 1 lin. longus; stylopodium fructu 4–5-plo brevius; valleculæ 3-vittatæ.

SZECHUEN: Mt. Omei at 8000 ft., *Faber*, 629; West Szechuen at 9000-13,500 ft., *Pratt*, 839.

3. **Cryptotæniopsis leptophylla**, *Dunn*; C. filicinæ, *Boissieu*, affinis, foliis inter se consimilibus distincta.

Herba perennis 7–10 poll. alta. *Rhizoma* horizontales. *Caulis* unica simplex. *Folia* radicalia tripinnatifida, ambitu lanceolata, breviter lateque vaginata, petiolis 3–5 poll. longis; lobi lineares acuti, margine involuto setuloso, aliter glabri. *Umbella* terminalis, 12–18-radiata; radii fructiferi 8–9 lin. longi, exinvolucrati. *Umbellulæ* irregulares, trifloræ; involucella 2–3-bracteata. *Flores* ignoti. *Mericarpia* teretia, 1 lin. longa; stylopodia brevia; valleculæ 1-vittatæ.

SZECHUEN: ravine on Mt. Omei, 4000 ft., *Faber*, 628.

4. **C. filicina**, *Boissieu, in Bull. Herb. Boiss.* sér. II. ii. p. 806. Carum filicinum, *Franch. in Bull. Soc. Philom. Paris*, sér. VIII. vi. (1894) p. 127. Pimpinella filicina, *Diels, in Engl. Jahrb.* xxix. (1900) p. 494.—HUPEH, *A. Henry*, 6600!

5. **C. cardiocarpa**, *Dunn.* Carum cardiocarpum, *Franch. in Bull. Soc. Philom. Paris*, sér. VIII. vi. (1894) p. 120.—YUNNAN, *Delavay*, 3907!

6. **C. Delavayi**, *Dunn.* Carum Delavayi, *Franch. in Bull. Soc. Philom. Paris*, sér. VIII. vi. (1894) p. 120.—YUNNAN, *Delavay*, 97!

7. **C. Tanakæ**, *Boissieu, in Bull. Herb. Boiss.* sér. II. ii. (1902) p. 806. Chamæle Tanakæ, *Franch. & Savat. Enum. Pl. Jap.* i. p. 185. Pimpinella Tanakæ, *Diels, in Engl. Jahrb.* xxix. (1900) p. 494. Carum Tanakæ, *Franch. & Savat.* l. c. ii. p. 571.—Tibet; China; Japan.

8. **Cryptotæniopsis mollis**, *Dunn*. Carum molle, *Franch. in Bull. Soc. Philom. Paris*, sér. VIII. vi. (1894) p. 120.—YUNNAN, *Delavay*, 4095!

9. **C. asplenioides**, *Boissieu, in Bull. Herb. Boiss.* sér. II. ii. (1902) p. 807.—SZECHUEN: Tchenkeoutin, *Farges*.

Œnanthe rivularis, *Dunn*; a *Œ. lineari*, Wall., foliis longe-petiolatis, brevi-vaginatis, tenuius dissectis differt.

Herba erecta, præter inflorescentiam scaberulam glabra, 2-pedalis. *Rhizoma* repens, gracile, caulem radicesque fibrosas nodis emittens. *Caulis* fistulosus, simplex vel pauciramosus. *Folia* pinnata, rarius bipinnata, ex vagina brevi petiolata, inferiorum segmentis ovatis acute inciso-serratis, superiorum linearibus paucis. *Umbellæ* 6–7-radiatæ, pollicares; bracteæ 0. *Umbellulæ* multifloræ; bracteolæ multæ, lineares, breves. *Calycis* dentes breves, lanceolatæ, deciduæ. *Petala* alba, obovata, acumine inflexo. *Fructus* globosus, 1 lin. diam.; juga primaria dorsalia incrassata valleculas tegentia, lateralia multo majora.

YUNNAN: Mengtze, in moist places, often in small rills, *A. Henry*, 10822.

Œnanthe sinensis, *Dunn*; ab *Œ. rivulari*, Dunn, fructu facile distincta.

Herba uliginosa, præter inflorescentiam minute scabridam, glabra, 1–3-pedalis, basi procumbens, radicans. *Caulis* fistulosus simplex vel rarius pauciramosus. *Folia* caulium longiorum fertilium ex vagina brevi petiolata, pinnata, inferiorum pinnis pluribus lineari-lanceolatis pinnatifidis, superiorum paucis linearibus. *Umbellæ* 4–6-radiatæ, 1–1½ poll. diam.; bractea 0 vel brevis vel rarius umbellam superans. *Umbellulæ* multifloræ; bracteolæ multæ, lineares, flores vix æquantes. *Calycis* dentes breves, lanceolatæ, persistentes. *Petala* alba, obovata, acumine inflexo. *Fructus* oblongus, cylindricus, 2½ lin. longus; juga primaria dorsalia incrassata, valleculis angustis separata, lateralia majora.

HUPEH: Ichang, rice-fields, *A. Henry*, 1663, 4089; SZECHUEN: Min River, *Faber*, 874.

Common in the Ichang prefecture and known locally as *shui-ch'in ts'ai*, or *Water-celery*.

Peucedanum medicum, *Dunn*; a *P. terebinthaceo*, Fisch., fructu majore, commissura plurivittata distincta.

Herba perennis, præter inflorescentiam glabra vel puberula, 2–4-pedalis. *Rhizoma* magnum, ramosum, vaginis petiolaribus vestitum. *Caulis* ramosus. *Folia* inferiora biternata, ex vagina brevi ovata, petiolata, 5–18 lin. longa, segmentis irregulariter incisis, lobis acuminatis, subter glaucis, ½–3 poll. longis, superiora similia, minora autem minusque dissecta. *Umbellæ* ramos terminantes, puberulæ, 2–6 poll. diam., 8–30-radiatæ, bracteæ 0. *Umbellulæ* multifloræ, bracteolæ multæ, lineares. *Calycis* dentes parvi. *Petala* ovata, acumine inflexo. *Fructus* glabri vel puberuli, 2½–3 lin. longi; mericarpia oblonga, dorso compressa, jugis dorsalibus filiformibus, lateralibus valliculas duplo superantibus, crassiusculis; vittæ dorsales jugis latiores, commissurales 4–10, regulares contigua.

HUPEH: Fang, *A. Henry*, 5868 A, Ichang, *A. Henry*, 1546, 2006, Nanto, *A. Henry*, 1906; SZECHUEN: South Wushan, *A. Henry*, 7473. Hort. Kew. culta.

Dr. Henry writes that this is common in the country near Ichang and in the mountains north and south of that place. The root is collected by the Chinese, and is apparently the drug of the *Pêu Ts'ao* Herbal, known as *Ch'ien-hu*.

Peucedanum præruptorum, *Dunn*; a *P. terebinthaceo*, Fisch., foliis sessilibus, commissura plurivittata differt.

Herba perennis, 1–3-pedalis. *Radix* magna fusiformis vel ramosa, fibris petiolaribus coronata, 1–(2-) caulis. *Caulis* ramosus, summus pubescens aliter glaber vel puberula. *Folia* subglabra, inferiora in vaginis ovatis sessilia biternata, segmentis 1–3 poll. longis, basi cuneatis, irregulariter incisis, lobis acuminatis, superiora similia, gradatim minora, minusque dissecta. *Umbellæ* ramos terminantes, 2–4 poll. diam., 6–16-radiatæ, bractea linearis vel 0. *Umbellulæ* multifloræ; bracteolæ multæ, ovatæ, acuminatæ, vel lineari-lanceolatæ. *Calycis* dentes minimi. *Petala* ovata, acumine inflexo. *Fructus* glaber vel puberulus, 1¼–1½ lin. longus; mericarpia orbicularia, dorso compressa, jugis dorsalibus filiformibus, lateralibus valliculas eorum æquantibus, crassiusculis, obtusis; vittæ dorsales, jugis latiores, commissurales 6–10, irregulares, superficiales.

HUPEH: Ichang, *A. Henry*, 2911, Changyang, *A. Henry*, 7505; SZECHUEN: North Wushan, *A. Henry*, 7475.

The root of this species is, Dr. Henry states, used in medicine and is the officinal drug known as *Fang-fêng*. It is also called

Ai-fêng, a contracted form of *Ai-fang-fêng* and meaning *Cliff Fang-fêng*, which suggested the trivial name *præruptorum*.

Aralia Searelliana, *Dunn*; ab *A. dasyphylla*, Miq., floribus pedicellatis differt.

Arbor 15-pedalis. *Folia* bipinnata, ad 8 ped. longa, in omnibus partibus fulvo-strigosa; petioli aculeis paucis armati; foliola sessilia, præter ea juxta rachidis nodos brevipetiolata, ovata, acuminata, cordata, 7–8 poll. longa, serrata. *Paniculæ* corymbosæ, ad 6 ped. longæ, ubique præter flores et antice bracteas, strigis aculeisque fulvis vestitæ, bracteis 4–15 lin. longis. *Flores* umbellati, bracteis sæpe superati 1–1½ lin. longi, pedicellis 3–4 lin. longis. *Sepala* 5, ovata, decidua. *Petala* 5, viridula, alabastro imbricata. *Ovarium* 4–5-loculare; styli 4–5, liberi.

YUNNAN: between Puerh and Szemao and in forests south of Szemao, at 4000 ft., *A. Henry*, 13426.

I have the honour to commemorate in connection with this fine *Aralia* the name of Miss Searell, who devoted some time to the study of botany during the period of her missionary work in China, a work in which she nobly sacrificed her life during the recent Boxer risings.

Pentapanax verticillatum, *Dunn*; a *P. parasitico*, Seem., foliis ternatis, floribusque verticillatis differt.

Frutex tripedalis, cortice levi papyraceo. *Folia* glabra, trifoliolata, petiolos duplo excedentia, exstipulata; foliola subcoriacea, ovata, 2–3 poll. longa, apice basique subito acuta, supra reticulata, subtus glauca, margine integro revoluto. *Panicula* rubropubescens, 2–3 poll. longa, sæpius in parte inferiore ramosa, basi rachidis et ramorum bracteis magnis cymbiformibus membranaceis induta; umbellæ in rachidi et ramis terminales et etiam laterales sessiles verticilla simulantes. *Flores* rubri, pedicellis articulati, bracteolati; pedicellis 3–6 lin. longis, bracteatis. *Sepala* 5, parva, dentiforma. *Petala* 5, in alabastro leviter imbricata. *Ovarium* 5-loculare; stylus in fructu juvenili simplex. *Fructus* maturus ignotus.

YUNNAN: Mengtze, south-west mountains at 7000 ft., *A. Henry*, 9284.

Heptapleurum Hoi, *Dunn*; H. racemoso, *Bedd.*, affinis, foliolis oblongis, panicula majore floribusque minoribus distincta.

Folia glabra, digitata, petiolos excedentia; foliola subcoriacea, oblonga, acuminata, basi rotundata vel acuta, 2–7 poll. longa, subtus glauca, virescentia, petiolulo 3–10-plo longiora, margine integro revoluto. *Panicula* sesquipedalis, tomento laxo rubro vel in calycibus albo vestita. *Flores* racemosi, 1–1½ lin. longi. *Sepali* 5, inconspicua. *Petala* 5, in alabastro leviter imbricata. *Ovarium* 5-loculare; styli connati.

YUNNAN: south of Red River from Manmei at 6000 ft., *A. Henry*, 9723.

The trivial name commemorates the services of Dr. Henry's most valued native collector *Ho*.

Heptapleurum macrophyllum, *Dunn*; in inflorescentia a *H. hypoleuco*, Kurz, differt.

Arbor 15–30-pedalis. *Folia* digitata, petiolis paullo excedentia; foliola 7, coriacea, ovato-oblonga, breviter acuminata, basi rotundata vel cordata, 7–19 poll. longa, supra glabra, subtus albo-tomentosa, petiolis 2–4-plo longiora, margine revoluto, integro vel obscure serrato. *Panicula* magna, tomento rubro deciduo vestito; rami basi bracteis ovatis acuminatis 3–15 lin. longis voluti; umbellæ in racemos longos cylindricos dispositæ; flores umbellati, 2–2½ lin. longi. *Sepala* 5, dentiformia. *Petala* 5. *Ovarium* 5-loculare; styli connati, stigmatibus apice radiantibus.

YUNNAN: high forests near Szemao, *A. Henry*, 13409.

Heptapleurum productum, *Dunn*; H. Wallichianum, *C. B. Clarke*, quoad inflorescentia propinquat, foliis longe recedit.

Arbor 10-pedalis. *Folia* glabra, digitata, petiolis subæquilonga; foliola 11, subcoriacea, lanceolata, longe acuminata, basi acuta, 3–7 poll. longa, utrinque reticulata, petiolis 4-plo longiora; margine revoluto serrato. *Panicula* pedalis, tomento rubro deciduo vestita. *Flores* umbellati, 3–4 lin. longi. *Sepala* 5, dentiformia. *Petala* 5, alba, in alabastro leviter imbricata. *Ovarium* 5-loculare; styli sub anthesi in conum brevem cohærentes.

YUNNAN: Mengtze mountains at 5000 ft., *A. Henry*, 9350.

Brassaiopsis ciliata, *Dunn*; a *B. miti*, C. B. Clarke, foliorum lobis oblongis ciliatis distincta.

Frutex 4-pedalis. *Folia* papyracea, supra et in venis infra sparse setosa, rotundato-cordata, palmatifida, 6–11 poll. longa, ciliato-serrata; lobi palmam bis excedentes, oblongi, acuminati, sinibus rotundatis divisi; petioli foliis subæquales, striati, setoso-aculeati; stipulæ in vaginam membranaceam pollicarem connatæ.

Umbellæ in rhachidem 7 poll. longam racemose dispositæ; rhachis ramique aciculis sparsis armati. *Fructus* ater, didymus, stylum longum bifidum (ante stigmatorum decessum) ferens: pedicelli bracteati, 4–6 lin. longi.

YUNNAN: Mengtze, mountain-forests at 5000 ft., *A. Henry*, 9180 A.

Brassaiopsis ficifolia, *Dunn.* *Frutex* nunquam erectus, sed super humum 3–4 pedes extensus, cortice pallido lenticellato, aculeis paucis rectis armato. *Folia* membranacea, triloba vel rarius 4–6-loba, cordata, lobis ovatis, acuminatis, basi angustatis, palmam 2–4-plo excedentibus, sinibus rotundatis, supra glabra, subter pallida, obscure et sparse stellato-pubescentia, serrata, petiolo glabro paullo longiora; stipuli obtusi, ultra vaginam petiolarem breviter producti, connati vel distincti. *Inflorescentia* foliis brevior, rubro-pubescens, inermis. *Umbellæ* in rachidi brevi racemose vel rarius paniculate dispositæ. *Flores* albi. *Sepala* obscura. *Petala* 5, valvata. *Stamina* 5. *Discus* sub anthesi convexus, in fructu planus. *Ovarium* 2-loculare; columna stylaris apice bilobata. *Fructus* vix maturus didymus, 4 lin. diam.

YUNNAN: common along the rocky banks of streamlets in the shade in the forests near Szemao, *A. Henry*, 11650, 12653, 12653 A, 12653 B. TONKIN: *Balansa*, 3490.

Oreopanax chinense, *Dunn*; species gerontogæa unica.

Arbor 30-pedalis. *Folia* digitata, petiolo æquilonga; foliola 6, subcoriacea, ovata, breviter acuminata, minora 3–7 poll. longa, supra glabra, subter sparse stellato-tomentosa alba, margine integro leviter revoluto, petiolulos 5-plo longiora. *Infructescentia* indumento stellato pulverulenta; umbellæ in ramis longis a rachidi brevi descendentibus, terminalia 1–1½-pollicaria, cetera minora in ramis brevibus secundariis disposita. *Fructus* bracteati, brevipedunculati, globos densos formantes, angulati, 3 lin. diam., 5-loculares, endocarpio membranaceo; discus explanatus, annulo calycis cinctus; stylorum columna stigmatibus 5 radiantibus coronata; semina ovoidea, albumine ruminato.

YUNNAN: Szemao, forests at 4500 ft., *A. Henry*, 12939.

The genus was hitherto known only from Tropical America.

Vernonia Henryi, *Dunn*; in genere ob floris aureis *V. Fargesii*, Franch., solum comparanda, ab hac longe remota.

Frutex scandens. *Caulis* angulatus, striatus, tenuiter tomentosus. *Folia* alterna, chartacea, late angusteve ovata, 3–4 poll. longa, acuminata, basi in petiolum brevem subito contracta, trinervia, integerrima, preæcipue subtus in nervis sparse pubescens, utrinque leviter reticulata, glandulis sessilibus nitentibus conspersa. *Capitula* in ramulorum finibus confertim 3–7na corymbosa, multiflora, fragrantia, 5–7 lin. diam. *Involucra* campanulata; bracteæ multiseriatæ, oblongæ, acutæ, leviter lanuginosæ. *Flores* involucro vix duplo longiores; receptacula foveolata. *Corolla* aurea, extus glandulosa. *Achænia* cylindrica, striata, hirtella; pappi setæ præcipue apice hirtæ, exteriores paucæ breviores.

YUNNAN: Linan at 5000 ft., *A. Henry*, 13343. "Only seen once on a march between Szemao and Mengtze, climbing over low shrubs."

Vernonia sylvatica, *Dunn*; a *V. scandente*, DC., pappo longo albo distincta.

Frutex alte scandens. *Ramuli* cylindrici, striati, cum petiolis, foliorum venis, pedunculis involucrisque rufo pubescentes. *Folia* alterna, breviter petiolata, chartacea, ovata vel oblonga, 3–6 poll. longa, acuta, acumine obtuso, mucronato, basi obliqua rotundata, integerrima, utrinque leviter reticulata, præter nervos glabra, glandulis immersis conspersa. *Capitula* in paniculis magnis terminalibus disposita, circiter 10-flora, 3-5 lin. diam. *Involucra* 1–2 lin. longa; bracteæ pluriseriatæ, lanceolatæ, acutæ. *Flores* purpurei, involucro 3–4-plo longiores. *Achænia* glabra; pappi setæ subleves, albæ, involucro 3-plo longiores, exteriores multæ, breves.

YUNNAN: forests of the Red River at Mengtze from 6000 to 7000 ft., *Hancock*, 470; Mengtze and Szemao forests, 4500–5000 ft., *A. Henry*, 11051, 11697, 11697 A.

Aster nigromontana, *Dunn*; ab *A. trinervio*, Roxb., involucro laxo, bracteis internis denticulatis distinguenda.

Caulis striatus, flexuosus, infra inflorescentiam glaber. *Folia* superiora sessilia, chartacea, ovata, acuminata, basi angustata, 4–6 poll. longa, grosse apiculato-serrata, supra hirtis paucis strigosis sparsa, aliter glabra; inferiora non visa. *Capitula* late corymbosa, 8–10 lin. diam., pedunculis pubescentibus, bracteolatis. *Involucra* campanulata, 3 lin. longa; bracteæ lineares, 2–3-seriatæ, laxæ, margine scariosæ, denticulatæ, puberulæ, apice purpureæ, acutæ vel exteriores obtusæ, ex duplo breviores. *Corollæ* ligulatæ, multæ, involucro duplo longiores; laminæ patentes. *Achænia* immatura hirtella.

YUNNAN: obtained by Henry's native collector *Ho* on the summit of Great Black Mountain at 8000 ft. near Mengtze, *A. Henry* 11302.

Aster tenuissimus, *Dunn*; inter species asiaticas habitu erecto tenuissimo distincta.

Herba erecta, subsimplex, 4-pedalis. *Caulis* striatus, subter glaber, supra pedunculisque hirtellus. *Folia* papyracea, inferiora lanceolata, obtusa, mucronata, basi in petiolis gradatim angustatis et cum eis 4–5 poll. longis, pauciserratis, basi apiceque integris, subglabris; superiora minora, brevius petiolata vel sessilia, integriora. *Capitula* in ramis erectis brevibus hirtellis racemose disposita, paniculam laxam angustam sesquipedalem formantia, 4–5 lin. diam. *Involucra* campanulata, 3 lin. longa; bracteæ 3–4-seriatæ, interiores acutæ, exteriores breves obtusæ, omnes denticulatæ, laxæ, margine scariosæ, dorso hirtellæ, costa fusca impressæ. *Corollæ* ligulatæ paucæ, involucro duplo longiores, ascendentes. *Achænia* immatura subglabra.

YUNNAN: *Ducloux*, 754.

Conyza pinnatifida, *Dunn*; a *C. ægyptiaca*, Ait., foliis regulariter pinnatifidis distincta.

Herba annua, 1–3-pedalis, strigosa atque simul laxe hirsuta. *Caulis* striatus, simplex vel pauciramosus. *Folia* sessilia, papyracea, ambitu ovata, 1½–3 poll. longa, pinnatifida, segmentis sæpissime linearibus, integris vel pauciserratis. *Capitula* in paniculis caules ramosque terminantibus disposita, 5–7 lin. diam. *Involucra* campanulata, 4 lin. longa; bracteæ lineares, acutæ, multiseriatæ, exteriores breviores. *Flores* flavi. *Achænia* compressa, ecostata, florum ♀ glabra, ☿ hirtella; pappus uniseriatus.

YUNNAN: common on the grass mountains near Mengtze at 6000 ft., *A. Henry*, 9982 A, Szemao, *A. Henry*, 12176, and at Yunnanfu, *Ducloux*, 128.

Blumea gracilis, *Dunn*; inflorescentia ei *B. glomeratæ*, DC., similis, sed foliis distincta.

Herba monocarpica, 1½–2-pedalis. Caulis erectus, strictus, simplex, scaber et superne etiam glandulosa. *Folia* sessilia, coriacea, lineari-lanceolata, obtusa, mucronata, basi attenuata, revoluta, utrinque scabra, margine denticulis distantibus notata, superiora minora. *Capitula* in racemo longiusculo interrupto vel in apice caulis congesta, 3–4 lin. diam., pedunculis longiora. *Involucra* campanulata, 3–4 lin. longa; bracteæ lineares, acutæ, multiseriatæ, exteriores gradatim minores, costis glanduloso-scabridis. *Flores* flavi, bracteis subæquales. *Corollæ* ♀ filiformes. *Achænia* immatura pubescens.

YUNNAN: in wet places in the open parts of a river-ravine near Szemao, *A. Henry*, 12526.

Blumea Henryi, *Dunn*; a *B. balsamifera*, DC., capitulis magnis, indumentoque distincta.

Herba plerumque 3–6-pedalis, basi frutescens. *Caules* juniores, foliorum paginæ inferiores, et pedunculi densissime sericei. *Folia* sessilia, membranacea, obovata, 8–15 poll. longa, acuta, basi angustata, margine sæpius denticulis distantibus notata, nonnunquam etiam grosse dentata, supra subglabra. *Capitula* in paniculam sæpe magnam sesquipedalem collecta, pedicellata vel sessilia congesta, 6–10 lin. diam. *Involucra* hemisphærica, 5–6 lin. longa; bracteæ lineares, acutæ, exteriores breviores, omnes dense sericeæ. *Corolla* flava, florum ♀, ☿, et neutrorum extus pubescens. *Achænia* puberula.

YUNNAN: Mengtze and Szemao, *A. Henry* 10405, 10405 B.

Dr. Henry first saw this splendid plant at Szemao in dark ravines at about 4000 ft. elevation; some plants were as much as 10 ft. high to the first branch, but average specimens were 3–6 ft. high in all.

Senecio dididymantha, *Dunn*; a *S. tangutica*, Maxim., foliis distincta.

Herba 2–4-pedalis. *Caulis* striatus, subsimplex, præter partem floriferam glaber. *Folia* chartacea, utrinque puberula, glabrescentia, deltoidea, basi infra angulos laterales 1–2-lobata vel rotundato-cordata dentata, petiolo 1–2 poll. longo, media 4–5 poll. longa, æquilateralia, acuta, inferiora æquilonga, 6–8 poll. lata, obtusa, superiora minora. *Capitula* numerosissima, brevi-pedunculata, radiata, sæpius 4-flora, 8 lin. diam., paniculam magnam formantia; pedunculi pubescentes; bracteæ sæpissime 3, oblongæ, apice obtusæ. *Flores* radii sæpissime 2, bracteis sesquilongiores vel duplo longiores, basi et in pedunculo brevi bracteolis paucis minimis provisi; flores disci sæpissime 2, bracteis subæquilongi, corolla infundibuliformi lanceolato-dentata, antheris sagittatis, styli ramis complanatis apice breviter penicillatis, achæniis immaturis glabris; pappo albo.

SZECHUEN: near Tachienlu, *Pratt*, 432, *A. Henry*, 8920.

Senecio Dryas, *Dunn*; in speciebus asiaticis *S. farfaræfolio*, Boiss., solum distantes propinquet.

Herba caule, petiolis, pedunculis, involucrisque rufo-tomentosis. *Caulis* brevis folia pedunculumque uniflorum apice ferens. *Folia* subcoriacea, infra marginibusque sparse tomentosa, mox glabra, rotunda, palmatim 7-loba, cordata, 2–3 poll. longa, sinu angusto, lobis triangularibus, obtusis, mucronatis, petiolis 3–4 poll. longis. *Capitulum* radiatum, multiflorum, $1\frac{1}{2}$ poll. diam.; pedunculus 14 poll. longus, paucibracteolatus. *Involucrum* turbinatum, 5–6 lin. longum; bracteæ circiter 10, lanceolatæ, acutæ, interiores late marginatæ, bracteolis paucis linearibus brevioribus. *Flores* lutei, radii 7–8, bracteis duplo longiores, ligulis oblongis, multinervis, apice obtusis, denticulatis, disci bracteis paullo longiores, corolla infundibuliforme, dentibus linearibus, antheris basi auriculatis, styli ramis papillosis, apice obtusis, breviter penicillatis; achænia striata, glabra; pappo albo.

SZECHUEN: South Wushan, *A. Henry*, 5697. Seen only once, in the forest, growing on rocks; Boissier's species, with which it is here compared, grows in similar situations in Cilicia.

Senecio Duclouxii, *Dunn*; S. Bhot, *C. B. Clarke*, forsan appropinquans, sed ab hac et ceteris speciebus asiaticis corymbo capitulorum radiatorum inter folia superiora immerso distincta.

Frutex caule striato glabro. *Folia* apice caulis conferta et inflorescentiam multo excedentia, chartacea, supra glabra, subter sparse puberula, ovato-lanceolata, acuta, basi in petiolum brevem attenuata, 5–7 poll. longa, supra medium paucidentata, dentibus apiculatis, venis subtus prominentibus. *Capitula* numerosa, radiata, multiflora, corymbosa, 6 lin. diam., pedunculis pubescentibus bracteolatis. *Involucra* anguste campanulata, sparse lanuginosa, 3 lin. longa; bracteæ interiores 8, acutæ, exterioribus paucis brevibus. *Flores* flavi; radii 6–10, bracteis duplo longiores, ligula lanceolata, apice obtusa; disci 8, bracteis sesquilongioribus, corolla infundibuliformi, lobis acuminatis, apice reflexis; antheris caudatis; styli ramis papillosis apice penicillatis. *Achænia* glabra, pappo albo.

YUNNAN: Yunnanfu, *Ducloux*, 658.

Senecio (§ **Ligularia**) **fibrillosus**, *Dunn*; a *S. subspicato*, Franch., capitulis majoribus longiusque pedunculatis distincta.

Herba perennis, 1–2-pedalis, præter pedunculos involucraque sparsissime lanuginosos glabra. *Caulis* simplex, striatus, basi fibrillosus. *Folia* chartacea, 1–3 poll. longa, crebre et acute dentata; inferiorum petioli 5–7 lin. longi, superiorum breviores, omnes basi in vaginam oblongam dilatati. *Capitula* numerosa, discoidea, 7–10-flora, racemosa, bracteata, 4 lin. diam., mediorum pedunculis 4–6 lin. longis, superiorum brevioribus, bracteis lineari-lanceolatis, 4–8 lin. longis. *Involucra* cylindrica, ebracteolata, 4–5 lin. longa; bracteæ 5–6, oblongæ, obtusæ. *Flores* flavi, bracteis subduplo longiores; corolla infundibuliformis, apice paulo contracta, dentibus brevibus recurvis; antheræ basi sagittatæ; styli rami revoluti, papillosi, apice breviter penicillati; achænium striatum glabrum.

SZECHUEN: near Tachienlu at 9000–13,500 ft., *Pratt*, 671 & 606.

Senecio glumaceus, *Dunn*; cum *S. monantho*, Diels, capitulo unifloro in genere solus stat, foliis subglabris floreque involucrum 2-plo superante ab hac differt.

Herba erecta, 2–4-pedalis. *Caulis* striatus, subsimplex, præter partem floriferam glaber. *Folia* papyracea, minute utrinque puberula, ovata, acuminata, basi obtusa, in petiolum subito angustata, bidentata, media 4–6 poll. longa, petiolo 2-pollicari, superiora minora brevius petiolata. *Capitula* numerosissima, sæpissime sessilia, discoidea, 1-flora, 2 lin. diam., dense thyrsoideo-paniculata; pedunculi puberuli; bracteæ 2, oblongæ, apice obtusæ, paullo reflexæ, puberulæ. *Flos* bracteis duplo tandem longior; corolla supra longe campanulata, dentibus longis linearibus; antheræ basi caudatæ, connatæ; achænium tenue, 2 lin. longum, puberulum, pappo sordido.

SZECHUEN, *Pratt*, 434; *Henry*, 8919, 8921. These specimens were probably collected in the same locality and at the same time, though reaching Kew by different routes, for Henry's specimens were collected by his coolie who went with Pratt to

Tachienlu. The same remark applies to other species described herewith.

Senecio Hoi, *Dunn*; a *S. araneoso*, DC., et *S. corymboso*, Wall., foliis grosse dentatis, supra scabridis subter lanuginosis distincte.

Frutex alte scandens. *Caulis* striatus, laxe lanuginosus. *Folia* subcoriacea, subter griseo-lanuginosa, supra scabrida, rotundata, breviter acuminata, cordata, grosse dentata, media 4–5 poll. longa, petiolis 2–3-pollicaribus, superiora minora. *Capitula* numerosa, discoidea, circiter 8-flora, 3–4 lin. diam., paniculas axillares terminales que formantia; pedunculi pubescentes, floribus breviores, multibracteolati, bracteolis parvis linearibus. *Involucra* cylindrico-campanulata, 3–4 lin. longa, basi bracteolata; bracteæ circiter 8, lineari-oblongæ, acutæ. *Flores* flavi, bracteis duplo longiores; corolla supra elongato-campanulata, dentibus longis lanceolatis; antheræ basi caudatæ connatæ; styli rami papillosi, apice penicillata; achænium immaturum glabrum, pappo albo.

Yunnan: Mengtze forests at 5000–6000 ft., *A. Henry*, 10392, 10392 A. Collected by *Ho*, Dr. Henry's best native collector.

Senecio leucanthemus, *Dunn*; facie *S. dahuricum*, Sch.-Bip., referens, foliis auriculatis antherisque sectionis alius distincta.

Herba elata, præter inflorescentiam glabra. *Folia* media membranacea, rotundata, 6–8 poll. diam., 7-lobata, lobis triangularibus, acutis, mucronato-dentatis, basi truncatis vel breviter cordatis, petiolis gracilibus, 4–6 poll. longis; folia superiora conformia, minora, brevius petiolata. *Capitula* numerosissima, discoidea, 5-flora, 2–3 lin. diam., laxe paniculata, pedunculis pubescentibus. *Involucra* cylindrica, minute bracteolata, 3–4 lin. longa; bracteæ 5, lineari-oblongæ, apice obtusæ. *Flores* polygami, albi, bracteis duplo tandem longiores (vel in plantis femineis breviores); corolla supra paullo dilata, cylindrica, dentibus brevibus lanceolatis; antheræ basi caudatæ, connatæ; styli rami papillosi, apice penicillati; achænium cylindricum, tenue, 2 lin. longum, glabrum, pappo albo.

Hupeh: Patung, *A. Henry*, 4667, Fang, *A. Henry*, 7571; Hunan: Shihmen, *A. Henry*, 7556; Szechuen: South Wushan *A. Henry*, 7331.

Senecio luticola, *Dunn*; a *S. saxatile*, Wall., foliis non amplectentibus distincta.

Herba perennis, multicaulis. *Rhizoma* ad 1 poll., rotundatum. *Caules* glabri, striati, 15–20 poll. alti, infra longe nudi, apice ramosi. *Folia* sessilia, subcoriacea, utrinque scabrida, lineari-lanceolata, 2–3 poll. longa, apice acuta, subulata vel obtusa, basi cuneata, margine revoluta, distanter mucronato-dentata. *Capitula* numerosa, radiata, multiflora, paniculata, 7–9 lin. diam.; pedunculis angulatis, multibracteolatis. *Involucra* campanulata, ob bracteolis sæpe turbinata, cum pedunculi apice sparse lanuginosa, 3 lin. longa; bracteæ 12, auctæ, exterioribus angustioribus inæqulibus. *Flores* flavi; radii circiter 12, bracteis sesquilongiores, disci bracteis paullo longiores; corolla infundibuliformis, antheris ecaudatis; styli ramis brevibus. *Achænia* puberula, pappo albo.

Yunnan: common on barren clay-hills near Mengtze, in exposed arid situations, *A. Henry*, 9916; *Hancock*, 9.

Senecio paucinervis, *Dunn*; facie *S. acuminatum*, Wall., referens, foliis paucinervis vix reticulatis distinguenda.

Caulis lignosus, striatus, superne ramosus et pubescens. *Folia* papyracea, utrinque sparse pubescentia, minute puberula vel glabra, lanceolata, acuminata, basi rotundata, 3–5 poll. longa, crebre serrata, serraturis ad mucrones sæpe reductis, nervis subter prominentibus, secundariis sæpius 8, 2 solum in dimidio folii superiore, petiolis pollicaribus. *Capitula* numerosissima, discoidea, 2–3-flora, dense paniculata, paniculis pedunculatis, ipsis paniculatis vel racemosis, 4 lin. longa. *Involucra* cylindrica, minute bracteolata, 3 lin. longa, bracteæ 2–3, oblongæ, apice obtusæ, paullo recurvæ. *Flores* flavi, bracteis sæpius paullo tantum longiores; corolla cylindrica, dentibus lanceolatis; antheræ basi caudatæ; styli rami papillosi, apice penicillati; achænium puberulum, pappo rubescente.

Szechuen: Tachienlu, *Soulié*, 439, 474; Yunnan: Yunnanfu, *Ducloux*, 693.

Senecio profundorum, *Dunn*; a *S. alato*, Wall., floris glabris eligulatis distincta.

Herba erecta, 3–4-pedalis, glabra. *Caulis* teres, striatus. *Folia* membranacea, late ovata, rotundata vel angulata, acuta, in petiolum alatum subito contracta, crebre dentata, media basi truncata vel late cordata, 4–5 poll. longa, petiolo 2–3 poll. longo, caulem semiamplectente, superiora minora, brevius petiolata. *Capitula* numerosa, discoidea, 5-flora, 3 lin. diam., laxe paniculata; pedicelli floribus breviores, 1–3-bracteolati. *Involucra* cylindrica, ebracteolata, 4–5 lin. longa; bracteæ 5, lineari-oblongæ, apice obtusæ. *Flores* lutei vel rosei, bracteis duplo tandem longiores; corolla supra campanulata, dentibus linearibus; antheræ basi caudatæ, connatæ; styli rami papillosi, apice breviter penicillati; achænium tenuiter cylindricum, striatum, pallidum, glabrum, nitens, 2 lin. longum, pappo albo.

HUPEH: Hsingshan, *A. Henry*, 7612; SZECHWEN: South Wushan, on cliffs, *A. Henry*, 5434.

Dr. Henry tells me that this species was found by him in a ravine north of Ichang among high cliffs and very dark woods; so thick indeed was the foliage that it was not penetrated by heavy rain which fell during the day of his exploration there.

Senecio solenoides, *Dunn*; a *S. nikoensi*, Miq., bracteis involucralibus latioribus paucioribus, floribus ligulatis longioribus differt.

Herba tripedalis, præter folia pedunculosque glabra. *Caulis* fistulosus, striatus, infra sub anthesi longe nudus. *Folia* pedunculata, membranacea, utrinque sparse puberula, ambitu late ovata, profunde pinnatifida, segmentis utrinque 3–4, lanceolatis, acutis, grosse et irregulariter mucronato-dentatis, terminali subæquali; petioli foliorum inferiorum 2 poll. longi, superiorum breviores. *Capitula* numerosa (vel ob macie pauca), radiata, multiflora, corymbosa, 10–13 lin. diam., pedunculis sparse glandulosis. *Involucra* campanulata, ebracteolata, 2–3 lin. longa; bracteæ 6–8, ovatæ, obtusæ vel rarius exteriores 1–2 lanceolatæ acutæ. *Flores* flavi; radii 5–9, bracteis duplo longiores, ligulis linearibus, 3–5-nervibus, disci bracteis paullo longiores; corolla apice campanulata, dentibus lanceolatis; antheris basi obtuse auriculatis, styli ramis longis revolutis papillosis apice breviter penicillatis. *Achænia* 1 lin. longa, pallida, glabra, nitentia, obtuse angulata, pappo albo.

YUNNAN: mountains east of Mengtze at 6000 ft., *A. Henry*, 9678. A starved state with one head only, Mi-lê, *A. Henry*, 9678 A.

Saussurea Bullockii, *Dunn*; a *S. Tanakæ*, Franch. et Sav., caulibus exalatis distincta.

Herba stricta, perennis, 1½–3-pedalis. *Rhizoma* obliqua. *Caulis* cum foliorum paginis inferioribus et inflorescentia lana tenui deciduo arachnoideus. *Folia* subcoriacea; inferiora anguste triangularia, acuminata, basi cordata, 4–6 poll. longa, margine repando-dentata, dentibus acuminatis, pugentibus, nervis subter prominentibus, petiolis 2–5 poll. longis; superiora magis ovata, minora; petioli semiamplexicaules. *Capitula* 5–6 lin. diam., corymboso-paniculata, pedunculis sæpius breviora; receptaculi squamæ dimidium involucri vix accedentes. *Involucrum* turbinatum vel anguste campanulatum, 8–9 lin. longum; bracteæ exteriores triangulares, breves, interiores gradatim longiores et obtusiores, arcte adpressæ. *Flores* intense purpurei, tandem bracteis sesquilongiores; antherarum caudiculæ lanatæ. *Achænia* anguste obovata, obscure striata, 3 lin. longa, pappo albido, setis exterioribus paucis.

Kiangsi: Kiukiang, *Dr. Shearer* (*cf.* Journ. Linn. Soc. xxiii. (1888) p. 468), Lushan Mts., *Bullock*, 40; Hupeh: Fang, *A. Henry*, 6692. Bullock's is the only specimen at Kew with perfect leaves and flowers.

Saussurea graminea, *Dunn*; a *S. romuleifolia*, Franch., capitulis minoribus, lanugine sparsiore distincta.

Herba perennis, semipedalis. *Rhizoma* squamosum, ramosum, caules fasciculosque steriles emittens. *Caulis* gracilis, sericeus, paucifoliatus, monocephalus. *Folia* papyracea, supra fusca tenuiter sericea, subter albotomentosa, anguste linearia, acuminata, margine revoluta, integerrima, 5–6 poll. longa, ½ lin. lata, basi latiora vaginantia. *Capitulum* 8–10 lin. diam., foliis paucis basi orientibus circumdatum et superatum; receptaculi squamæ vix dimidium involucri accedentes. *Involucrum* laxe sericeum, campanulatum, 8–9 lin. longum; bracteæ exteriores basi late ovatæ in acumen longum reflexum abeuntes, interiores lineares erecti. *Flores* violacei, bracteis paullo longiores; antheræ basi fimbriato-caudatæ. *Achænium* glabrum, pappo fusco, basi corona brevi circumdato.

Szechuen: Tachienlu, *Soulié*, 594.

Saussurea Leontodon, *Dunn*; a *S. semilyrata*, Franch. et Bur., indumento distincta.

Herba perennis, pedalis, omnino scabrida, quasi pulvere brunneo sparsa. *Caulis* simplex, foliatus, monocephalus. *Folia* chartacea, subter pallidiora, ambitu longe lanceolata, inferiora 7–8 poll. longa, runcinato-pinnatifida, lobis integris vel paucidentatis, terminali æquali, petiolo alato lamina duplo breviore; superiora sessilia, semiamplexicaulia, lobo terminali magis attenuato. *Capitulum* 11–13 lin. diam.; receptaculi squamæ dimidium involucri accedentes. *Involucrum* campanulatum, 10 lin. longum; bracteæ exteriores basi ovatæ, in acumen longum laxum vel reflexum abeuntes, interiores angustæ acutæ. *Flores* bracteis paullo longiores; antherarum caudiculæ apice fimbriatæ. *Achænium* glabrum; pappo sordido, setis paucis circumdato.

SZECHUEN: Tachienlu, *Soulié*, 209.

Saussurea vaginata, *Dunn*; a *S. salicifolia*, DC., capitulis magnis 1–2nis differt.

Herba perennis, sesquipedalis. *Rhizoma* petiolis vestigii coronata. *Caulis* laxe lanatus, foliosus, 1–2-capitatus. *Folia* inferiora, papyracea, supra siccitate atra, subter niveo-tomentosa, linearia, 8–10 poll. longa, 3–6 lin. lata, margine revoluta, integerrima, apice attenuata, in petiolum alatum basi expansum angustata; inferiora sessilia, basi expansa, vaginantia. *Capitula* 11–13 lin. diam., receptaculi squamæ dimidium involucri accedentes. *Involucrum* tenuiter arachnoideum, campanulatum, 10 lin. longum; bracteæ exteriores lanceolatæ, longe acuminatæ, interiores lineares, breviter acuminatæ. *Flores* violacei, corolla bracteis paullo longiore, antheris basi fimbriato-caudatis. *Achænium* glabrum; pappo albido, setis paucis basi circumdato.

YUNNAN: Yunnanfu, *Ducloux*, 261.

Ainsliæa scabrida, *Dunn*; ab *A. aptera*, DC., foliis subcoriaceis scabridis distinguenda.

Herba perennis, 1–1½-pedalis, rhizomate ascendente apice lanuginoso. *Caulis* simplex, paucifoliatus, cum foliorum paginis inferioribus, petiolis basique capitulorum laxe tomentosus. *Folia* radicalia subcoriacea, utrinque scabrida, ovata, acuta, basi rotundata vel in petiolum 1–2-pollicarem subito contracta, 1½–2 poll. longa, apiculo-denticulata; superiora 1–2, minora vel bracteiformia. *Capitula* 3–4 lin. diam., fasciculato-spicata, spica terminali, vel rarius in ramis brevibus eodem modo instructa. *Involucra* 7 lin. longa, purpureo tincta. *Flores* pallide rosei, involucro paullo longiores. *Antherarum* caudiculæ ciliatæ. *Achænium* sericeum; pappo rubido.

YUNNAN: mountain-slopes at 6000 ft. near Mengtze, *Hancock*, 8; in woods at Mengtze, *A. Henry*, 9851.

Gerbera Henryi, *Dunn*; a *G. Delavayi*, Franchet, bracteis involucralibus angustis, vel certius, quum plantæ vivæ comparantur, nervis prominentibus (*A. Henry*) distinguenda.

Herba perennis, pedalis, acaulis; rhizomate erecto vel ascendente, fibros longos crassos emittente. *Folia* petiolata, subcoriacea, supra glabra, subter præter nervos albotomentosa, ovata, 2½–6 poll. longa, cordata, apice obtusa, dentata vel irregulariter inciso-sinuata, nonnunquam basi lobis paucis runcinatis; petioli alati, ½–1½ poll. longi. *Scapa* solitaria, monocephala, laxe lanuginosa, bracteis subulatis multis provisa. *Capitulum* radiatum, 1–1¼ poll. diam. *Involucrum* ex basi turbinata campanulatum, 8–9 lin. longum; bracteæ exteriores subulatæ, interiores gradatim latiores, acutæ. *Flores* radii dilute rosei, 10–11 lin. longi, ligula tubo æquali tridentata, biseriati. *Antherarum* caudiculæ glabræ. *Achænium* pubescens, pappo albido.

YUNNAN: Mengtze, on grassy mountains in exposed rather barren spots, *Henry*, 9111.

Crepis Phœnix, *Dunn*; ex affinitate *C. setosæ*, Hall. f.

Herba perennis, 6–18 poll. alta, rhizomate multicauli. *Caulis* undulatus, striatus, ramosus, setis flavidis plus minus indutus vel subglaber. *Folia* sessilia, chartacea, setis flavidis subter (præcipue in venis) conspersa, supra subglabra, oblonga, acuta vel breviter acuminata, basi rotundata vel subcordata amplexicaulia, 1½–2½ poll. longa, margine setaceo-dentata. *Capitula* corymbosa, sæpe numerosa, 6–9 lin. diam., receptaculo nudo. *Involucrum* 4–6 lin. longum; bracteæ uniseriatæ cum paucis exterioribus brevibus, laxis, linearibus, angustæ, obtusæ, margine scarioso, costa setis pectinata. *Flores* flavi, 8–9 lin. longi. *Achænia* brunnea, supra angustata, vix rostrata, striata; pappo albo.

YUNNAN: Mengtze, mountain pastures and waste places, local, *Hancock*, 162, grass mountains at 6000 ft., *A. Henry*, 10290; Yunnanfu, *Ducloux*, 293.

Six out of eight of these specimens, collected at different times and places, had apparently sprung up after older stems had been destroyed by fire. It is possible that the species affects such pastures as are subject to periodical fires.

Crepis rapunculoides, *Dunn*; a *C. racemifera*, Hook. f., capitulis magnis nutantibus distincta.

Herba perennis, pedalis, glabra, rhizomate parvo, conico. *Caulis* striatus, simplex. *Folia* chartacea, inferiora ovata, gradatim acuta, basi subito in petiolum alatum contracta, ½–1½ poll. longa, denticulata, petiolo 1¼ poll. longo, superiora lanceolata vel linearia, integra, sessilia. *Capitula* racemosa, pendula, ½ poll. lata, pedunculo pluribracteato, 1–2 lin. longo; receptaculum nudum. *Involucrum* 6–7 lin. longum; bracteæ exteriores breves, laxæ, lineares, interiores uniseriatæ, lineari-oblongæ, acutæ. *Flores* flavi, 9–10 lin. longi. *Achænia* immatura glabra, apice contracta.

SZECHUEN: Tachienlu, *Pratt*, 449.

Lactuca Henryi, *Dunn*; a *L. sororia*, Miq., achæniis foliisque sessilibus distincta.

Herba elata. *Caulis* fistulosus, foliosus, striatus, glaber. *Folia* sessilia, papyracea, utrinque sparse setosa, media ambitu ovata, pinnatifida, 4–7 poll. longa, lobis paucis ovatis obtusis, sinibus angustis, terminali ovato acuminato, superiora lanceolata integra. *Capitula* paniculum magnam formantia; pedunculi bracteolati, setoso-pubescentes, floribus sæpe longiores. *Involucrum* pluriseriatum, 6–7 lin. longum; bracteæ lineari-lanceolatæ, acutæ, exteriores paucæ, gradatim breviores. *Flores* violacei (?), 9 lin. longi. *Achænium* 4–5 lin. longum, oblongum in rostrum attenuatum, rubrum, rostro pallido, duplo breviore, compressum, obtuse costatum, puberulum; pappo albo.

YUNNAN: Puerh, at 4500 ft., *A. Henry*, 13494.

Lactuca humifusa, *Dunn*; *L. stoloniferam*, A. Gray, referens, sed foliis majoribus sinuatis vel angulatis, achæniisque setulosis distincta.

Herba stolonifera, stolonibus ex caulium basi axillisque orientibus. *Caules* plures, debiles, prostrati, glabri. *Folia* petiolata, membranacea, sparse puberula vel glabra; inferiora nonnulla runcinata, lobis lateralibus paucis, oblongis, acutis, vel ad dentes in petiolis alatis reductis, lobis terminalibus magnis, 2½–3½ poll. longis, rotundatis, subcordatis, angulato- vel sinuato-dentatis (dentibus apiculatis), quam folia tota 2–3-plo brevioribus; inferiora cetera superioraque lobis his terminalibus conformia, minora, minus cordata; suprema basi cuneata. *Capitula* 7–9 lin. diam., in corymbis paucifloris laxis attenuatis disposita; pedunculis brevibus vel longissimis. *Involucrum* 4–5 lin. longum; bracteæ glabræ, uniseriatæ, cum exterioribus perpaucis setaceis, obtusæ. *Flores* flavi, 7–8 lin. longi. *Achænia* immatura ad apicem attenuata, costis setulosis; pappo albo.

HUPEH: Patung district, *A. Henry*, 4761; SZECHUEN: South Wushan, *A. Henry*, 5762. "A cliff plant remarkable for its spreading stolons which sometimes cover the ground."—*Henry*.

Lactuca Prattii, *Dunn*; a specie bengalense *L. filicata*, Duthie, floribus parvis, foliisque supremis integris distinguenda.

Herba perennis, præter inflorescentiam nonnunquam setulosam glabra. *Caulis* sæpius simplex, foliatus, striatus, bipedalis. *Folia* ambitu lanceolata, runcinato-pinnatifida, 4–7 poll. longa, lobis fortiter reflexis linearibus, acutis, rarius paucidentatis vel lobatis, terminali angusto; inferiora alato-petiolata, petiolo basi lato semiamplexicauli; superiora sessilia, caulem auriculis magnis amplectentia; suprema linearia integra. *Capitula* 2–4 lin. diam., anguste paniculata; pedunculi sæpius floribus breviores, pauci-bracteolati. *Involucrum* pluriseriatum, 4–5 lin. longum; bracteæ lineari-oblongæ, obtusæ, exterioribus paucis gradatim brevioribus. *Flores* violacei (?), 5–6 lin. longi. *Achænia* 2½ lin. longa, oblonga, abrupte breviter rostrata, rubra, cum rostro pallido, striata, compressa, margine setulosa; pappo albo.

SZECHUEN: Tachienlu, *Pratt*, 502, *Soulié*, 608; Tongolo, *Soulié*, 369.

Lactuca umbrosa, *Dunn*; a *L. macrorhiza*, Hook. f., caule aphyllo vel unifoliato differt.

Herba subscaposa, biennis, glabra. *Caulis* simplex, 1–0-foliatus, fistulosus, striatus, 1½–4½ ped. altus. *Folia* petiolata, membranacea, nunc runcinata, lobis lateralibus paucis ovatis obtusis vel ad dentes in petiolis alatis reductis, lobis terminalibus, magnis, 2–3 poll. longis, ovato-sagittatis vel triangularibus, anguloso- vel sinuato-dentatis, dentibus apiculatis, quam folia tota 2–3-plo brevioribus, nunc lobis carentia. *Capitula* 4 lin. diam., pauca vel numerosa, paniculata, pedunculis bracteolatis breviora. *Involucrum* pluriseriatum, 4–6 lin. longum; bracteæ lineari-oblongæ, obtusæ, exteriores paucæ gradatim breviores. *Flores* purpureo-rosei, 5–7 lin. longi. *Achænia* rubra, linearia, apice in rostro gracili attenuata, compressa, multicostata; rostrum flavum, achænio 3–4-plo brevius; pappo albo.

YUNNAN: in shade on dry clay walls of ravines in forests near Szemao, *A. Henry*, 11694, 11694 A.

Prenanthes glandulosa, *Dunn*; a *P. scandente*, Hook. f. et Thoms., pedunculis glanduliferis differt.

Herba 1–1½-pedalis, superne dense setaceo-glandulosa, infra glabra. *Caulis* simplex, foliatus, striatus. *Folia* petiolata, subcoriacea, triangulato-cordata, præter petiolum 2–4 poll. longa, irregulariter sinuato-dentata, dentibus apiculatis; inferiora petiolo gracili basi dilatato amplexicauli æquilonga; media petiolo alato in vagina oblonga abeunte; suprema oblonga, sessilia, amplectentia. *Capitula* numerosa, ½ poll. diam., paniculata, pedunculis bracteolatis sæpius æquilongis. *Involucrum* 6 lin. longum; bracteæ lineari-oblongæ, interiores obtusæ, glabræ, violaceæ, exteriores paucæ, lineares, glanduliferæ. *Flores* 9–10 lin. longi, styli rami tenues. *Achænia* 3 lin. longa, pallida, leviter compressa, 6-striata, apice basique paullo contracta; pappo sordido.

Grown from seed received from West China by Mr. A. K. Bulley.

Prenanthes Henryi, *Dunn*; a *P. khasiana*, C. B. Clarke involucro imbricato distincta.

Herba elata, præter paginam inferiorem foliorum pedunculosque nonnunquam puberulos glabra. *Caulis* simplex, foliatus, fistulosus, striatus. *Folia* petiolata, membranacea; media pinnata ambitu ovata, 6–12 poll. longa, pinnis 2–6 ovatis lanceolatis, petiolulatis vel sessilibus, irregulariter sinuato-dentatis, incisis, lobatis vel subintegris, dentibus apiculatis, lobo terminali similariter inciso, magno, triangulari; suprema lanceolata, pinnati-lobata vel serrata, sessilia. *Capitula* 2–3 lin. diam., 6-flora, numerosa, paniculata, pedunculis bracteolatis sæpius quam flore brevioribus. *Involucrum* pluriseriatum, 6 lin. longum; bracteæ lineari-oblongæ, obtusæ, exteriores paucæ, gradatim breviores. *Flores* rosei, 7 lin. longi; styli ramis brevibus. *Achænia* vix matura, rubra, compressa, striata, apice paullo contracta; pappo albo.

SZECHUEN: North Wushan, *A. Henry*, 7022, 7022 A; YUNNAN: Feng Chen Lin, mountain forests, 7000 ft., *A. Henry*, 11214.

Agapetes parviflora, *Dunn*; floribus *A. piliferæ*, Hook. f., affinis, aliter longe distans.

Arbor 20-pedalis vel frutex alte scandens varie descripta, omnino glabra. *Folia* alterna, sessilia, lanceolata, 6–9 poll. longa, apice acuminata, basi subcordata, integra, coriacea, nervis supra impressis, subter prominentibus. *Racemi* pauciflori, ½–1½ poll. longi, in axillis sessiles, basi squamis laxis cincti. *Flores* pedicellati, pedicellis 6–11 lin. longis, deflexis, apice articulatis. *Calyx* 5-dentatus, dentibus ovarium bis excedentibus, corollæ dimidio superantibus, lanceolatis. *Corolla* campanulata, 2–3 lin. longa, ad dimidium 5-fida, lobis lanceolatis, apice revolutis. *Stamina* vix exserta, filamentis glabris, liberis, antheras cohærentes fere æquantibus, antherarum tubulis dorso bicalcaratis. *Stylus* filiformis. *Bacca* 4 lin. diam. *Semina* numerosissima, pyriformia, ½ lin. longa.

YUNNAN: Mengtze, south-east forests at 5000 ft., *A. Henry*, 10488 and 10488 A.

Agapetes vaccinioides, *Dunn*; inter species asiaticas racemis elongatis distincta.

Arbor 50-pedalis vel frutex alte scandens varie descripta, filamentis exceptis glabra. *Folia* alterna, sessilia, lanceolata, 4–7 poll. longa, apice sensim acuminatissima, basi rotundata vel subcordata, integra, coriacea, nervis supra impressis subter prominentibus. *Racemi* multiflori, unilaterales, 2–6 poll. longi, 1–3ni in axillis dispositi, basi squamis parvis cincti. *Flores* rubri (?), pedicellati, pedicellis 3–5 lin. longis, bracteolatis, sub flore articulatis. *Calyx* 5-dentatus, dentibus lanceolatis, ovario æqualibus, corolla 3–4-plo brevioribus. *Corolla* campanulata, 2 lin. longa, lobis tertiam partem corollæ aperientibus, triangularibus, apice reflexis. *Stamina* vix exserta, filamentis ciliatis liberis, antheras cohærentes fere æquantibus, antherarum tubulis dorso bicalcaratis. *Stylus* filiformis. *Fructus* ignotus.

YUNNAN: south of Red River, *A. Henry*, 13664; Mengtze, south-east mountains at 5000 ft., *A. Henry*, 10707.

Æschynanthus (§ **Microtrichum**) **buxifolius**, *Hemsl.*; foliis iis *Æ. Hildebrandii*, Hemsl. (Bot. Mag. t. 7365), similibus sed ab eo corollæ lobis subæqualibus et seminum pilis brevissimis differt.

Fruticulus ramosus, procumbens vel adscendens, fere undique glaber, caulibus vel ramis interdum saltem pedalibus, cortice insigniter ruguloso vel verruculoso. *Folia* conferta, subternaria, distincte petiolata, crassa, coriacea, glaberrima, circumscriptione variabilia, sæpius oblongo-lanceolata, interdum fere orbicularia sæpissime circiter semipollicaria, obtusiuscula, integerrima, venis obsoletis. *Flores* coccinei, absque staminibus exsertis circiter $1\frac{1}{4}$ poll. longi, in axillis foliorum superiorum solitarii, breviter graciliterque pedicellati, erecti. *Sepala* 5, libera, linearia, circiter 3 lin. longa et $\frac{3}{4}$ lin. lata, obtusiuscula. *Corolla* minutissime papillosa, tubulosa, arcuata, tubo sursum leviter ampliato; limbus obliquus, 7–8 lin. diametro, fere æqualiter 5-lobatus, lobis rotundatis intus puberulis. *Stamina* didynama, 6–8 lin. exserta; filamenta ultra corollæ medio adnata, per totam longitudinem parce glanduloso-puberula; antheræ approximatæ. *Discus* carnosus, cupularis, $\frac{1}{2}$ lin. altus. *Ovarium* nudum, longe stipitatum; stylus exsertus, staminibus brevioribus æquans, stigmate capitato. *Capsula* stipitata, clavata, cum stylo persistente 3-pollicaris. *Semina* ferruginea, papillosa, utrinque breviter monotricha cum pilis albis circiter $1\frac{1}{2}$ lin. longa.

YUNNAN: Mengtze, 7000 ft., *A. Henry*, 11217; wooded mountain crags above the Red River, 6000–7000 ft., *Hancock*, 397.

Æschynanthus humilis, *Hemsl.*; habitu omnino *Æ. Hildebrandii*, Hemsl. (Bot. Mag. t. 7365), differt corollæ lobis fere æqualibus.

Frutex nanus, epiphyticus (fide Henryi), ut videtur caudic incrassato; rami 3–6 poll. longi, cortice ferrugineo verruculoso. *Folia* sparsa vel ad apices ramorum floriferorum conferta, distincte petiolata, crassa, coriacea, spathulata vel obovata, maxima pollicaria, apice rotundata, basi cuneata, primum utrinque parce puberula, margine recurva, venis obsoletis. *Flores* coccinei, circiter pollicares, in axillis foliorum superiorum solitarii, distincte pedicellati, pedicellis gracilibus quam flores dimidio brevioribus. *Calyx* puberulus, circiter 2 lin. longus, subæqualiter 5-lobus; lobi haud ad medium connati, lanceolati, acutissimi. *Corolla* tubulosa, arcuata, tubo sursum leviter ampliato, intus infra medium papilloso; limbus obliquus, 3–4 lin. diametro; lobi fere æquales, ciliolati. *Stamina* didynama, longiora, 3–4 lin. exserta; filamenta glabra, fere filiformia, ad corollæ medium adnata; antheræ approximatæ. *Discus* carnosus, cupularis, $\frac{1}{2}$ lin. altus.

Ovarium sessile, ac stylus breviter exsertus parcissime minuteque glanduloso-puberulum. *Capsula* ignota.

YUNNAN: on trees, Szemao forests, 5500 ft., *A. Henry*, 13204.

RHABDOTHAMNOPSIS, *Hemsl.*

Cyrtandracearum genus novum ex affinitate *Boeæ* et *Streptocarpi*, adspectu aliquanto *Rhabdothamni Solandri* e Nova Zealandia.

Calyx fere æqualiter 5-partitus, segmentis angustis acutis. *Corolla* oblique tubuloso-campanulata, curvata; limbus subbilabiatus. *Stamina* 2, antica inclusa, tubo infra medium affixa; antheræ apice conniventes vel cohærentes, barbatæ, loculis demum divergentibus apice confluentibus. *Capsula* elongata, torta; semina minutissima, numerosissima.—*Fruticulus* nanus, ramosus. *Folia* parva, opposita. *Flores* mediocres, axillares, solitarii.

Rhabdothamnopsis sinensis, *Hemsl.*, species unica.

Fruticulus debilis, a basi ramosus, ut videtur procumbens, *Loniceræ* speciebus nonnullis simillimis. *Caules* ramique graciles, vetustorum cortice ferrugineo desquamanto, ramulis ultimis puberulis. *Folia* opposita, quam internodia sæpius longiora, breviter petiolata, membranacea, circumscriptione variabilia sed sæpius ovato-lanceolata vel obovato-lanceolata, interdum fere orbicularia, $\frac{1}{2}$–2 poll. longa, sæpius circiter sesquipollicaria, basi semper plus minusve cuneata, apice acuta, obtusa vel rotundata, nisi partem tertiam inferiorem crenulato-serrata, simul in margine ciliolata, utrinque primum parce puberula, deinde glabrescentia. *Flores* circiter $1\frac{1}{4}$ poll. longi, axillares, solitarii, graciliter pedicellati; pedicelli quam folia nunc longiores nunc breviores, ebracteolati. *Calycis* pubescentis segmenta 5, æqualia, lineari-lanceolata, circiter 3 lin. longa, acutissima. *Corolla* $1\frac{1}{4}$–$1\frac{1}{2}$ poll. longa, puberula, intus glabra, tubuloso-campanulata; tubus leviter curvatus, prope basin circiter 2 lin. diametro, sursum sensim dilatatus, 4–5 lin. diametro, longitudinaliter striatus; limbus oblique bilabiatus, lobis rotundatis, labii inferioris longioribus. *Stamina* 2, antica tubo inclusa; filamenta infra medium tubo affixa, dilatata, apice incrassata; antheræ cohærentes, dense barbatæ. *Discus* leviter oblique cupularis. *Ovarium* elongatum, styloque pubescens, distincte biloculare, ovulis numerosissimis;

stylus filiformis, vix exsertus, stigmate distincte bilamellato. *Capsula* pubescens, immatura cum stylo persistente sesquipollicaris, matura absque stylo circiter pollicaris, valvis tortis. *Semina* numerosissima, oblonga vel ovoidea, $\frac{1}{7}$–$\frac{1}{5}$ lin. longa, utrinque apiculata, foveolato-reticulata.

Szechuen: near Tachienlu, *Pratt*, 147; Yunnan: Yunnanfu, *Ducloux*, 120.

Quercus (§ **Pasania**) **Carolinæ**, *Skan*; *Q. pallidæ*, Blume, similis, sed foliis serratis, cupulæ squamis arcte adpressis, glande majore, differt.

Arbor 40 ped. alta (*Henry*). *Ramuli* juniores paulum sulcati, grisei, sparse conspicueque lenticellati. *Folia* oblonga, 5–6 poll. longa, 1$\frac{1}{4}$–2 poll. lata, acuminata, basi cuneata, supra medium serrata, axillis nervorum primariorum tomentosis exceptis glabra, costa et nervis primariis lateralibus arcuatis utrinque circiter 20 supra leviter impressis, infra conspicue elevatis; petioli 6–9 lin. longi. *Flores* desunt. *Fructus* maturi solitarii secus pedunculum crassum dispositi. *Cupula* patelliformis, 1$\frac{3}{4}$ poll. diametro; squamæ multoseriatæ, arcte adpressæ, glabræ, incrassatæ, basi latæ, superiorum apice apiculatæ. *Glans* depresso-globosa, glabra, nitida, 14 lin. alta, 1$\frac{3}{4}$ poll. diametro.

Yunnan: Talang, 6000 ft., *A. Henry*, 13239.

The species is named in memory of Caroline, the deceased wife of Dr. Augustine Henry.

Pellæa squamosa, *Hope et C. H. Wright*; *P. geraniæfoliam*, Fée, et *Cheilanthem* Kirkii, Hook., simulans, differt frondibus basalibus subter dense squamosis.

Stipites cæspitosi, paleis lanceolatis deciduis vestiti, castanei, 1–6 poll. longi. *Frondes basilares* deltoideæ, bipinnatifidæ, supra glabræ (costa parce squamosa excepta), subtus paleis lanceolatis acuminatis stramineis dense vestitæ; *frondes superiores* deltoideæ, bi- vel (in parte inferiore) tri-partitæ, lobis oblongis obtusis, supra glabræ, subtus albido-farinosæ et ad costas squamosæ. *Sori* lineati, integri, multisporangiati; sporæ globosæ, 45–55 μ diam.

Yunnan: Yuanchang, 2500 ft., *A. Henry*, 13209.

SCOTTISH FRESHWATER PLANKTON.—No. I.

By W. WEST, F.L.S., and G. S. WEST, M.A., F.L.S., Professor of Natural History at the Royal Agricultural College, Cirencester.

(PLATES 14–18.)

[Read 18th June, 1903.]

CONTENTS.

I.—INTRODUCTION.

A CONSIDERABLE amount of work has been done at the phytoplankton of the freshwaters of Western Europe and even of Africa, but up to the present little attempt has been made to investigate the freshwater plankton of the British Islands.

The first paper dealing with this subject was a short description of some plankton from the Isle of Mull, published by Borge * in 1897. Another and more comprehensive paper has dealt with the plankton of Lough Neagh, Lough Beg, and the Upper River Bann †. A "Preliminary Report on the Phytoplankton of the Thames" has also been recently published by Dr. Fritsch ‡. These are the sole contributions to British freshwater phytoplankton up to this date.

The present contribution deals with plankton-material collected from lochs in different parts of Scotland and the Outer Hebrides. By means of two successive grants obtained from the Royal Society during 1901 and 1902, we have been enabled to investigate the Alga-flora of large areas of Scotland, particularly of the north and north-west. The collections were very varied and

* O. Borge. "Algologiska Notiser: 4. Süsswasser-Plankton aus der Inseln Mull." Botaniska Notiser, 1897.

† W. West & G. S. West. "A Contribution to the Freshwater Algæ of the North of Ireland." Trans. Roy. Irish Acad. xxxii. sect. B, part i., August 1902.

‡ F. E. Fritsch. "Preliminary Report on the Phytoplankton of the Thames." Ann. Bot. xvi., Sept. 1902.

rich, but, owing to the extensive nature of the districts that required investigation, comparatively little time could be devoted to the special work of plankton-collection. As the mass of material collected is representative of one of the richest and most prolific areas in Europe for freshwater algæ, it will require considerable time to thoroughly work up, and for this reason we have thought it advisable to publish the few plankton-algæ separately.

The plankton-material was obtained in the usual way by using long conical nets of very fine miller's silk. On some of the lochs on which boats could not be obtained, good material was collected by taking up a position on rocks at a distance from the shore and bailing the clear water through the nets for an hour or more.

The plankton was found to be very rich in Desmids, and several very interesting new species were obtained.

A few Peridinieæ, Rhizopods, Rotifers, &c. have been noted from the different collections, and for the determination of certain of these forms we express our thanks to Mr. E. Lemmermann of Bremen. He has also examined some of the material from certain of the lochs for algæ, and we have included one or two species which he noted but which we ourselves had not observed.

II.—Detailed Account of the Plankton of the Lochs investigated.

In the tabulated descriptions of the plankton-collections the relative frequency of a species is indicated by the letters "ccc" = very abundant, "cc" = common, "c" = fairly common, "r" = infrequent, "rr" = rare, and "rrr" = very rare.

The plankton from the following eleven Lochs was mostly collected in the summer and autumn, and is tabulated separately from a few small collections made in the South of Scotland during the spring.

Loch Shin, Loch a Gharbh Bhaid Mhoir, Sutherland.

The collections were made in August 1901, and on both lochs boats were used. The material obtained from Loch Shin was collected from a broad part towards the south-east end of the loch. Although this loch is 17 miles in length, it scarcely averages half a mile in width; it is 270 feet above the sea-level and is situated in a wild hilly district, although the hills in the immediate neighbourhood seldom rise higher than 1500 feet. Loch a Gharbh Bhaid Mhoir is situated in a very wild region north-west of Ben Arcuil (2580 feet), and is very deep for its size; it is about a mile and a half in length and less than a quarter of a mile broad.

The two Rotifers *Notholca longispina*, Kellicott, and *Anuræa cochlearis*, Gosse, were abundant in both these lochs. The Heliozoan *Clathrulina elegans*, Cienk., was by no means uncommon in Loch Shin. *Ceratium hirundinella* occurred in both lochs, and was particularly abundant in Loch a Gharbh Bhaid Mhoir. From the latter loch Lemmermann reports the occurrence of *Peridinium Willei*, Huitfeldt-Kass.

Loch Mor Bharabhais, Lewis, Outer Hebrides.

This loch is a little more than a mile in length and rather less in width; it is situated near Barvas quite close to the sea, and is somewhat shallow. The surrounding land is not many feet above sea-level, and the margin of the loch is in some places quite sandy. The material was collected in August 1902 by means of a boat.

The Rotifer *Anuræa cochlearis*, Gosse, was abundant, and the three following species of Rhizopods occurred profusely:—*Arcella discoides*, *A. vulgaris*, *A. vulgaris* var. *gibbosa*, and *Trinema enchelys*. A long-spined form of *Mallomonas acaroides*, Perty, was also observed, but not in abundance. One of the features of this plankton was the abundance of the lower forms of the green algæ.

Loch Laxadale, Harris, Outer Hebrides.

This loch is situated amongst rocky hills near Tarbert, the highest mountain in Harris (Clisham, altit. 2622 ft.) being only three miles distant. It is about one and a half miles long, a quarter of a mile in width, and is about 40 ft. above sea-level. The material was obtained on a stormy day in August 1902, when there were very large waves on the loch, by passing a large volume of water through one of the silk nets. The following Rhizopods were observed:—*Arcella discoides*, *Difflugia pyriformis*, *D. globulosa*, *Centropyxis aculeata*, *Euglypha ciliata*, and *Trinema enchelys*.

Loch Nan Eun, Loch Skealtur, N. Uist, Outer Hebrides.

The material was collected in very stormy weather in August 1902, by allowing a large volume of water to pass through silk nets.

Loch Nan Eun, which is about two miles in length and very little above sea-level, has both rocky and peaty surroundings. The plankton contained the following Rhizopods :—*Arcella vulgaris* (gigantic form), *Difflugia pyriformis*, *Euglypha alveolata*, *Sphenoderia lenta*, and *Trinema enchelys*. The Rotifer *Notholca longispina* was also in abundance. It was the richest plankton we have examined for Desmids.

Loch Skealtur is not more than half a mile in length, and is very little above sea-level; its surroundings are both rocky and peaty. The following Rhizopods were abundant in the plankton :—*Difflugia pyriformis*, *Centropyxis aculeata*, *Euglypha ciliata*, and *Cyphoderia Ampulla*.

Loch a Bhursta, Benbecula, Outer Hebrides.

This is a small loch situated towards the centre of the island amidst surroundings of rock and peat. It is not more than half a mile in length, and the material was obtained by passing a large volume of water through the nets. The collections were made in August 1902.

Loch Tay, Loch Katrine, Loch Achray, Perthshire.

Loch Tay is about twelve miles long and 290 ft. above sea-level; it is situated in proximity to high mountains which reach an altitude of 4000 ft. The opportunity thoroughly to investigate this loch did not occur, and the plankton-collections were made in July 1902 from near the head of the loch *.

Loch Katrine is about seven or eight miles long and 364 ft. above sea-level; it lies in the midst of mountains from 2000–3000 ft. high. The plankton was obtained from the outlet of the loch in April 1903.

Loch Achray is a little more than a mile in length and 276 ft. above sea-level. It receives its water from Loch Katrine, which is only a mile and a quarter distant. The plankton was obtained over the deeper parts of the loch, in April 1903, and is very similar to that obtained from Loch Katrine.

* [Since the above was written, further plankton collections have been made in July 1903.—G. S. W., 3rd Sept., 1903.]

The two Rotifers *Notholca longispina*, Kellicott, and *Anuræa cochlearis*, Gosse, were very abundant in the plankton of Loch Tay; and the following Rhizopods occurred:—*Arcella discoides*, *A. vulgaris* var. *gibbosa*, *Difflugia globulosa*, *Euglypha alveolata*, and *Trinema enchelys*.

In Loch Katrine the Rhizopods *Cyphoderia Ampulla* and *Trinema enchelys* were abundant.

In Loch Achray *Peridinium tabulatum* was abundant, and *Microgromia socialis*, *Diplophrys Archerii*, and *Arcella vulgaris* were observed frequently.

The Heliozoan *Clathrulina elegans* was plentiful in the plankton of all three lochs. *Ceratium tetraceros* was observed from Loch Katrine.

Loch Doon, Ayrshire.

Loch Doon is the largest loch in the South-west of Scotland, being some five or six miles in length. The head of the loch is situated near high mountains, which reach an altitude of 2668 ft. on the one side and 2764 ft. on the other. The material was collected in May 1902, chiefly towards the south end of the loch.

The Rotifers *Notholca longispina*, Kellicott, and *Anuræa cochlearis*, Gosse, were abundant; and *Peridinium Willei*, Huitfeldt-Kaas, and *Mallomonas acaroides*, Perty, were also frequent.

The following Rhizopods were also observed in the plankton:—*Centropyxis aculeata*, *Nabela collaris*, *N. flabellulum*, and *Euglypha ciliata*.

Species.	*a.* Loch Shin.	*b.* Loch a Gharbh Bhaid Mhoir.	*c.* Loch Mor Bharabhais.	*d.* Loch Laxadale.	*e.* Loch Nan Eun.	*f.* Loch Skealtur.	*g.* Loch a Bhursta, Benbecula.	*h.* Loch Tay.	*i.* Loch Katrine.	*j.* Loch Achray.	*k.* Loch Doon.	Remarks. [In order to save space, the letters *a*, *b*, *c*, &c., are used to indicate the various Lochs in this column.]
Chlorophyceæ.												
Œdogonium sp. (sterile)	...	...	...	rr	...	...	...	...	...	...	...	A very minute species, *d*.
,, spp. (sterile)	...	...	...	...	cc	cc	...	cc	...	...	cc	Several small sterile species, *e* & *f*. Two sterile species, *k*.
Ulothrix subtilis, Kütz., var. *variabilis*, Kirchn.	...	...	...	...	...	...	...	...	...	...	r	
,, *moniliformis*, Kütz.	...	...	...	...	...	...	...	...	...	...	cc	
Mougeotia elegantula, Wittr.	...	...	...	...	...	...	c					
,, spp. (sterile)	cc	...	...	...	...	...	cc	r	r	...	...	Two species: (1) Cells 5½–8 times longer than broad; diam. 10–12 μ. (2) Cells 7–11 times longer than broad; diam. 11–14 μ. *a*. There were 3 sterile species and the filaments were in all cases most curiously contorted, *g*. A small species 7·5 μ in diameter, with cells 6–8 times longer than broad, *h*. A species 8–9·5 μ in diameter, with cells 9–11 times longer than broad, *i*.
,, sp. (sterile)	...	cc	...	...	...	...	...	...	...	...	c	Cells 10–16 times longer than broad; diam. 16–18 μ.
Zygnema ericetorum, Hansg.	...	...	...	...	r	...	...	...	...	...	...	A few scattered filaments, *e*.
Genicularia elegans, sp. n.	...	...	...	...	rr	...	...	...	...	...	...	This is an interesting species of the rarest genus of Desmids.
Gonatozygon Kinahani, Rabenh.	...	...	...	...	rrr							
,, *Ralfsi*, De Bary	rrr											
Netrium Digitus, Itzigs. & Rothe	...	...	...	...	rrr							
Penium Libellula, Nordst.	...	...	...	...	...	...	...	...	...	...	rrr	
,, *minutum*, Cleve	...	...	...	...	...	...	...	rrr				

Closterium Pseudodianæ, Roy	rrr											
,, *Venus*, Kütz.	...	...	rr	...	...	...	...	rrr				
,, *parvulum*, Näg.	...	...	...	...	...	...	...	...	...	...	r	With zygospores, *k*.
,, *Jenneri*, Ralfs	...	...	...	...	...	...	rr	...	rr			
,, *Cynthia*, De Not., var. *curvatissimum*, var. n.	...	...	...	...	...	...	rrr					
,, *Ehrenbergii*, Menegh.	...	...	...	...	...	...	...	...	...	...	rrr	
,, *striolatum*, Ehrenb.	...	...	...	...	...	...	...	...	...	...	rrr	
,, *lineatum*, Ehrenb.	...	...	...	...	...	...	...	rr	...	...	...	A broad form; long 700 μ, lat. 36 μ, *h*.
,, *Ulna*, Focke	...	...	...	...	...	...	r					
,, *Kützingii*, Bréb.	cc	...	...	...	...	...	...	r	...	c	r	
,, *rostratum*, Ehrenb.	...	...	r	...	...	...	...	c				
,, *setaceum*, Ehrenb.	c	...	...	...	...	...	c	...	..	...	rr	With zygospores, *k*.
,, *Toxon*, West	...	...	...	...	rrr							
,, *acutum*, Bréb.	...	...	...	...	r							
,, *pronum*, Bréb.	...	...	...	...	...	...	...	...	...	r		
Pleurotænium Ehrenbergii, De Bary	rr	...	rrr	...	cc	r	...	...	...	...	r	
Tetmemorus granulatus, Ralfs	...	...	...	...	rrr	...	...	...	...	...	r	
,, *Brébissonii*, Ralfs	...	...	...	rrr	...	...	...	...	...	...	rrr	
Euastrum pectinatum, Bréb.	...	...	...	rr	r	...	r	...	...	r	...	Small reduced forms, *d*.
,, *verrucosum*, Ehrenb.	c	...	...	c	cc	...	c	...	...	...	c	
,, ,, var. *reductum*, Nordst.	...	...	...	...	...	...	...	c	...	c	...	Some of the species were very small; long. 86 μ, lat. 82 μ.
,, *oblongum*, Ralfs	...	...	...	...	...	...	...	...	...	...	c	
,, *ampullaceum*, Ralfs	...	...	...	...	...	...	...	...	...	...	rrr	
,, *gemmatum*, Ralfs	...	...	...	...	...	...	rr	...	...	...	...	The plankton from *g* is somewhat remarkable for the abundance of species of *Euastrum*.
,, *pinnatum*, Ralfs	...	...	r	rrr								
,, *ansatum*, Ehrenb.	...	...	...	...	c	rr	c	...	...	r	r	
,, *denticulatum*, F. Gay	...	...	...	...	r	...	c	...	...	...	r	
,, *elegans*, Kütz.	...	...	...	...	ccc	...						
,, *bidentatum*, Näg.	...	...	...	...	...	...	r	r				
,, *binale*, Ehrenb.	...	...	...	...	c	...	cc					
Micrasterias rotata, Ralfs	...	...	r	rr	...	...	...	...	...	...	...	All the specimens were dead empty cells in *c*.
,, *denticulata*, Bréb.	...	...	...	...	r							
,, *radiosa*, Ralfs	rrr	...	...	...	r	...	...	...	...	...	...	Long. 180 μ; lat. 168 μ, *e*.
,, ,, var. *ornata*, Nordst.	...	...	...	...	...	...	...	...	...	...	c	Long. 180 μ; lat. 173 μ, *k*.
,, *conferta*, Lund.	...	...	rr									

Species.	*a.* Loch Shin.	*b.* Loch a Gharbh Bhaid Mhoir.	*c.* Loch Mor Bharabhais.	*d.* Loch Laxadale.	*e.* Loch Nan Eun.	*f.* Loch Skealtur.	*g.* Loch a Bhursta, Benbecula.	*h.* Loch Tay.	*i.* Loch Katrine.	*j.* Loch Achray.	*k.* Loch Doon.	Remarks.
CHLOROPHYCEÆ (*cont.*).												
Micrasterias furcata, Agh.	rrr											
,, *pinnatifida*, Ralfs	...	...	...	...	rr							
,, *Jenneri*, Ralfs	...	...	...	...	...	...	...	...	...	...	rr	
,, *americana*, Ralfs	...	...	...	...	...	...	...	...	...	...	rrr	Long. 125–151 μ ; lat. 100–113 μ.
,, *Murrayi*, sp. n., var. *triquetra*.	...	...	...	...	...	...	...	...	...	...	rrr	
Cosmarium Ralfsii, Bréb.	...	...	...	...	...	...	...	...	...	...	rrr	
,, *Lundellii*, Delp., var. *æthiopicum*, West & G. S. West.	rrr											
,, *contractum*, Kirchn.	cc	...	r	...	cc	...	c	...	...	...	r	
,, *granatum*, Bréb.	...	...	...	...	c	cc						
,, *Scenedesmus*, Delp.	c	r	c	...	c	r	...	c	...	...	...	Some specimens from *h* possessed thickenings in the middle of each semi-cell. The thickened areas showed out plainly in the vertical view. Long. 42 μ ; lat. 44 μ ; lat. isthm. 13 μ ; crass. 22 μ.
,, *moniliforme*, Ralfs	...	...	...	...	r							
,, *bioculatum*, Bréb.	...	..		...	rr	...	ccc	...	...	...	cc	
,, *abbreviatum*, Racib.	...	...	...	...	...	...	...	r	r	r		
,, ,, var.	r	...	c	...	...	...	...	ccc	...	...	...	Large variety with more rounded apices ; long. 28 μ ; lat. 29 μ ; lat. isthm. 8 μ : *a*. Forms with more rounded apices similar to those from *a* ; long. 20 μ ; lat. 22 μ ; lat. isthm. 5·5 μ : *c*.
,, *capitulum*, Roy & Biss., var. *grœnlandicum*, Börges.	...	...	...	...	...	...	...	...	...	...	c	
,, *difficile*, Lütken	rr											

Cosmarium læve, Rabenh., var. *septentrionale*, Wille.	...	...	rrr									
,, *humile*, Gay	rr											
,, *formosulum*, Hoff.	...	...	...	...	r	...	r	...	...	...	r	
,, *Kjellmannii*, Wille, var. *grande*, Wille.	...	...	...	rr								
,, *Malinvernianum*, Schmidle, var. *badense*, Schmidle.	c	...	...	rrr								
,, *Botrytis*, Menegh.	...	...	...	cc	...	c	...	c	...	...	c	
,, *cœlatum*, Ralfs	...	...	...	...	...	...	...	...	...	...	rrr	
,, *reniforme*, Arch.	...	...	...	...	...	...	rrr					
,, *ornatum*, Ralfs	...	...	...	...	...	...	r	...	...	...	rr	
,, *subcostatum*, Nordst.	...	...	...	...	...	...	...	r				
,, *subcrenatum*, Hantzsch	...	...	...	...	...	...	...	...	rrr			
,, *ovale*, Ralfs	...	...	...	...	rr							
,, *Brébissonii*, Menegh.	...	...	...	...	...	...	...	...	...	...	rrr	
,, *margaritatum*, Roy & Biss.	...	...	...	...	...	...	...	...	...	...	rrr	
Xanthidium antilopæum, Kütz.	rrr	r	r	c	r	...	c	cc	...	r	c	Some forms with three spines at the basal angles, *a* & *b*. Several different forms, *d*. None of the examples were typical, *j*.
,, ,, var.	...	...	...	...	...	...	...	...	...	...	cc	Cells much inflated, spines reduced both in number and length, *k*.
,, ,, var. *polymazum*, Nordst.	...	...	...	...	c	...	...	...	...	...	...	Many of the specimens were furnished with three spines at the basal angles.
,, *tetracentrotum*, Wolle, forma	...	...	...	rrr								
,, *controversum*, West & G. S. W., var. *planctonicum*, var. n.	cc	c										
,, *cristatum*, Bréb.	...	...	...	...	rrr							
,, *armatum*, Rabenh., var. *cervicorne*, West & G. S. West.	r											
Arthrodesmus quiriferus, sp. n.	ccc	...	...	ccc	...	...	...	...	...	c	...	Very abundant and somewhat variable in form and size. Most of the specimens were twisted at the isthmus, *a*.
,, *crassus*, sp. n.	...	...	cc									Abundant, but most of the specimens were damaged, *d*.
,, *Incus*, Hass.	...	...	...	...	rr	...	cc	rr	...	...	...	Large forms with diverging spines, *h*.

Species.	*a.* Loch Shin.	*b.* Loch a Gharbh Bhaid Mhoir.	*c.* Loch Mor Bharabhais.	*d.* Loch Laxadale.	*e.* Loch Nan Eun.	*f.* Loch Skealtur.	*g.* Loch a Bhursta, Benbecula.	*h.* Loch Tay.	*i.* Loch Katrine.	*j.* Loch Achray.	*k.* Loch Doon.	Remarks.
CHLOROPHYCEÆ (*cont.*).												
Arthrodesmus Incus, var. *Ralfsii*, West & G. S. West.	...	...	...	...	...	...	r					
,, *convergens*, Ehrenb.	...	...	...	...	...	...	...	r	...	...	...	Forms with the spines much reduced and sometimes almost wanting, *h*.
,, *triangularis*, Lagerh.	...	...	...	...	...	...	...	...	rr	r		
var. *Hebridarum*, var. n.	...	...	...	...	r							
,, *subulatus*, Kütz.	...	...	...	...	c	...	...	...	...	...	...	Long. 38 μ; lat. s. spin. 42 μ; long. spin. 11·5 μ; crass. 19·5 μ: *e*.
,, *octocornis*, Ehrenb.	...	...	...	...	...	...	rr					
Staurastum dejectum, Bréb.	rr	...	...	...	cc	...	c	r	...	...	c	Forms with long spines which were less divergent than usual. Long. s. spin. 25 μ; lat. s. spin. 27 μ; long. spin. 17–21 μ: *h*.
,, ,, var. *inflatum*, West	...	...	cc	...	r							
,, *Dickiei*, Ralfs, var. *rhomboideum*, var. n.	...	...	...	...	r							
,, *curvatum*, West	cc	...	...	...	...	...	...	...	...	...	r	
,, *jaculiferum*, West	...	rr	r	...	...	rr	...	ccc	r	...	rr	All biradiate forms (= *Arthrodesmus longicornis*, Roy), *h*. Typical forms, some of which were biradiate (=*Arthrodesmus longicornis*, Roy), others triradiate, and others quadriradiate, *c*. All biradiate forms (= *Arthrodesmus longicornis*, Roy), *f*. All were biradiate forms with outwardly divergent spines (=*Arthrodesmus longicornis*, Roy), *i*. Both biradiate forms (= *Arthrodesmus longicornis*, Roy) and triradiate forms, *k*.
,, ,, var. *excavatum*, var. n.	c											

Staurastrum megacanthum, Lund.	rr	...	...	...	rr	...	...	...	...	...	...	Small forms with relatively smaller spines, *a*.
,, ,, var. *scoticum*, var. n.	r	...	...	...	...	...	...	...	...	...	r	
,, *aristiferum*, Ralfs, var. *protuberans*, var. n.	...	...	...	...	rrr							
,, *cuspidatum*, Bréb., var. *maximum*, West.	ccc	...	ccc	...	c	...	...	cc	ccc	ccc	...	In many specimens the spines were divergent, *a*.
,, *teliferum*, Ralfs	...	..	...	...	...	...	...	...	...	rrr		
,, *hirsutum*, Bréb.	...	...	...	...	...	...	...	...	...	...	rr	
,, *longispinum*, Arch.	r	...	...	...	c	...	...	...	...	...	...	Typical long-spined forms, *a*.
,, *brasiliense*, Nordst., var. *Lundellii*, West & G.S.West	rr	...	...	...	rrr							
,, *brevispinum*, Bréb.	rr	...	r	...	rrr							
,, *angulatum*, West, var. *planctonicum*, var. n.	r											
,, *lunatum*, Ralfs, var. *planctonicum*, var. n.	cc	r	c	...	c	...	...	cc	...	...	cc	Somewhat variable in size, in outward form, and in length of spines, *a* & *b*.
,, *granulosum*, Ralfs	...	...	ccc	...	r	r	cc					
,, ,, var. *acutum*, West & G. S. West.	...	...	c	...	...	...	...	...	...	...	...	Forms of this species greatly resemble the plankton forms of *St. lunatum*, *c*.
,, *Avicula*, Bréb.	...	...	rrr	...	...	...	rrr					
,, *polytrichum*, Perty	rr	...	...	...	...	...	...	...	...	...	...	Small forms with more depressed semicells; long. s. spin. 51 μ; c. spin. 58 μ; lat. s. spin. 44–48 μ, c. spin. 54–56 μ: *a*.
,, *punctulatum*, Bréb.	...	...	rr	...	rr							
,, *orbiculare*, Ralfs	...	...	...	...	c							
,, *lævispinum*, Biss.	...	...	...	...	rrr							
,, *mucronatum*, Ralfs, var. *subtriangulare*, var. n.	...	...	...	...	...	...	...	...	...	...	rr	
,, *crasum*, Bréb.	...	...	...	...	...	...	...	...	...	...	rr	
,, *aversum*, Lund.	r	...	...	...	rrr							
,, *brachiatum*, Ralfs	...	...	...	...	rrr							
,, *pseudopelagicum*, sp. n.	ccc	...	...	...	...	...	...	cc				
,, *polymorphum*, Bréb.	...	...	...	...	...	...	r	...	...	...	...	The specimens were not typical, *g*.
,, *paradoxum*, Meyen	...	...	r	ccc	ccc	r	r	cc				
,, var. *longipes*, Nordst.	ccc	...	cc	...	c	...	ccc	ccc	...	...	...	This Desmid was not abundant and the processes were shorter than usual in *h*.
,, var. *cingulum*, var. n.	c	...	...	...	...	...	...	...	ccc	ccc		
,, *gracile*, Ralfs	r"	...	rr	r	c	...	rr	...	...	r	c	Several different forms observed, *a*. Very large forms, *k*.

Species.	a. Loch Shin.	b. Loch a Gharbh Bhaid Mhoir.	c. Loch Mor Bharabhais.	d. Loch Laxadale.	e. Loch Nan Eun.	f. Skealtur.	g. Loch a Bhursta, Benbecula.	h. Loch Tay.	i. Loch Katrine.	j. Loch Achray.	k. Loch Doon.	Remarks.
CHLOROPHYCEÆ (*cont.*).												
Staurastrum grande, Buln.	r	...	...	...	rr	...	...	...	...	...	r	Forms with a less convex dorsal margin, *a*. Relatively broad forms, *e*.
,, *conspicuum*, sp. n.	rr											
,, *tetracerum*, Ralfs	...	rrr										
,, *anatinum*, Cooke & Wills	cc	r	rrr	rr	ccc	...	...	...	...	...	cc	Numerous and variable forms observed from *a*; there was great variability in the length of the processes, some being very short. Mostly large forms with four processes in *k*.
,, ,, var. *grande*, West & G. S. West.	c	...	...	...	...	...	...	...	...	..	c	Lat. cum proc. 131–148 μ, *a* & *b*.
,, ,, var. *pelagicum*, West & G. S. West.	ccc	...	r									
,, *Ophiura*, Lund.	rr	c	...	c	...	...	...	r	...	...	cc	All typical 8-rayed forms, *d* & *h*.
,, *verticillatum*, Arch.	...	...	r									
,, *furcatum*, Bréb.	...	...	...	...	...	rrr						
,, *furcigerum*, Bréb.	r	...	...	...	...	...	...	c				
,, ,, forma *armigera* (Bréb.).	...	...	...	...	...	...	...	cc	...	...	...	All specimens with six dorsal processes, *h*.
,, *sexangulare*, Rabenh.	r											
,, ,, var. *supernumerarium*, var. n.	rrr											
,, *Arctiscon*, Lund.	r	...	...	r	r	..	...	...	...	...	cc	Densely scrobiculate and with long processes, *e*. Some specimens approached very closely the var. *glabrum*, West & G. S. West, *k*.
Spondylosium pulchrum, Arch., var. *planum*, Wolle.	c	...	...	...	...	...	...	cc	cc	c	...	Only short filaments, *a*.
Sphærozosma granulatum, Roy & Biss.	...	...	...	...	rrr							
,, *vertebratum*, Ralfs	...	...	...	...	rr							

Desmidium aptogonum, Bréb.	...	...	...	...	r							
" *graciliceps*, Lagerh.	...	...	...	...	c							
Gymnozyga moniliformis, Ehrenb.	...	...	...	...	cc							
Hyalotheca neglecta, Racib.	c	...	...	...	r	...	...	...	...	...	...	This species seems generally distributed in
" *dissiliens*, Bréb.	rr	...	...	...	r	...	...	rr				the North-west of Scotland, *e*.
" *mucosa*, Ehrenb.	rrr	...	...	...	...	..	...	...	...	...	rr	
Eudorina elegans, Ehrenb.	...	...	...	...	...	...	...	...	...	...	r	
Pediastrum Boryanum, Menegh.	...	...	cc	r	c	ccc	ccc	...	...	...	...	Some of the cœnobia were very large, *c*.
" *duplex*, Meyen	...	...	c	...	...	cc						
" *Tetras*, Ralfs	...	...	rr	...	...	...	...	...	...	...	...	This species includes *P. angulosum*, Menegh., *c*.
Sorastum americanum, Schmidle	...	...	...	rrr								
Scenedesmus obliquus, Kütz.	..	...	...	...	...	...	ccc					
" *quadricauda*, Bréb.	rr	...	ccc	...	...	...	cc	cc				
" var. *abundans*, Kirchn.	...	...	r									
" *bijugatus*, Kütz.	...	...	rrr									
" *Hystrix*, Lagerh.	...	...	rrr									
Rhaphidium fasciculatum, Kütz.	...	...	r	...	...	...	c	r				
" var. *aciculare*, Rabenh.	c	r	...	...	...	...	...	r	...	...	...	Solitary individuals with much attenuated
" *Pfitzeri*, Schröd.	...	...	rr									[apices, *h*.
Kirchneriella obesa, Schmidle	...	...	rrr	...	...	...	ccc	...	...	...	...	In very large colonies, *g*.
" *lunaris*, Moeb.	...	...	c	...	...	...	...	...	..	...	...	Large colonies with young autocolonies, *c*.
Crucigenia rectangularis, West & G. S. West	...	...	c	...	...	..	...	...	...	...	...	Large forms with autospores.
Tetraedron regulare, Kütz.	...	...	r									
" *cruciatum*, West & G. S. West	...	...	rr	...	...	...	...	...	...	...	r	Some forms somewhat irregular, *c*.
												A somewhat irregular variety, *k*.
Dimorphococcus lunatus, A. Br.	...	...	rr	...	...	...	...	...	...	...	...	Large colonies, mostly producing autospores.
Dictyocystis Hitchcockii, Lagerh.	cc	...	...	...	r	...	...	...	...	...	rr	
Botryococcus Braunii, Kütz.	ccc	c	r	r	r	...	c					
" *sudeticus*, Lemm.	...	rr										
" var. *planctonicus*, Lemm.	rr											
Ineffigiata neglecta, West & G. S. West	cc	...	c	...	r	c	cc					
Dictyosphærium pulchellum, Wood	cc	...	...	...	...	...	...	...	...	...	...	Some of the colonies were very large; diam.
" *Ehrenbergianum*, Näg.	..	...	...	...	rrr							cell. 4·8–7·5 μ: *a*.
Nephrocytium Agardhianum, Näg.	rr	...	...	...	...	...	...	...	rrr			
" *lunatum*, West	r	...	...	...	...	...	...	rrr				
Oocystis solitaria, Wittr.	rrr											
Sphærocystis Schroeteri, Chodat	ccc	cc	...	...	...	...	...	r	...	cc	...	This alga most probably includes *Tetraspora*
Glæocystis gigas, Lagerh.	...	rr	...	...	...	...	c	...	...	...	c	[*lacustris*, Lemm., *a* & *b*.

Species.	*a.* Loch Shin.	*b.* Loch a Gharbh Bhaid Mhoir.	*c.* Loch Mor Bharabhais.	*d.* Loch Laxadale.	*e.* Loch Nan Eun.	*f.* Loch Skealtur.	*g.* Loch a Bhursta, Benbecula.	*h.* Loch Tay.	*i.* Loch Katrine.	*j.* Loch Achray.	*k.* Loch Doon.	Remarks.
Heterokontæ.												
Ophiocytium bicuspidatum, Lemm.	...	...	...	...	...	r						
,, *capitatum*, Wolle	...	...	...	...	...	...	...	...	...	r		
,, *cochleare*, A. Br.	...	...	...	...	...	...	...	...	...	...	r	Lemmermann states that he has found *Oodesmus Doederleinii*, Schmidle, in the plankton of *k*, but we have failed to observe this plant.
Phæophyceæ.												
Stichoglœa olivacea, Chodat	...	rr	...	...	...	...	...	...	...	...	...	We include this alga on the authority of Lemmermann, *b*.
Dinobryon cylindricum, Imhof, var. *palustre*, Lemm.	cc	...	...	...	c	...	...	...	ccc			
,, ,, var. *divergens*, Lemm.	...	c	c									
,, ,, var. *angulatum*, Lemm.	...	...	...	...	...	...	...	...	...	...	cc	
,, *protuberans*, Lemm.	...	...	...	...	...	...	...	...	...	...	r	
,, *stipitatum*, Stein, var. *bavaricum*, Lemm.	...	...	...	...	...	...	...	...	...	...	c	
Bacillarieæ.												
Amphipleura pellucida, Kütz.	c	...	...	...	...	...	...	r				
Amphora ovalis, Kütz.	...	...	c	...	...	...	...	r	...	...	rr	Some very large valves were noticed, 106 μ in length, *h*.
Cymbella cuspidata, Kütz.	...	...	...	...	...	...	...	r				
,, *cymbiformis*, Bréb.	...	...	...	...	...	...	...	c				
,, *Cistula*, Kirch., v. *maculata*, Grun.	...	...	...	...	...	...	...	cc				
Encyonema ventricosum, Kütz.	...	...	c									
Vanheurckia rhomboides, Bréb.	...	...	...	...	cc							
,, ,, var. *saxonica*, West & G. S. West.	...	...	...	cc	...	...	...	...	...	...	cc	
Navicula gibba, Kütz.	...	...	rr									
,, *divergens*, Ralfs	...	...	...	rrr	...	...	...	...	...	...	r	

Navicula major, Kütz.	...	...	...	...	c	cc	...	...	...	...	ccc	
" *elliptica*, Kütz.	...	...	...	...	...	...	...	r				
" " var. *minima*, V. Houtte	...	...	...	...	...	...	...	...	...	...	rrr	
" *nobilis*, Kütz.	...	...	...	...	...	...	...	...	...	rr		
" *alpina*, Kütz.	...	...	...	...	...	...	...	...	...	...	rrr	
Stauroneis anceps, Ehrenb.	...	...	...	...	...	...	...	r				
Gomphonema acuminatum, Ehrenb.	...	...	...	cc	rrr	...	...	...	...	..	...	Some specimens were very elongate, *d*.
" *geminatum*, Agh.	...	...	...	...	...	...	...	c	...	...	...	This diatom was fairly common in *h*, but all the specimens noticed were empty valves.
" *constrictum*, Ehrenb.	...	...	...	...	...	...	...	r				
Epithemia turgida, Kütz.	...	...	r									
Achnanthes exilis, Kütz.	...	...	...	...	...	...	...	...	c			
Achnanthidium flexellum, Bréb.	...	...	...	c	...	...	...	r				
Synedra pulchella, Kütz.	...	...	rr									
" *Acus*, Grun.	..	...	...	cc	r	ccc	...	...	cc	c		
" *Ulna*, Ehrenb.	...	...	...	...	...	...	...	c				
Ceratoneis Amphioxys, Rabenh.	..	...	...	...	...	...	...	r				
Eunotia lunaris, Grun.	rr	...	...	c	...	...	...	c	...	...	cc	
" *gracilis*, Rabenh.	...	...	...	r								
" *pectinalis*, Rabenh.	...	...	...	cc	...	...	...	cc	...	...	cc	
" " var. *bidens*, Grun.	...	...	...	...	...	...	...	...	...	..	r	
" " var. *undulata*, Ralfs.	...	...	...	..	...	...	...	...	...	...	c	
" *flexuosa*, Kütz., var. *bicapitata*, Grun.	...	...	...	ccc	...	...	...	...	...	...	...	Small slender forms, *d*.
" *tetraodon*, Ehrenb.	...	...	...	...	...	...	rrr	...	...	...	...	All the diatoms were very scarce, *g*.
Asterionella gracillima, Heib.	ccc	ccc	cc	...	...	...	...	...	...	...	cc	
" *formosa*, Hass.	...	...	c	...	..	...	...	ccc	c	ccc	c	
Fragilaria construens, Grun.	...	...	ccc	...	c							
" *mutabilis*, Grun.	...	...	...	ccc								
Diatoma elongatum, Agh.	...	...	...	...	...	...	r					
Tabellaria flocculosa, Kütz.	ccc	cc	ccc	ccc	...	...	...	ccc	ccc	...	cc	
" *fenestrata*, Kütz.	cc	ccc	...	ccc	ccc	ccc	rr	c	cc	ccc	ccc	
" var. *asterionelloides*, Grun.	...	rrr										
Tetracyclus lacustris, Ralfs.	r	...	...	...	...	...	...	...	...	...	rr	
Surirella robusta, Ehrenb.	...	...	...	...	c	c	...	...	...	...	c	
" var. *splendida*, V. Houtte	...	...	c	r	cc	cc	...	...	...	cc	r	
" *biseriata*, Bréb.	...	...	...	..	..	...	...	...	...	...	cc	
" *linearis*, W. Sm.	...	...	r	c								
" *ovalis*, Bréb.	...	...	...	...	...	...	...	...	...	...	r	
" " var. *pinnata*, V. Houtte	...	...	...	...	...	...	...	...	...	...	r	
" " var. *angusta*, V. Houtte	...	...	...	rr								

Species.	*a.* Loch Shin.	*b.* Loch a Gharbh Bhaid Mhoir.	*c.* Loch Mor Bharabhais.	*d.* Loch Laxadale.	*e.* Loch Nan Eun.	*f.* Loch Skealtur.	*g.* Loch a Bhursta, Benbecula.	*h.* Loch Tay.	*i.* Loch Katrine.	*j.* Loch Achray.	*k.* Loch Doon.	Remarks.
BACILLARIEÆ (*cont.*).												
Cymatopleura Solea, W. Sm.	...	...	rr									
Nitzschia Palea, W. Sm.	...	...	c	...	. .	...	rrr	...	...	...	c	
Cyclotella Meneghiniana, Kütz.	cc											
" *compta*, Kütz.	...	...	cc									
" *operculata*, Kütz.	...	...	...	c								
Rhizosolenia eriensis, H. Sm.	rrr											
" *longiseta*, Zach.	r	rr										
" " var. *stagnalis*, Zach.	r											
Myxophyceæ.												
Hapalosiphon hibernicus, West & G. S. West	...	...	...	...	cc							
Lyngbya limnetica, Lemm.	...	...	...	...	...	...	...	...	...	...	rr	
" *versicolor*, Gomont	r	...	...	...	...	...	...	...	...	...	...	Cells subquadrate; lat. 2·5–2·7 μ, *a*.
Nostoc microscopicum, Carm.	...	...	...	...	r							
Anabaina circinalis, Rabenh.	c	...	ccc	...	c	...	...	...	...	...	...	Abundant with spores, *c*.
" *Lemmermannii*, P. Richter	r	c										
Cœlosphærium Nägelianum, Unger	...	cc	...	...	...	...	...	...	ccc	ccc		
" *Kützingianum*, Näg.	...	...	...	...	...	...	...	ccc				
Gomphosphæria lacustris, Chodat	rrr	rrr	...	...	...	...	...	...	...	...	...	Inserted on the authority of Lemmermann, *a* & *b*.
Synechococcus major, Schroet.	...	...	...	...	...	...	c					
Merismopedia glauca, Näg.	...	...	...	...	...	...	r	...	...	...	cc	
Microcystis incerta, Lemm.	...	...	ccc									
" *elabens*, Kütz.	...	...	...	c								
Chroococcus limneticus, Lemm.	rr	...	r	...	...	...	...	...	...	...	rrr	
" *cohærens*, Näg.	...	...	ccc									
" *minor*, Kütz.	...	...	...	...	...	...	rr					
" *turgidus*, Näg.	...	...	...	...	...	...	...	...	...	...	r	

The Plankton from three of the more Lowland Lochs was not rich, and contained no Desmids; it has therefore been placed in a separate table, as it is so very different from the rest of the material obtained from the more hilly regions.

Plankton from Loch Thom, Renfrewshire; Loch Humphrey, Dumbartonshire; and Loch Woodend, Lanarkshire.

The material was collected from these three lochs in April, 1903, by allowing the water near the outlet of each loch to pass through the nets for some time. Few species were obtained, and this is to be chiefly attributed to the earliness of the season.

Loch Thom is about one and a half miles in length, and is 600 ft. above sea-level, with high moorlands at its head.

Species.	Loch Thom.	Loch Humphrey.	Loch Woodend.	Remarks.
Chlorophyceæ.				
Ulothrix zonata, Kütz.	...	r		
Sphærella lacustris, Wittr.	...	...	cc	
Pandorina Morum, Bory	...	...	c	
Sphærocystis Schroeteri, Chodat	...	c		
Phæophyceæ.				
Dinobryon Sertularia, Ehrenb.	...	...	c	
Bacillarieæ.				
Synedra pulchella, Kütz.	...	r		
Asterionella formosa, Hass.	ccc	ccc		
„ *gracillima*, Heib.	...	...	ccc	This might readily be placed as a slender form of *A. formosa*.
Tabellaria flocculosa, Kütz.	r	r		
„ *fenestrata*, Kütz., var. *asterionelloides*, Grun.	...	c		
Tetracyclus lacustris, Ralfs	...	cc		
Melosira granulata, Ralfs	ccc	cc	...	Abundant and with sporangia.
Myxophyceæ.				
Oscillatoria tenuis, Agh.	...	r		
Cœlosphærium Kützingianum, Näg.	ccc	cc		

Loch Humphrey is less than a mile in length, and is situated at an altitude of over 1000 ft.

Loch Woodend is a small lowland loch about 260 ft. above sea-level.

Peridinium tabulatum and *Glenodinium cinctum* were frequent in Loch Humphrey, and *Ceratium tetraceros*, Schranck, was present in Loch Thom. The Rotifer *Anuræa cochlearis*, Gosse, was abundant in both Loch Thom and Loch Humphrey.

III.—Systematic Account of the most interesting Species in the preceding Plankton Collections.

Owing to the extraordinary richness of the Scottish plankton in Desmids, the following account is almost entirely concerned with these plants, and in it we have attempted to clear up many of the difficulties of their nomenclature.

With the permission of Sir John Murray, we have included in this account six Desmids from the plankton of Sutherland:—*Euastrum verrucosum*, Ehrenb., var. *planctonicum*, var. n.; *Micrasterias Murrayi*, sp. n.; *Xanthidium subhastiferum*, West, and var. *Murrayi*, var. n.; *Staurastrum jaculiferum*, West, var. *subexcavatum*, var. n.; *St. Arachne*, Ralfs, var. *curvatum*, var. n.; and *St. brevispinum*, Bréb., var. *retusum*, Borge: material containing specimens of these has been collected and kindly forwarded to us by Mr. J. Murray of Edinburgh, who is engaged on the Lake Survey (Pullar Trust). These are included because of the interesting comparisons they afford with other Desmids observed in our own plankton collections.

Class CHLOROPHYCEÆ.

Order **Conjugatæ**.

Family Desmidiaceæ.

Genus Genicularia, *De Bary*.

1. G. elegans, sp. n. (Pl. **14.** figs. 1, 2.)

G. elongata, cellulis diametro 20–28-plo longioribus, leviter curvatis, cylindricis, polis leviter dilatatis et firmioribus; membrana dense et irregulariter asperulata; chromatophoris 2, parietalibus, laxe spiraliter contortis, anfractibus $1\frac{1}{2}$–4, pyrenoidibus in serie singula numerosis.

Long. cell. 303–427 μ; lat. cell. 14–16·3 μ; lat. apic. 17–18·5 μ.

Hab. Loch Nan Eun, N. Uist, Outer Hebrides.

This interesting Desmid occurred in small quantity amongst other rare species in the plankton collections from the above-mentioned lake. It is distinguished from *Genicularia spirotænia*, De Bary, by its narrower and more elongate cells, and by the fewer turns (from one and a half to four), and therefore the laxer disposition of the two spiral chloroplasts.

The cell-wall is rough with small sharp granules as in *G. spirotænia* and the rough species of the genus *Gonatozygon.* Each cell possesses a prominent nucleus embedded in a small mass of protoplasm near its central portion.

Genus Closterium, *Nitzsch.*

2. C. Cynthia, *De Not. Desm. Ital.* 1867, p. 65, t. 7. f. 11.

Var. curvatissimum, var. n. (Pl. **14**. fig. 3.)

Var. cellulis plus elongatis et multi incurvatis; pyrenoidibus 6 in chromatophora unaquaque.

Lat. 12·5 μ; apicibus 88 μ inter se distantibus.

Hab. Loch a Bhursta, Benbecula, Outer Hebrides.

This variety is much elongated without changing the curvature, so that although the apices are only 88 μ apart, a distance of 102 μ can be measured across the curvature. The curvature occupies 210° of arc, which is greater than any curvature recorded for this genus.

Genus Euastrum, *Ehrenb.*

3. E. verrucosum, *Ehrenb.*; *Ralfs, Brit. Desm.* 1848, p. 79, t. 11. f. 2.

Var. planctonicum, var. n. (Pl. **15**. fig. 4.)

Var. sinu late aperto; lobis lateralibus integris, obtuse conicis.

Long. 90 μ; lat. 91 μ; lat. isthm. 19·5 μ.

Hab. Loch Ruar, Sutherland (*J. Murray*)!

This striking variety occurred plentifully in the plankton of the above-mentioned lake, and is characterized by the conical outstanding lateral lobes with entire margins. With the exception of the sinus, which is widely open, the rest of the characters are as in the typical form.

Genus Micrasterias, *Agh.*

4. M. Murrayi, sp. n. (Pl. **15**. figs. 1, 2.)

M. mediocre, tam longa quam lata, profundissime constricta, sinu acutangulo late aperto; semicellulæ late subsemicirculares et profunde quinquelobæ, incisuris inter lobos late apertis; lobo polari cum lateribus subparallelis, prope apicem subito dilatato, apice retuso-emarginato, angulis emarginato-dentatis, cum denticulo minuto intra marginem angulos emarginatos versus; lobis lateralibus æqualibus, in lobulis æqualibus 4 divisis, incisura mediana multe profundiore, lobulis emarginato-dentatis; cum serie denticulorum minutorum intra margines incisurorum primariarum 4 et sinus.

Long. 142–151 μ; lat. 142–147 μ; lat. isthm. 18 μ.

Hab. Loch Ruar, Sutherland (*J. Murray*)!

This species was in abundance, and its characters, which are very constant, do not agree with those of any described species of *Micrasterias*. The incisions between the lobes and lobules are all widely open with concave sides, which causes them to be widest about the middle. The sinus, which is more open than that of any other incised *Micrasterias*, is one of the most striking features of the species.

The only two species with which it could be confounded are *M. papillifera*, Bréb., and *M. radiosa*, Ralfs (particularly var. *ornata*, Nordst.).

From *M. papillifera* it is distinguished by the widely open sinus and incisions, which are also deeper, and by the very different form of the polar lobe. It is distinguished from *M. radiosa* by the widely open sinus and incisions, which are not so deep, and by the absence of the further subdivision of the superior lateral lobes.

M. Murrayi possesses a series of minute denticulations along the margins of the sinus and each of the incisions between the lobes. This character is present in *M. papillifera*, and also in *M. radiosa* var. *ornata*.

Var. triquetra. (Pl. **15**. fig. 3.)

Var. cellulis triquetris, a vertice visis triradiatis.

Long. 163 μ; lat. 151 μ; lat. isthm. 16 μ.

Hab. Loch Doon, Ayrshire.

This extraordinary variety is of great interest, as only one other triangular form of this genus has been previously observed, viz., *M. pinnatifida*, Ralfs, var. *trigona*, West (in Journ. Bot. xxvi. (1888) p. 206, t. 291. f. 15).

Genus XANTHIDIUM, *Ehrenb.*

5. X. ANTILOPŒUM, *Kütz. Spec. Algar.* p. 177.—Cosmarium antilopœum, *Bréb. in Linnæa*, xiv. (1840) p. 218. X. fasciculatum, *Ralfs, Brit. Desm.* (ex parte), t. 20. f. 1 *a*, *c*.

The plankton-forms of this species are numerous and variable. Many of them are strictly typical, but more often they are not. One of the most abundant forms has the spines much reduced in size and number, some of the angles being occasionally quite destitute of spines. The semicells are also somewhat inflated. (Pl. **16**. fig. 1.)

Long. sine spin. 51–55·5 μ ; lat. sine spin. 44–50 μ ; long. spin. 2–9·5 μ ; lat. isthm. 14·5–14 μ.

Hab. Loch Doon, Ayrshire.

6. X. CONTROVERSUM, *West & G. S. West, in Journ. Linn. Soc., Bot.* xxxiii. (1898) p. 298, t. 17. f. 2.—X. antilopœum? var., *West & G. S. West, in Trans. Linn. Soc.*, ser. 2, *Bot.* v. (1896) p. 252, t. 16. f. 1.

Var. PLANCTONICUM, var. n. (Pl. **16**. figs. 2, 3.)

Var. major; sinu minus aperto, lineari, ad extremum ampliato: semicellulis in centro scrobiculatis et cum tumore parvo; a vertice visis ellipticis cum tumore parvo in medio utrobique.

Long. sine spin. 49–52 μ; lat. sine spin. 46–49 μ; long. spin. 16–23 μ; lat. isthm. 12·5–13·5 μ; crass. 31 μ.

Hab. Loch Shin, Sutherland.

This variety was extremely abundant from Loch Shin, and its characters are so striking that it might perhaps be regarded as a distinct species (*X. planctonicum*). The cells are larger than those of *X. controversum*, the sinus is closed, the spines are longer, and those of the inferior angles are less divergent; in the centre of the semicells is a scrobiculated area which is thickened and shows as a protuberance in the vertical and lateral views. As in typical *X. controversum*, odd spines of this variety are frequently replaced by a pair.

It should be compared with *X. tetracanthum*, W. B. Turn. (in Kongl. Sv. Vet.-Akad. Handl. Bd. xxv. (1893) no. 5, p. 101, t 13. f. 29), from which it differs in its hexagonal semicells, closed sinus, and longer spines.

7. X. TETRACENTROTUM, *Wolle, Desm. U. S.* p. 95, t. 22. ff. 8, 9; *West & G. S. West, in Trans. Linn. Soc.*, ser. 2, *Bot.* v. (1896) p. 253, t. xv. f. 24.—Arthrodesmus incrassatus, *Lagerh. in. Öfvers. af K. Vet.-Akad. Förh.* (1885) no. 7, p. 242, t. 1. f. 18.

A form with a more pronounced central protuberance. (Pl. **16**. fig. 7.)

Long. 58 μ; lat. sine spin. 52 μ, cum spin. 79 μ; long. spin. 10·5–15 5 μ; lat. isthm. 15 μ; crass. 36 μ.

Hab. Loch Laxadale, Harris, Outer Hebrides.

8. X. SUBHASTIFERUM, *West, in Journ. Linn. Soc., Bot.* xxix. (1892) p. 166, t. 22. f. 4.

Long. 52–53·5 μ; lat. sine spin. 48·5–53·5 μ, cum spin. 81–86 μ; long. spin. 14–16 μ; lat. isthm. 14–16·5 μ; crass. 29 μ. (Pl. **16**. figs. 4, 5.)

Hab. Loch Ghriar and Loch Nan Cuinne, Sutherland (*J. Murray*)!

The Scotch specimens of this species were identical in all respects with those observed from Ireland. A certain amount of variability of the spines was noticed, one spine being frequently reduced or absent (*cf.* Pl. **16**. fig. 5 *a*). The great majority of the specimens possessed two equal divergent spines placed one above the other.

Var. MURRAYI, var. n. (Pl. **16**. fig. 6.)

Var. semicellulis subobsemicircularibus, apicibus truncato-convexis, angulis superioribus cum spinis longis geminatis subhorizontaliter dispositis.

Long. 52 μ; lat. sine spin. 50·5–51·5 μ, cum spin. 87–89 μ; long. spin. 18–20 μ; lat. isthm. 17 μ; crass. 28 μ.

Hab. Loch Nan Cuinne, Sutherland (*J. Murray*)!

Genus COSMARIUM, *Corda*.

9. C. LUNDELLII, *Delp. in Mem. Accad. Sci. Torino*, ser. 2, xxx. (1878) p. 13, t. 7. ff. 62–64.—C. subcirculare, *W. B. Turn. in K. Sv. Vet.-Akad. Handl.* xxv. (1892) no. 5, p. 52, t. 8. f. 3, and t. 9. ff. 27, 37.

Var. ÆTHIOPICUM, *West & G. S. West*, *in Journ. Bot.* xxxv. (April 1897) p. 114.

Long. 69 μ; lat. 61 μ; lat. isthm. 28 μ; crass. 40 μ. (Pl. **15.** fig. 7.)

Hab. Loch Shin, Sutherland.

10. C. CAPITULUM, *Roy & Biss. in Journ. Bot.* xxiv. (1886) p. 195, t. 268. f. 9.

Var. GRŒNLANDICUM, *Börgesen*, *Ferskv. alg. Östgrönl.*, *Meddelelsen om Grönl.* 18, Kjöbenhavn, 1894, p. 16, t. 1. f. 5.

Long. 28–31 μ; lat. 25 μ; lat. isthm. 9–11·5 μ; crass. 16 μ. (Pl. **15.** fig. 5.)

Hab. Loch Doon, Ayrshire.

11. C. ABBREVIATUM, *Racib. in Pamietnik. Wydz. matem.-przy. Akad. Umiej. Krakow.* x. (1885) p. 83, t. 10. f. 13.

Var. major, angulis superioribus rotundatioribus.

Long. 20–28 μ; lat. 22–29 μ; lat. isthm. 5·5–8 μ; crass. 10·5–13 μ. (Pl. **15.** fig. 6.)

Hab. Loch Shin, Sutherland. Loch Mor Bharabhais, Lewis Outer Hebrides.

Genus ARTHRODESMUS, *Ehrenb.*

12. A. CRASSUS, sp. n. (Pl. **14.** figs. 8, 9.)

A. parvus, circiter tam longus quam latus (sine spinis), modice constrictus, sinu latissime aperto leviter acuminato; semicellulæ obverse subtriangulares, marginibus lateralibus levissime convexis, apice late convexo, angulis acutis spina brevissima instructis; a vertice visæ late elliptico-fusiformes, polis acutis cum spina brevissima.

Long. 21–24 μ; lat. (sine spin.) 19–23 μ; long. spin. 1·5 μ; lat. isthm. 9·5–12·5 μ; crass. 13 μ.

Hab. Loch Mor Bharabhais, Lewis, Outer Hebrides.

This plant is of the same size as *A. psilosporus*, Nordst. et Löfgr. (in Wittr. & Nordst. Alg. Exsic. 1883, no. 558), but is relatively shorter, and the semicells are never retuse either at the sides or the apex; the vertical view has also more acute poles.

It is distinguished from *A. Phimus*, W. B. Turn., by its more robust aspect, its convex apices, much shorter spines, and its greater thickness in the vertical view.

In its general form *A. crassus* might be compared with *A. controversus*, West, but the exceedingly small size and delicacy of the latter is sufficient to distinguish it. The vertical view is also broadly elliptical, whereas that of *A. crassus* is fusiform-elliptic.

13. ARTHRODESMUS QUIRIFERUS, sp. n. (Pl. **17.** figs. 9, 10.)

A. submagnus, paullo longior quam latus (sine spinis), modice constrictus, sinu latissime aperto et rotundato vel interdum extremum versus angustiore; semicellulæ subtriangulares, marginibus lateralibus convexis, apice late concavo, angulis spina valida longissima recta divergente instructis; a vertice visæ ellipticæ, polis cum spina valida longissima; cellulis fere tortis.

Long. sine spin. 28–31 μ; lat. sine spin. 25–26 μ; long. spin 31–44 μ; lat. isthm. 6–9·5 μ; crass. 10–11 μ.

Hab. Loch Shin, Sutherland; Loch Laxadale, Harris, Outer Hebrides.

This species occurred in prodigious quantity in the plankton of Loch Shin. It is distinguished from the biradiate form of *Staurastrum jaculiferum* by the outward form of the cells, with retuse apices, and by the longer spines. One of its most conspicuous features is the torsion of its cells, which appear to be twisted at the isthmus. The specimens showed a certain amount of variability.

14. A. TRIANGULARIS, *Lagerh. in Öfvers. af K. Vet.-Akad. Förh.* (1885) no. 7, p. 244, t. 27. f. 22.—A. Incus, *Hass.*, var. triangularis, *Lagerh. in Nuova Notarisia*, iv. (1893) p. 182.

Var. HEBRIDARUM, var. n.

Var. corpore semicellularum robustiore, apicibus convexis, sinu minus aperto, spinis validioribus et paullo longioribus: membrana cum scrobiculis parvis et sparsis.

Long. 32·5 μ; lat. sine spin. 25 μ, cum spin. 84·5 μ; lat. isthm. 8·5 μ; long. spin. 27–31 μ.

Hab. Loch Nan Eun, N. Uist, Outer Hebrides.

This variety resembles *A. triangularis*, var. *americanus*, West & G. S. West, more than the typical form, but the spines are much stouter and longer. It should also be compared with *A. Incus*, var. *subtriangularis*, Borge (in Botan. Notiser, 1897, p. 212, t. 3. f. 4).

Genus Staurastrum, *Meyen.*

15. S. curvatum, *West, in Journ. Linn. Soc., Bot.* xxix. (1892) p. 172, t. 22. f. 13.

The specimens were almost exactly like the original Irish examples.

Long. sine spin. 31–32·5 μ; lat. sine spin. 31–35 μ; lat. cum spin. 71–75 μ; long. spin. 21–23 μ; lat. isthm. 6·5–8 μ. (Pl. **17.** fig. 12.)

Hab. Loch Shin, Sutherland.

16. S. jaculiferum, *West, l. c.* t. 22. f. 14.

There seems little doubt that *Arthrodesmus longicornis*, Roy, is merely a biradiate form of *S. jaculiferum* in which the spines are not quite so divergent. Börgesen ("Freshw. Alg. Færöes," in Botany of the Færöes, part i., Copenhagen, 1901, p. 232, t. 8. f. 1) has observed specimens from the Faroe Is. in which one semicell was biradiate and identical with that of *Arthrodesmus longicornis*, the other semicell being triradiate and agreeing with that of typical *Staurastrum jaculiferum*. Borge (in Botan. Notiser, 1897, p. 213, t. 3. ff. 5, 6) has also found the biradiate form in plankton material collected in the Isle of Mull.

We find considerable variability in the amount of divergence of the spines, and the three forms of *S. jaculiferum* generally met with are:—

Forma biradiata. (*Arthrodesmus longicornis*, Roy.) A variable form, sometimes with a longer isthmus. (Pl. **17**. fig. 1.)

Long. sine spin. 21–27 μ; lat. sine spin. 17–20 μ; long. spin. 25–31 μ; lat. isthm. 5·5–7·5 μ; crass. 12·5 μ.

Hab. Loch a Gharbh Bhaid Mhoir, Sutherland. Loch Mor Bharabhais, Lewis; and Loch Skealtur, N. Uist, Outer Hebrides. Loch Tay and Loch Katrine, Perthshire. Loch Doon, Ayrshire.

Forma triradiata. (Pl. **17**. figs. 2, 3.)

Long. sine spin. 21–24 μ; lat. sine spin. 17–18 μ; long. spin. 24–35 μ; lat. isthm. 7·5 μ.

Hab. Loch Mor Bharabhais, Lewis, Outer Hebrides. Loch Doon, Ayrshire. Loch Tay, Perthshire.

Forma quadriradiata. (Pl. **17**. fig. 4.)

Long. sine spin. 23 μ; lat. sine spin. 17–19 μ; long. spin. 29–31 μ; lat. isthm. 6 μ.

Hab. Loch Mor Bharabhais, Lewis, Outer Hebrides.

Var. EXCAVATUM, var. n. (Pl. **17**. fig. 5.)

Var. cum sinu latissime excavato et isthmo elongato-cylindrico.

Long. sine spin. 26–27 μ; lat. sine spin. 16–19 μ; long. spin. 21–29 μ; lat. isthm. 8·5 μ.

Hab. Loch Shin, Sutherland.

Var. SUBEXCAVATUM, var. n. (Pl. **17**. figs. 6–8.)

Var. corpore minore et spinis validioribus; sinu excavato et isthmo subcylindrico.

Long. sine spin. 25–28 μ; lat. sine spin. 16–18 μ; long. spin. 25–31 μ; lat. isthm. 6·5–7 μ.

Hab. Loch Ruar, Sutherland (*J. Murray*)!

17. STAURASTRUM ARISTIFERUM, *Ralfs, Brit. Desm.* 1848, p. 123, t. 21. f. 2.

Var. PROTUBERANS, var. n. (Pl. **14**. fig. 5.)

Var. apicibus cellularum in medio valde convexis; semicellulæ a vertice visæ triangulares, lateribus in medio convexis.

Long. sine spin. 23–27 μ; lat. sine spin. 24–27 μ; long. spin. 13·5–17 μ; lat. isthm. 9·7 μ.

Hab. Loch Nan Eun, N. Uist, Outer Hebrides.

This variety differs principally in the convex apices of the semicells, and in the convex swelling in the middle of each side of the vertical view.

18. S. MEGACANTHUM, *Lund. in Nov. Act. R. Soc. Scient. Upsala*, ser. 3, viii. (1871) no. 2, p. 61, t. 4. f. 1.

Var. SCOTICUM, var. n. (Pl. **16**. fig. 8.)

Var. apicibus cellularum rectis vel leviter concavis, sinu paullo apertiore, spinis longioribus et leviter divergentibus.

Long. sine spin. 35–44 μ; lat. sine spin. 38–51 μ, cum spin. 79–111 μ; long. spin. 19–34 μ; lat. isthm. 10·5 μ.

Hab. Loch Shin, Sutherland. Loch Doon, Ayrshire.

This variety varies considerably in size, and is unquestionably the plant described and figured by Borge as "? *S. megacanthum*, Lund. forma" from plankton collected in the Isle of Mull. It is readily distinguished from typical *S. megacanthum* by the slightly hollow apices of the cells and the longer, slightly divergent spines.

19. STAURASTRUM MUCRONATUM, *Ralfs, in Jenner, Fl. Tunbridge Wells*, 1845, p. 192; *in Ann. & Mag. Nat. Hist.* xv. (1845) p. 152, t. 10. ff. 5, 6.—*West & G. S. West, in Trans. Roy. Irish Acad.* xxxii. sect. B, part 1 (1902) p. 44, t. 2. f. 31.

Var. SUBTRIANGULARE, var. n. (Pl. **17**. fig. 11.)

Var. major, sinu apertiore, semicellulis cum dorso subrecto vel leviter convexo et ventre subsemicirculari.

Long. 38·5 μ; lat. sine spin. 42–44 μ, cum spin. 51–53·5 μ; long. spin. 3·8–4·6 μ; lat. isthm. 9·5 μ.

Hab. Loch Doon, Ayrshire.

20. S. DICKIEI, *Ralfs, Brit. Desm.* 1848, p. 123, t. 21. f. 3.

Var. RHOMBOIDEUM, var. n. (Pl. **16**. fig. 9.)

Var. semicellulis distincte rhomboideis, spinis valde incurvatis.

Long. 37 μ; lat. sine spin. 38·5–46 μ; long. spin. 6–9·5 μ; lat. isthm. 8·5 μ.

Hab. Loch Nan Eun, N. Uist, Outer Hebrides.

21. S. CUSPIDATUM, *Bréb. in Menegh. Synops. Desm.* 1840, p. 226; *Ralfs, Brit. Desm.* 1848, p. 122, t. 21. f. 1, t. 33. f. 10.

Var. MAXIMUM, *West, in Naturalist* (1891), p. 247.

Long. sine spin. 32–34·5 μ; lat. sine spin. 24–25·5 μ; long. spin. 15–17 μ; lat. isthm. 3·5–7 μ. (Pl. **17**. fig. 13.)

Hab. Loch Shin, Sutherland. Loch Mor Bharabhais, Lewis; and Loch Nan Eun, N. Uist, Outer Hebrides. Loch Katrine and Loch Achray, Perthshire.

This variety was very abundant in some of the plankton collections and also very variable. In most of the examples the spines were curved outwards, sometimes only a little, but often very much.

The different forms of this variety seem to embrace the var. *longispinum*, Lemm. (Botan. Centralbl. Bd. lxxvi. 1898, p. 4 sep.).

22. S. LONGISPINUM *Arch. in Pritch. Infus.* ed. 4, 1861, p. 743.—Didymocladon? longispinum, *Bail.* 1851.

Long. 90–101 μ; lat. sine spin. 73–82 μ; long. spin. 9·5–32·5 μ.

Hab. Loch Nan Eun, N. Uist, Outer Hebrides.

The spines of this species vary much in length, and all intermediate stages are met with between the long-spined typical form and var. *bidentatum* nob. (= *Staurastrum bidentatum*, Wittr.).

23. STAURASTRUM BRASILIENSE, *Nordst. in Vidensk. Meddel.* (1870) p. 227, t. 4. f. 39.

Var. LUNDELLII, *West & G. S. West, in Trans. Linn. Soc.*, ser. 2, *Bot.* v. (1896) p. 259; *Journ. Bot.* xxxviii. (1900) p. 295. —S. brasiliense, var. Lundellianum, *Schmidle, in Bih. till K. Sv. Vet.-Akad. Handl.* Bd. xxiv. (1898) Afd. III. no. 8, p. 58.

Long. sine spin. 79 μ, cum spin. 125 μ; lat. sine spin. 68 μ, cum spin. 125 μ; lat. isthm. 30 μ.

Hab. Loch a Gharbh Bhaid Mhoir, Sutherland. Loch Nan Eun, N. Uist, Outer Hebrides.

All the specimens observed were pentagonal in vertical view, and were precisely like numerous examples seen from Wales and the West of Ireland. It appears to be a Desmid of a distinctly western type, and even in those areas in which it occurs it is more abundant in the plankton than in bog-pools.

24. S. BREVISPINUM, *Bréb. in Ralfs, Brit. Desm.* 1848, p. 124, t. 34. f. 7.

Var. RETUSUM, *Borge, in Bih. till K. Sv. Vet.-Akad. Handl.* Bd. xix. (1894) no. 5, p. 36, t. 3. f. 42.

Long. 52 μ; lat. 41 μ; lat. isthm. 13·5 μ. (Pl. **14**. fig. 6.)

Hab. Loch Nan Cuinne, Sutherland (*J. Murray*)!

25. S. LUNATUM, *Ralfs, Brit. Desm.* 1848, p. 124, t. 34. f. 12.

Var. PLANCTONICUM, var. n. (Pl. **16**. figs. 11, 12.)

Var. paullo major et latior, angulis semicellularum acutioribus, spinis minoribus; semicellulæ a vertice visæ cum lateribus latissime retusis.

Long. 40–44 μ; lat. sine spin. 42–50 μ; long. spin. 3–5·5 μ; lat. isthm. 14·5–16 μ.

Hab. Loch Shin and Loch a Gharbh Bhaid Mhoir, Sutherland. Loch Mor Bharabhais, Lewis; and Loch Nan Eun, N. Uist, Outer Hebrides. Loch Doon, Ayrshire. Loch Tay, Perthshire.

This variety is one of the most frequent Desmids of the Scottish plankton, and is distinguished from the type by the more angular semicells in which the angles are more produced, and by the smaller spines at the angles. There is no very obvious constriction at the base of the spines. The entire cell is finely granulated, the granules being very acute and arranged in concentric rings round the angles.

26. Staurastrum conspicuum, sp. n. (Pl. **14**. fig. 4.)

S. permagnum, circiter $1\frac{1}{6}$-plo latius quam longum, profundissime constrictum, sinu lineari sed aperto, ad extremo subampliato, extrorsum valde aperto; semicellulæ elliptico-fusiformes, ventre valde convexo, dorso convexo et late truncato ad medium, angulis valde mamillatis et incrassatis; a vertice visæ triangulares, lateribus late concavis, angulis acute rotundatis et mamillatis: membrana delicate scrobiculata.

Long. 83–103 μ; lat. 111–134 μ; lat. isthm. 21–27 μ.

Hab. Loch Shin, Sutherland.

This plant is one of the largest and most striking species of the genus *Staurastrum*, and, considering its size, it is somewhat surprising that it has so long escaped observation. It was scarce in the plankton of Loch Shin, but occurred abundantly at Rhiconich in a small pool amongst rocks, along with *Pleurotænium nodosum*, *Staurastrum sexangulare*, *S. verticillatum*, and other rare Desmids. It can be compared with *S. majusculum*, Wolle, from which it is easily distinguished by the form of its semicells, its sinus, and the form of the vertical view.

27. S. grande, *Buln. in Hedwigia* (1861), p. 51, t. 9. f. 14.

Long. 88–98 μ; lat. 88–111 μ; lat. isthm. 21–24 μ.

Hab. Loch Shin, Sutherland. Loch Nan Eun, Outer Hebrides. Loch Doon, Ayrshire.

This species was present in moderate quantity in the plankton of the above-mentioned lakes. It was subject to certain variations of form, some of the individuals being proportionately wider than others, and many were noticed with a less convex back as in the form mentioned by Lundell (in Nov. Act. R. Soc. Scient. Upsala, ser. 3, viii. (1871) no. 2, p. 72, t. 4. f. 11).

28. S. pseudopelagicum, sp. n. (Pl. **18**. figs. 1–3.)

S. submediocre, circiter $1\frac{1}{4}$-plo latius quam longum (cum processibus), profunde constrictum, sinu aperto et acuminato; semicellulæ obverse subsemicirculares, apicibus leviter convexis, angulis in processus breves validos divergentes productis, apicibus processuum profundissime bifurcatis; corpore et processibus granulatis, granulis in annulis concentricis circa processus; a vertice visæ triangulares, lateribus levissime concavis vel convexis, angulis in processus breves robustos productis.

Long. sine proc. 27–34·5 μ, cum proc. 57–71 μ; lat. sine proc. circ. 23–30 μ, cum proc. 63–86·5 μ; lat. isthm. 7·5–13 μ.

Hab. Loch Shin, Sutherland. Loch Tay, Perthshire.

This species bears considerable resemblance to *S. pelagicum*, West & G. S. West (in Trans. Roy. Irish Acad. vol. xxxii. part 1 (1902) p. 46, t. 2. ff. 26, 27), but is distinguished by the different form of the semicells and the more open sinus and by the processes. The processes of *S. pseudopelagicum* are *hollow*, containing part of the cell-cavity, whereas those of *S. pelagicum* are *solid* projections of the cell-wall.

S. pseudopelagicum might also be compared with some forms of *S. paradoxum*, Meyen, but is readily distinguished by its shorter processes, which are terminated by two large divergent spines situated in the same vertical plane.

29. STAURASTRUM PARADOXUM, *Meyen*, 1829; *Ralfs, Brit. Desm.* 1848, p. 138, t. 23. f. 8.

Many of the plankton forms of this species are considerably rougher than ordinary examples. The processes are adorned with short papillæ instead of granules, and near their bases these papillæ become short spines.

The two following forms are deserving of special mention:—

Forma *a*.—A triangular form with the processes short and only slightly diverging.

Long. sine proc. 33 μ, cum proc. 51 μ; lat. cum proc. 65–68 μ; lat. isthm. 12·5 μ. (Pl. **18**. fig. 5.)

Hab. Loch Tay, Perthshire.

Except for the three diverging spines at the apices of the processes, this form greatly resembles *St. pseudopelagicum*. It also closely resembles *S. Magdalenæ*, Börgesen ("Phytoplankton of Lakes in the Færöes," Bot. of Færöes, 1903, pp. 618-619, fig. 148); in fact the latter has the appearance of some of the plankton-forms of *S. paradoxum* with spines instead of granules or papillæ and quadrifurcate apices to the processes.

Forma *b*.—A quadrangular form with the processes of normal length and more diverging; also with a row of papillations along the upper margins of the semicells (visible within each lateral margin in the vertical view).

Long. sine proc. 37 μ, cum proc. 63 μ; lat. cum proc. 63 μ; lat. isthm. 14 μ. (Pl. **18**. fig. 4.)

Hab. Loch Laxadale, Harris, Outer Hebrides.

Var. CINGULUM, var. n. (Pl. **18**. figs. 6, 7.)

Var. processibus longioribus et tenuioribus, sursum gracile curvatis; apicibus semicellularum rectis vel convexis; basi semicellularum angustiore et subcylindrica, cum annulo spinarum minutarum circ. 12 (visis 7).

Long. sine proc. 32–40 μ, cum proc. 71–81 μ; lat. sine proc. circ. 16–23 μ, cum proc. 64–77 μ; lat. bas. semicell. 11·5–12 μ; lat. isthm. 7·5–8·5 μ.

Hab. Loch Shin, Sutherland. Lochs Katrine and Achray, Perthshire.

This variety is distinguished by the narrow, cylindrical base of the semicells furnished with a ring of about a dozen minute spines. The processes are longer than in typical forms and are gracefully curved upwards. The body of the semicell is frequently covered with small granules, similar to those on the processes and arranged in concentric rings round the base of each process. In length and in curvature the processes are similar to those of *S. paradoxum*, var. *longipes*, Nordst.

30. Staurastrum gracile, *Ralfs, in Ann. & Mag. Nat. Hist.* xv. (1845) p. 155, t. 11. f. 3; *Brit. Desm.* 1848, p. 136, t. 22. f. 12.

A form with the processes horizontally disposed, but curved upwards towards their apices; with a few large granules at each side of the base of every process.

Long. sine proc. 52 μ; lat. cum proc. 96–102 μ; lat. isthm. 12 μ.

Hab. Loch Shin, Sutherland.

31. S. Arachne, *Ralfs, in Ann. & Mag. Nat. Hist.* xv. (1845) p. 157, t. 11. f. 6; *Brit. Desm.* 1848, p. 136, t. 23. f. 6.

Var. curvatum, var. n. (Pl. **18.** fig. 9.)

Var. processibus leviter extrorsum curvatis; a vertice visæ 4- vel 5-radiatæ.

Long. 30 μ; lat. sine proc. 18 μ, cum proc. 57–70 μ; lat. isthm. 9 μ.

Hab. Loch Nan Cuinne, Sutherland (*J. Murray*)!

This variety is either 4- or 5-radiate, and differs from all other forms of *S. Arachne* in the outwardly curved processes, a character which was constant in all the specimens examined.

32. S. verticillatum, *Archer, in Quart. Journ. Micr. Sci.* new ser. ix. (1869) p. 196.

Long. sine proc. 76–79 μ; cum proc. 136–143 μ; lat. sine proc. circ. 36–38 μ, cum proc. 124–130 μ; lat. isthm. 20 μ.

Hab. Loch Mor Bharabhais, Lewis, Outer Hebrides.

This is one of the most interesting of British Desmids, and has never been recorded since the appearance of Archer's meagre description in 1869. The figure given by Cooke in his 'British Desmids,' 1886, t. 61. f. 3, is entirely imaginary, as he possessed neither specimens nor figures. The specimens from the plankton agreed well with a good drawing in our possession, which was copied by the late Dr. J. Roy from Archer's original sketch. Fig. 7, Pl. **14,** *is the first figure ever published of the species* and illustrates the remarkable divergent character of the processes. We have also obtained numerous scattered specimens of this rare *Staurastrum* from bogs in western Sutherland. As in *S. Ophiura*, the upper surface of the processes is considerably rougher than the lower surface.

33. Staurastrum Ophiura, *Lund. in Nov. Act. R. Soc. Scient. Upsala*, ser. 3, viii. (1871) no. 2, p. 69, t. 4. f. 7.

Long. 77–91 μ; lat. sine proc. 40–46 μ, cum proc. 128–169 μ; lat. isthm. 19·5–26 μ.

Hab. Loch Shin and Loch a Gharbh Bhaid Mhoir, Sutherland. Loch Laxadale, Harris, Outer Hebrides. Loch Tay, Perthshire. Loch Doon, Ayrshire.

This fine Desmid appears to be a general constituent of the Scottish plankton, although not occurring in large numbers. Like *S. brasiliense* var. *Lundellii* and *S. Arctiscon*, it is a Desmid of a western type, confined in the British Islands to the western districts of Wales and Scotland. It is not confined to the plankton, and we have observed it from bogs in both Sutherland and the Outer Hebrides.

Some of the specimens reached a very large size (larger than any others we have seen from Britain or the United States, or those recorded for Scandinavia), and in all cases the central ring of papillæ on the apices was composed of conical (and not quadrifid) warts.

No individuals were observed which could have been referred to var. *cambricum*, West, although the apical papillæ were not strictly in accordance with Lundell's Swedish specimens. As in the Welsh variety, the 8-rayed forms were the most numerous.

34. S. sexangulare, *Rabenh. Krypt. Fl. Sachs.* 1863, p. 621; *Lund. l. c.* p. 71, t. 4. f. 9.—Didymocladon sexangularis, *Buln. in Hedwigia* (1861), p. 51, t. 9 A. f. 1.

Some very large forms were observed from Loch Shin, Sutherland; they were both 5- and 6-rayed, and reached a diameter (with processes) of 122 μ.

Var. SUPERNUMERARIUM, var. n. (Pl. **18**. fig. 8.)

Var. semicellulis cum processu parvo supernumerario inter processibus superioribus inferioribusque.

Long. sine proc. 51 μ, cum proc. 65 μ; lat. sine proc. circ. 42–46 μ, cum proc. 84·5–90 μ; lat. isthm. 12 μ.

Hab. Loch Shin, Sutherland.

35. STAURASTRUM ARCTISCON, *Lund. in Nov. Act. R. Soc. Scient. Upsala*, ser. 3, viii. (1871) p. 70, t. 4. f. 8.—Xanthidium Arctiscon, *Ehrenb.*

Long. sine proc. 67–77 μ, cum proc. 105–136 μ; lat. sine proc. 42–49 μ, cum proc. 94–121 μ; lat. isthm. 24–26 μ.

Hab. Loch Shin, Sutherland. Loch Laxadale, Harris; and Loch Nan Eun, N. Uist, Outer Hebrides. Loch Doon, Ayrshire.

This is another Desmid of a distinctly western type, and it is much more abundant in the plankton than in any other habitat in the areas in which it is found.

The processes vary considerably in length, and there may be from two to seven rings of small denticulations on each process.

36. S. ANGULATUM, *West*, '*Desm. Massachusetts*,' *Journ. Roy. Micr. Soc.* (1888) p. 20, t. 3. f. 20.

Var. PLANCTONICUM, var. n. (Pl. **16**. fig. 10.)

Var. minor, semicellulis rhomboideo-depressis, angulis apiculo minuto instructis.

Long. 47 μ; lat. 44–46 μ; lat. isthm. 9·5–10·5 μ.

Hab. Loch Shin, Sutherland.

Genus SPONDYLOSIUM, *Bréb.*

37. S. PULCHRUM, *Arch. in Pritch. Infus.* ed. 4, 1861, p. 724.—Sphærozosma pulchrum, *Bail. in Ralfs, Brit. Desm.* 1848, p. 209, t. 35. f. 2.

Var. PLANUM.—Sphærozosma pulchrum, *Bail.*, var. planum, *Wolle, Desm. U.S.* 1884, p. 29, t. 4. ff. 3, 4.

Small forms:—Long. 16·5–19·5 μ: lat. 18–25 μ; lat. isthm. 8–11·5 μ.

Hab. Loch Shin, Sutherland. Lochs Katrine and Achray, Perthshire.

This variety has not been previously recorded from the British Islands.

Genus Desmidium, *Agh.*

38. D. graciliceps, *Lagerh. in Öfvers. af K. Vet.-Akad. Förh.* (1885) no. 7, p. 228.—D. quadratum, *Nordst.*, var. graciliceps, *Nordst.* 1880.

Long. 23–25 μ; lat. 25–27 μ; lat. apic. 9·5–11 μ; lat. isthm. 18·5–20 μ.

Hab. Loch Nan Eun, N. Uist, Outer Hebrides.

This species was in comparative abundance, and has not previously been recorded from the British Islands. We have also observed it from Sutherland.

Order **Protococcoideæ.**

Family Protococcaceæ.

Genus Sorastrum, *Kütz.*

39. S. americanum, *Schmidle.*—Selenosphærium americanum, *Bohlin, in Bih. till K. Sv. Vet.-Akad. Handl.* Bd. xxiii. (1897) no. 7, p. 40, t. 2. ff. 38–41.

Diam. cœnob. (c. corn.) 55–61 μ; diam. cell. 11·5–15 μ.

Hab. Loch Nan Eun, N. Uist, Outer Hebrides.

Genus Tetraëdron, *Kütz.*

40. T. cruciatum, *West & G. S. West, in Botanisk Tidsskrift*, Bd. xxiv. (1901) p. 99; *Trans. Linn. Soc.*, ser. 2, *Bot.* vi. (1902) p. 198.—Micrasterias cruciata, *G. C. Wall. in Ann. Mag. Nat. Hist.* ser. 3, v. (1860) p. 281, t. 13. f. 12. Staurophanum cruciatum, *W. B. Turn. in Kongl. Sv. Vet.-Akad. Handl.* xxv. (1893) no. 5, p. 159, t. 20. ff. 20, 21.

(*a*) Forms with each angle subdivided and somewhat irregular.

Diam. 42–49 μ.

Hab. Loch Doon, Ayrshire.

(*b*) Smaller forms, very little irregular.

Diam. 34–38 μ.

Hab. Loch Mor Bharabhais, Lewis, Outer Hebrides.

Genus Botryococcus, *Kütz.*

41. B. sudeticus, *Lemm. in Forschungsberichte Biol. Stat. Plön*, iv. 1896, p. 111, cum fig. 6 u. 7.

Var. planctonicus, *Lemm. in litt.*

Cellulæ globosæ, 7–9 μ crassæ, in familiis globosis vel oblongis consociatæ.

Hab. Loch Shin and Loch a Gharbh Bhaid Mhoir, Sutherland.

The cells are much smaller than in typical *B. sudeticus.*

We think it most probable that both this variety and the type are merely forms of *B. Braunii*, Kütz.

IV.—Conclusions.

1. The Scottish phytoplankton differs considerably from that of the western parts of continental Europe.

2. It is unique in the abundance of its Desmids. No known plankton can compare with it in the richness and diversity of the Desmid-flora.

3. The most conspicuous of the Desmids are of a distinctly western type,—a type confined almost exclusively to the extreme western and north-western shore-districts of Europe and to North America. This type of Desmid is known from the west of Scotland, Ireland, and Wales, also from Scandinavia, and in some cases from Lapland; it is well represented by *Staurastrum longispinum*, *S. brasiliense* var. *Lundellii*, *S. curvatum*, *S. jaculiferum*, *S. anatinum*, *S. Ophiura*, *S. verticillatum*, *S. Arctiscon*, *Micrasterias furcata* and *M. conferta*, and to a less extent by *Staurastrum sexangulare*, *S. aversum*, *S. lunatum* var. *planctonicum*, and *S. megacanthum*.

These Desmids which occur in the plankton are also known to us from the bogs and rocky pools of North-west Scotland and the Outer Hebrides, and it is of surpassing interest that they should have this exclusive European distribution and at the same time be frequent in the eastern parts of the United States and in Nova Scotia. Certain of these species are also known from the Faroe Islands and from Iceland.

4. The commonest and most abundant Desmids of the plankton are invariably species of the genus *Staurastrum*; and the two most abundant species are *S. paradoxum* var. *longipes* and *S. jaculiferum*.

5. One of the most suprising features is the abundance of

Staurastrum Ophiura, *S. Arctiscon*, and *S. grande* in the plankton, as all three species are extremely rare in the bogs of the western areas in which they occur.

6. As a striking contrast to the abundance of Desmids, there is a most remarkable scarcity of many of the free-swimming Protococcoideæ, which the researches of Lemmermann, Chodat, Schröder, and others have shown to be relatively abundant in the lakes of Switzerland and Germany. Amongst those Protococcoideæ noted only the genus *Sphærocystis* is exclusively confined to the plankton, although many genera which are commonly more abundant in the plankton than elsewhere, such as *Kirchneriella*, *Botryococcus*, *Dictyosphærium*, &c., were present in quantity.

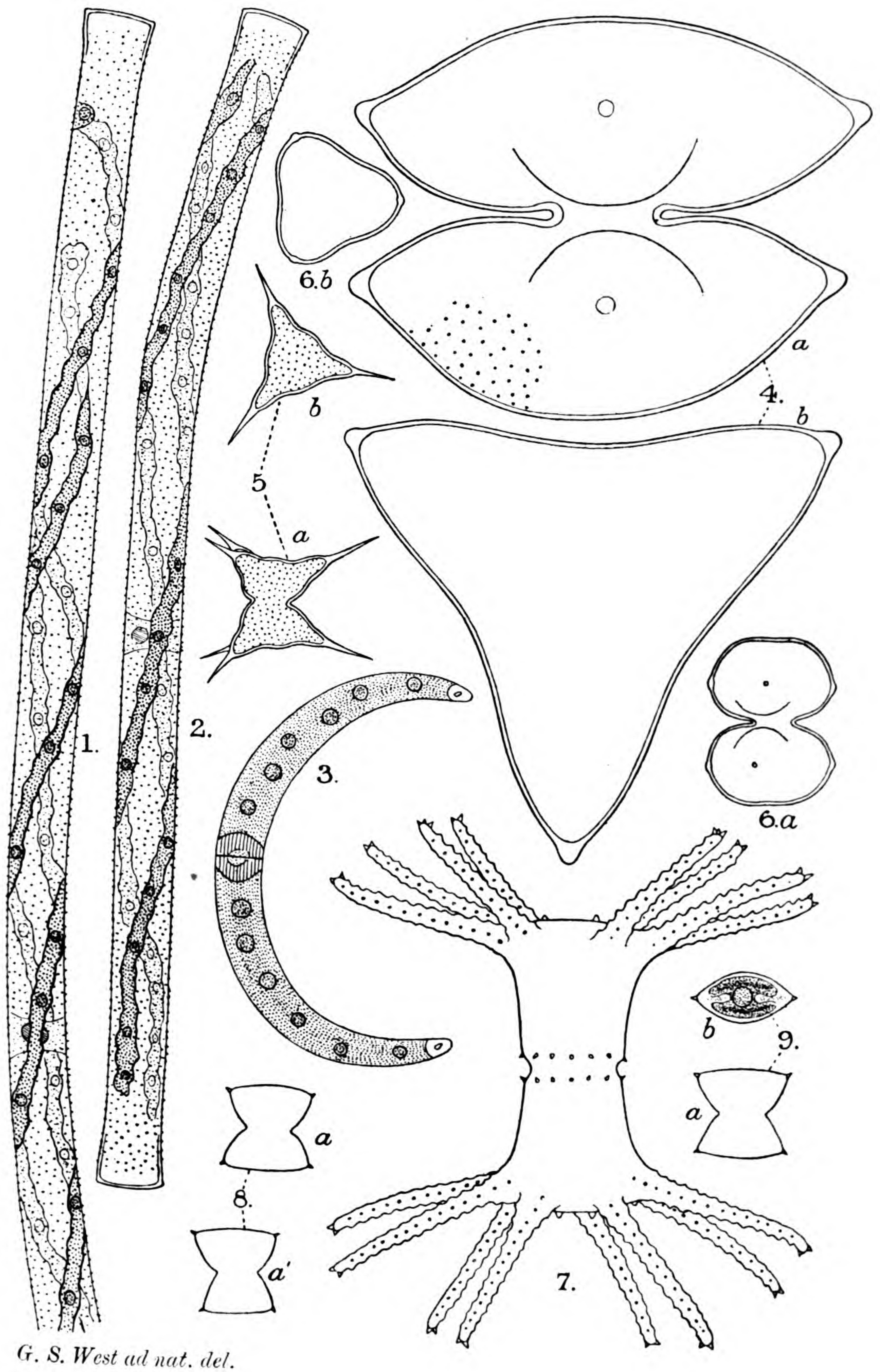
7. The most striking and characteristic Diatoms are *Asterionella gracillima*, *Tabellaria fenestrata* var. *asterionelloides*, and forms of *Surirella robusta*. Two other interesting species are *Rhizosolenia eriensis* and *R. longiseta*.

8. The majority of the species of *Staurastrum* and *Arthrodesmus* which occur in the plankton are remarkable for their long spines or long processes with spinate apices. Even those species which are normally long-spined increase the length of their spines when in the plankton. The genus *Xanthidium*, all the species of which are spined, is also one of the commonest genera of the plankton. Again, in the Protococcoideæ, the subfamily Phythelieæ is almost an exclusively plankton group, all the species of which are remarkable for their armature of long spines.

This excessive development of spines, which occurs amongst the plankton Diatoms as well as amongst the Chlorophyceæ, is obviously for protection, and has been rendered necessary owing to the assumption of a purely free-floating existence.

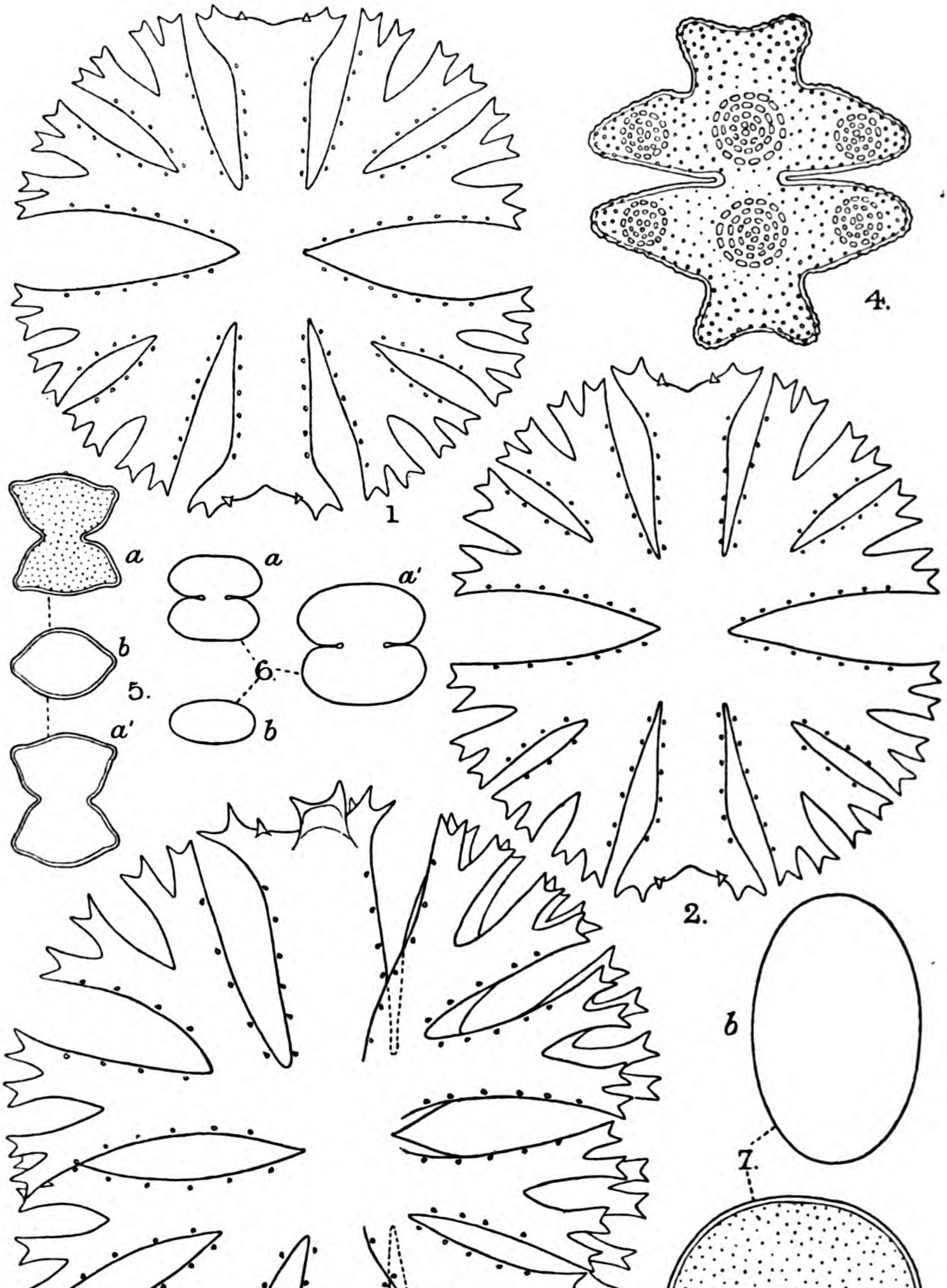
9. The plankton is much richer in species in the late summer and autumn than in the spring.

10. Several very interesting new species have been obtained from the Scottish plankton. *Staurastrum conspicuum* is one of the largest and most striking British species of the genus. *Genicularia elegans* is the second known species of the rarest of all the genera of Desmids. *Arthrodesmus quiriferus* is remarkable for the length of its spines, and the triquetral variety of *Micrasterias Murrayi* merits special mention on account of the additional evidence it affords towards a correct idea of the evolution of the genera of Desmids.



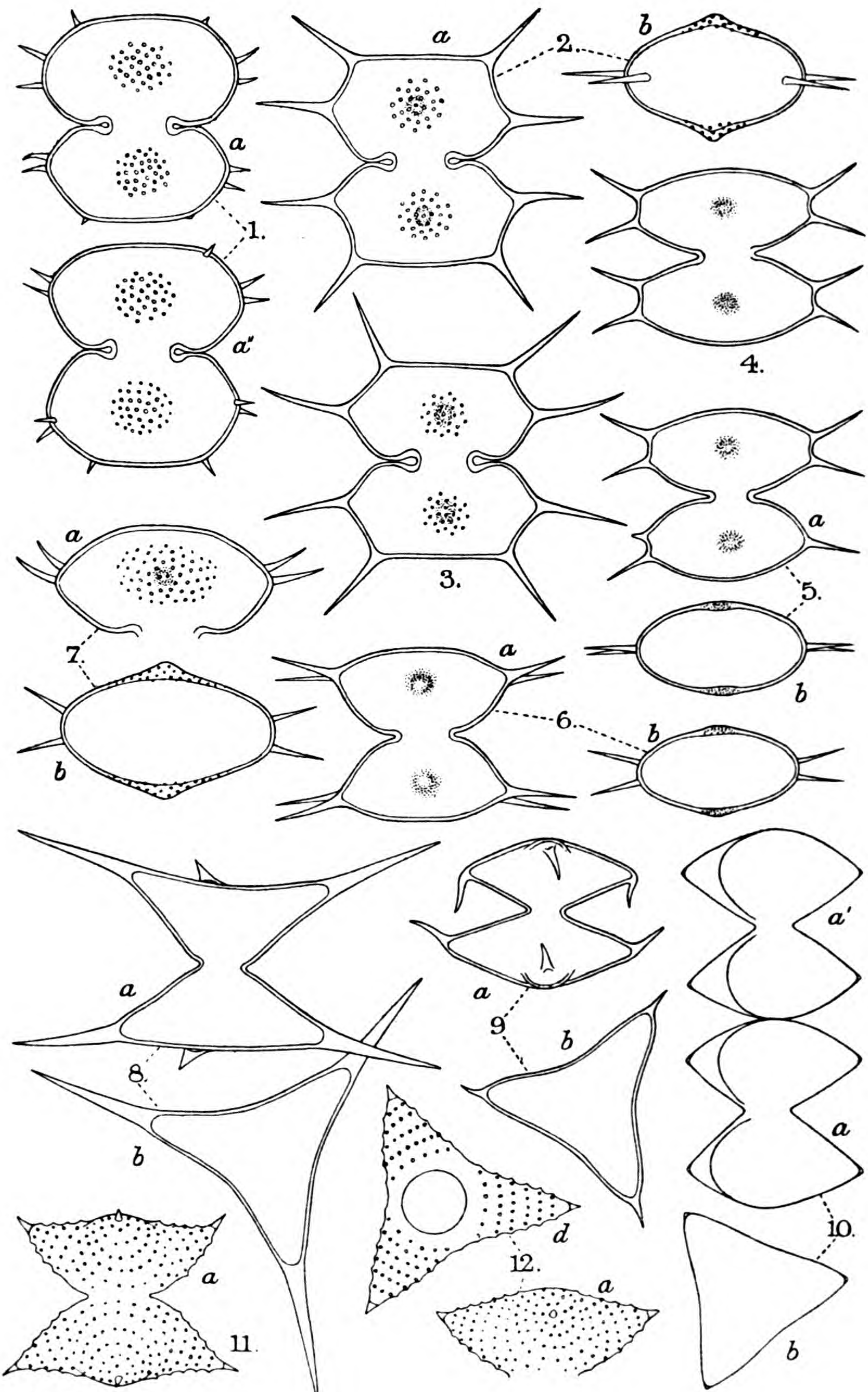
G. S. West ad nat. del.

SCOTTISH PLANKTON DESMIDS.



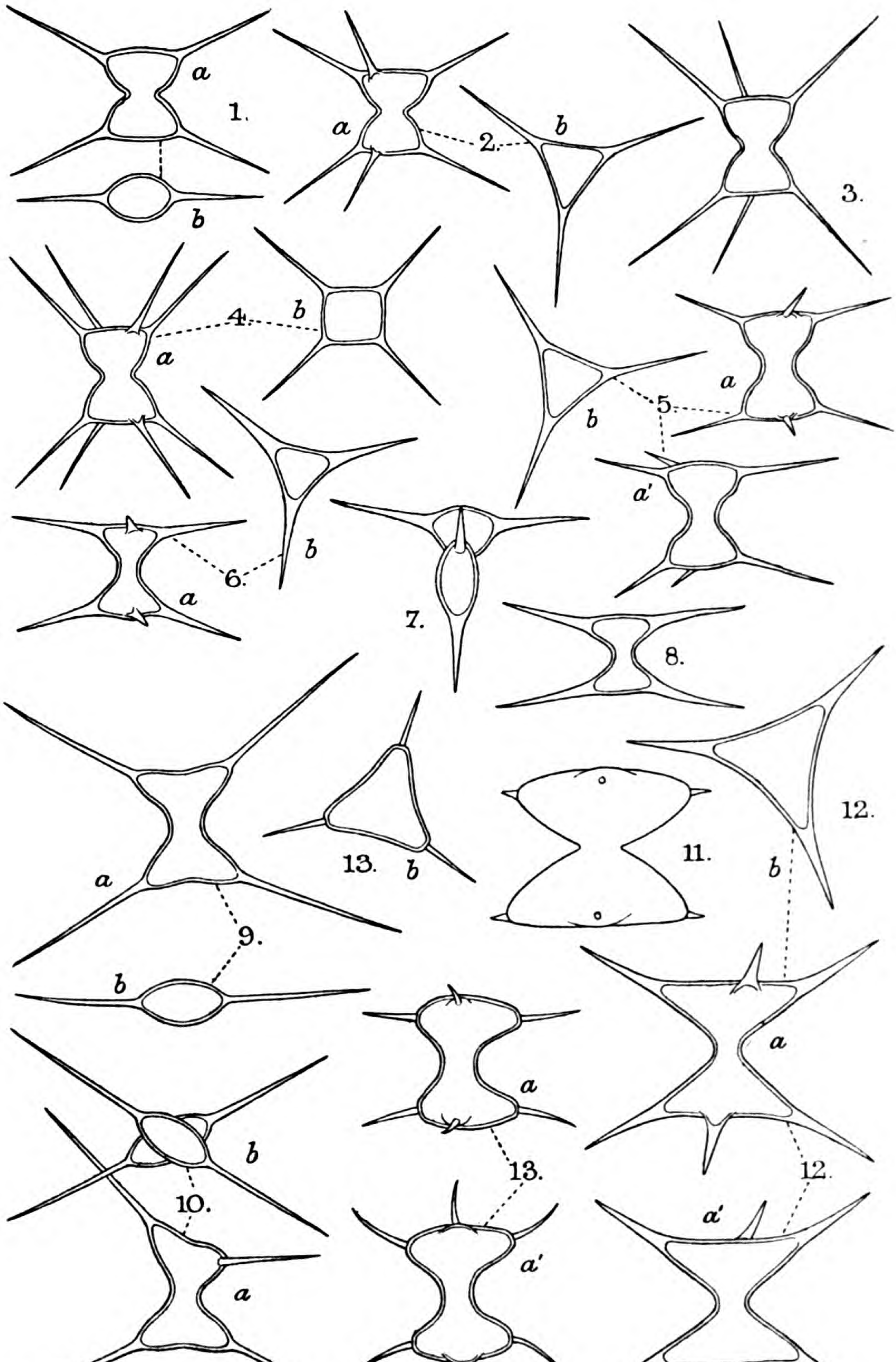
G. S. West ad nat. del.

SCOTTISH PLANKTON DESMIDS.



G. S. West ad nat. del.

SCOTTISH PLANKTON DESMIDS.



G. S. West ad nat. del.

SCOTTISH PLANKTON DESMIDS.

G. S. West ad nat. del.

SCOTTISH PLANKTON DESMIDS.

EXPLANATION OF THE PLATES.

a, *a′* = front view (a fronte visa).
b = vertical view (a vertice visa).
d = basal view of semicell (a basi visa).

Plate 14.

Figs. 1, 2. *Genicularia elegans*, sp. n. × 470.
3. *Closterium Cynthia*, De Not., var. *curvatissimum*, var. n. × 470.
4. *Staurastrum conspicuum*, sp. n. × 470.
5. „ *aristiferum*, Ralfs, var. *protuberans*, var. n. × 470.
6. „ *brevispinum*, Bréb., var. *retusum*, Borge. × 384.
7. „ *verticillatum*, Arch. × 470.
8, 9. *Arthrodesmus crassus*, sp. n. × 470.

Plate 15.

Figs. 1, 2. *Micrasterias Murrayi*, sp. n. × 384.
3. „ „ var. *triquetra*. × 470.
4. *Euastrum verrucosum*, Ehrenb., var. *planctonicum*, var. n. × 384.
5. *Cosmarium Capitulum*, Roy & Biss., var. *grœnlandicum*, Börges. × 470.
6. „ *abbreviatum*, Racib., var. × 470.
7. „ *Lundellii*, Delp., var. *æthiopicum*, West & G. S. West. × 470.

Plate 16.

Fig. 1. *Xanthidium antilopæum*, Kütz., forma. × 470.
2, 3. „ *controversum*, West & G. S. West, var. *planctonicum*, var. n. × 470.
4, 5. „ *subhastiferum*, West. × 384.
6. „ „ var. *Murrayi*, var. n. × 384.
7. „ *tetracentrotum*, Wolle, forma. × 470.
8. *Staurastrum megacanthum*, Lund., var. *scoticum*, var. n. × 470.
9. „ *Dickiei*, Ralfs, var. *rhomboideum*, var. n. × 470.
10. „ *angulatum*, West, var. *planctonicum*, var. n. × 470.
11, 12. „ *lunatum*, Ralfs, var. *planctonicum*, var. n. × 470.

Plate 17.

Fig. 1. *Staurastrum jaculiferum*, West, forma *biradiata* (= *Arthrodesmus longicornis*, Roy). × 470.
2, 3. *Staurastrum jaculiferum*, West, forma *triradiata*. × 470.
4. „ „ forma *quadriradiata*. × 470.
5. „ „ var. *excavatum*, var. n. × 470.
6–8. „ „ var. *subexcavatum*, var. n. × 384.
9, 10. *Arthrodesmus quiriferus*, sp. n. × 470.
11. *Staurastrum mucronatum*, Ralfs, var. *subtriangulare*, var. n. × 470.
12. „ *curvatum*, West. × 470.
13. „ *cuspidatum*, Bréb., var. *maximum*, West. × 470.

PLATE 18.

Figs. 1–3. *Staurastrum pseudopelagicum*, sp. n. × 470.
4. „ *paradoxum*, Meyen, forma. × 470.
5. „ „ forma. × 470.
6, 7. „ „ var. *cingulum*, var. n. 6, × 470; 7, × 384.
8. „ *sexangulare*, Rabenh., var. *supernumeraria*, var. n. × 470.
9. „ *Arachne*, Ralfs, var. *curvatum*, var. n. × 384.
10. „ *gracile*, Ralfs, forma. × 470.

On the Germination of the Seeds of *Davidia involucrata*, Baill.

By W. Botting Hemsley, F.R.S., F.L.S., Keeper of the Herbarium and Library, Royal Botanic Gardens, Kew.

(Plate 19.)

[Read 18th June, 1903.]

Davidia is one of the most remarkable of the endemic genera of the trees of China. It is a monotype with foliage strongly resembling that of a lime-tree and an inflorescence resembling no other.

The flowers are borne in globose, solitary heads about an inch in diameter on axillary peduncles, two or three inches long, and bearing two oblong, nearly opposite, pure white, leaf-like bracts, four to six inches long.

The inflorescence consists of a number of male flowers, without any perianth, encircling a solitary, obliquely inserted female flower, which bears five rudimentary stamens around the ovary near the top. Or sometimes the inflorescence consists of male flowers alone; sometimes of a solitary hermaphrodite flower.

The ellipsoid fruit, about an inch and a half in length, is drupoid in composition and is obliquely attached.

The pericarp consists of a thin epicarp and mesocarp and a very hard, bony endocarp which intrudes between the six to ten 1-seeded cells to the axis, with which it is consolidated. Both the dehiscence of the fruit and the germination of the seeds are of a highly curious character. After the decay of the outer layer of the pericarp, dehiscence takes place by the separation of the upper half, or sometimes as much as two-thirds, of the back of each carpel in the form of a valve or shutter.

Usually only about half the ovules are fertilized and developed;

sometimes only one. By the falling away of the dorsal valves the solitary, pendulous seeds become partially visible, but they are not released. On the contrary, they are held fast until after germination and considerable development of the young plant has taken place.

The seeds are pendulous from above the middle of the inner angle of the cell, with the micropyle near the top on the outside. The embryo is straight, nearly as long as the seed, with foliaceous, flat cotyledons, twice as long as the straight radicle, and it is embedded in endosperm somewhat thicker than itself.

After the dehiscence of the dorsal valves of the carpels, which apparently only takes place when the conditions are favourable to germination, the radicles of as many seeds as are present in the fruit emerge simultaneously. There is also rapid elongation of the cotyledons, by which the axis of the plantlet is carried outside of the testa. Then, according to the position of the fruit, the radicle turns towards the soil, which it enters, when the developing cotyledons absorb the reserve-materials of the endosperm, soon free themselves and assume a horizontal position, become green and persist a long time.

This stage is soon followed by the full development of the two first foliage-leaves, which are opposite and at right angles to the cotyledons, whilst all succeeding leaves are alternate. This primary pair of leaves reaches a conspicuous stage in the dormant embryo.

The advantages, if any, of the simultaneous germination of a number of imprisoned seeds in such close proximity are not obvious, at least to me. Unfortunately I was unable to follow the subsequent behaviour of seedlings produced under such conditions, or I might have been able to offer some explanation of the phenomenon. Of course it is no unusual thing in nature for a whole podful of seeds to germinate in a cluster, and for one, or few, to smother the rest in the struggle for existence. But in *Davidia* the proximity is unavoidable.*

* I may mention incidentally that seedlings do sometimes, in a sense, devour each other. Mr. Hackett, the foreman of the Tropical Department at Kew, gave me the Brazil-nut as an instance. In a fruit full of nuts (seeds) he had under observation, the seeds germinated in the shell and decayed one after another until only one was left to grow up. He could not assert that this behaved as a saprophyte, though appearances favoured the view that it did to some extent.

I can only suggest that in a cluster of seedlings there is a greater chance of partial escape from phytophagous organisms of various kinds than there is for solitary individuals; but I am aware that this suggestion is open to numerous objections. Taking our native trees for comparison: they have mostly either solitary seeds, as in the oak; or, if there are several, they are furnished with some appendage that facilitates dispersal, as the comose seeds of the willow.

Another interesting point is the presence of buds in the axils of the cotyledonary leaves of *Davidia.* The advantage of cotyledonary buds is probably this, as in many other instances, that if the plumule is injured or destroyed the development of the plant is continued by them. But this is not always the case, as is shown by Gustav Köck in 'Oesterreichische Botanische Zeitschrift,' liii. p. 58, who there gives the results of the investigation by himself and others of seedlings of 152 different plants belonging to 49 different natural orders. In *Dianthus Caryophyllus* the cotyledonary buds develop simultaneously with the plumule. In *Nasturtium officinale* they grow into roots. In *Trapa natans* they form shoots which soon detach themselves and become independent plants. In *Ulex* they grow into thornless branches. In *Lathyrus tuberosus* they grow out as runners. In many species of *Linum* the plant becomes perennial through their development after the primary stem has died down. In *Thesium montanum* only the cotyledonary shoots bear flowers. And in *Scrophularia Ehrharti* they grow during the summer and autumn into short-jointed shoots which strike root and grow out the following spring.

Davidia was discovered by the Abbé David near Moupin in the Province of Szechuen, and apparently only in small quantity. It was described by the late Dr. H. Baillon ('Adansonia,' x. p. 114) in 1871, from flowering specimens. In 1889 Dr. A. Henry sent a fruiting specimen to Kew, and a figure of it is given in Hooker's 'Icones Plantarum,' t. 1961, but with very little detail. Dr. Henry saw only one tree, and this was in Eastern Szechuen.

Subsequently Mr. E. H. Wilson, collector for Messrs. James Veitch & Sons, discovered about a hundred trees in the same region, and succeeded in obtaining a quantity of good seed, from which a large stock of plants has been raised. Kew is indebted to Messrs. Veitch for the material on which the foregoing observations were made.

M. Smith del[t]. J. N. Fitch lith. imp.

DAVIDIA INVOLUCRATA, Baill.

Davidia is usually placed in the Cornaceæ, next to *Nyssa*, a genus of Asiatic and North American trees, which it resembles in some particulars, but from which it differs greatly in appearance and floral structure. However, I do not intend to discuss its affinities on this occasion.

Miss M. Smith's careful drawings in the Plate, explained below, show what I have attempted to describe in the germination of *Davidia*.

EXPLANATION OF PLATE 19.

Davidia involucrata, Baill.

Fig. 1. A ripe fruit.
2. The same with the outer layers of the pericarp removed and one of the valves opening nearly to the base.
3. Cross-section of a fruit in which seven of the cells are fertile.
4. Cross-section of a fruit in which only one of the cells is fertile.
5. A fruit from which the valves have fallen away and the seeds have begun to germinate.
6. Dorsal view of one of the valves.
7. Ventral view of the same.
8. Cross-section of a seed.
9. A germinating seed.
10. Section of germinating seed showing the highly developed plumule and one cotyledon.
11. A portion of the embryo from the same seed.
12. Section of old, empty fruit.
13. A seedling showing buds in the axils of the cotyledonary leaves, first pair of foliage-leaves opposite and succeeding ones alternate.

Figs. 1–5, 12, & 13 are natural size.
Figs. 6–10, & 11 are more or less enlarged, most of them, as will be seen by comparison, only very slightly.

A General View of the Genus *Pinus*. By MAXWELL T. MASTERS, M.D., F.R.S., F.L.S., Correspondent of the Institute of France.

(PLATES 20-23.)

[Read 19th November, 1903.]

THE special object of the following notes is to add to our knowledge of the species of *Pinus* and to facilitate their determination. Without any pretence to be complete, they comprise details either imperfectly appreciated or not included in the ordinary text-books. For the present purpose it is not necessary to cite the whole of the voluminous literature pertaining to the subject. It is sufficient to indicate here some of the more important and more recent publications, and those in which full bibliographical references may be found *.

In addition to the very extensive literature, I have availed myself of the resources of the principal herbaria in London, Paris, and elsewhere, and have, wherever practicable, studied the living trees—in some few cases in a wild state, but in the large majority of instances as growing in the Pinetum at the Royal Gardens, Kew, and in numerous other botanical and private establishments. Many specimens have also been obligingly communicated to me from botanists in the United States and the continent of Europe.

The genus *Pinus* is here taken in the limited acceptation now usually adopted. So limited, it forms a very natural and easily recognized group. It includes those Abietineæ in which both shoots and leaves are dimorphic, or, as regards the leaves, polymorphic.

The extension-shoots grow rapidly and during the season more or less continuously, and are elongated; the lateral shoots are either elongate or short and thick, forming "spurs," which

* Bentham and Hooker, 'Genera Plantarum,' iii. (1880) p. 438; Parlatore in DeCandolle, Prodromus, xvi.[2] (1868); Engelmann in Trans. Acad. St. Louis, iv. p. 161 (1880); Eichler in Engler and Prantl, Pflanzenfamilien, ii. p. 70 (1880); Beissner, Handbuch d. Nadelholzkunde (1891); Masters in Journ. Linn. Soc., Bot. xxvii. (1889) p. 226, xxx. (1892); Sargent, Silva, xi. (1897); Kent in Veitch's Manual, ed. 2 (1900); Conifer Conference Report R. Hortic. Society, vol. xiv. (1892). Other references will be given incidentally or under the head of particular species.

the Germans call *Kurztriebe*. These are axillary shoots, which grow slowly and are soon arrested in their growth, so that they do not materially lengthen between the internodes, and probably serve as store-places for reserve food or for water. They are surrounded by bud-scales. The leaf-organs are very polymorphic; three forms only need here be mentioned—the cotyledons; the primordial or transitional leaves, which may be mere scales, or linear leaves scattered spirally around the extension-shoots; and the adult leaves, which are arranged in tufts of from 2–5 (rarely more than 5) on the ends of the "spurs" (see fig. 1, p. 585). The number of leaves in each tuft is usually, but not invariably, constant in particular species. The fascicles are encircled at the base by a number of perular scales, subcoriaceous in texture, or more or less membranous and arranged spirally. The male flowers are borne on the shoots of the year, are amentaceous in appearance, and arranged in clusters, never solitary. Each flower is surrounded by a perianth of imbricating bracts, varying in number but constant in each species. There are not more than 4 in *P. quadrifolia, cembroides, edulis, Balfouriana*, and *aristata*; 6 in *P. monophylla, resinosa*, and *contorta*; 8–10 in the majority of species, including all those of the *Strobus* section; and as many as 14–16 in *P. Torreyana* and *P. Sabiniana*. The details relating to the number and arrangement of these scales are mostly taken from Engelmann. In several species this character has not as yet been observed. These imbricating scales are homologous with those that surround the fascicles of leaves, and the stamens, though separated by a bare interval, are serially continuous with them. The anthers or micro-sporanges are borne on the under surface of the sporophyll. The pedicel bearing the young female cone is clothed with spirally arranged perulæ or scales, like those on the vegetative shoots, but they have no tufts of leaves in their axils. By tracing these perulæ upwards, they may be seen gradually to become shorter and to pass insensibly into the bracts, in whose axils are placed the ovuliferous scales.

The female flowers are, unless in rare exceptions, lateral. At first sight, from their erect direction and from the fact that they overtop the terminal leaf-bud, they appear to be terminal. Subsequently the peduncle curves downwards, and the lateral position then becomes obvious. In some species the mature cones remain in proximity to the terminal leaf-bud, in which case, for classificatory purposes, they are said to be "subterminal." In other species the shoot lengthens beyond the insertion of the cones, so that the cones then spring from the sides of the shoot at some distance from the apex, when they are spoken of as "lateral." As an exceptional occurrence, I have seen the cones of *P. sylvestris* erect and apparently, if not really, terminal; and a similar position was observed by Sir Charles Lemon in the case of *P. maritima* (Pinaster): see Trans. Hort. Soc. London, 2nd series, vol. i. pl. 20 (1833). In the var. *terthrocarpa* of *P. cubensis* the growth of the axis is, according to Engelmann, entirely arrested after producing an ament, and does not even elongate in the following season; the maturing cone, therefore, remains erect near the top of the branch ("Revision of the Genus *Pinus*," Trans. Acad. St. Louis, iv. 1880).

The characters offered by the ripe cone and seed are of special importance; but as they are dealt with by all writers on these plants, it is not necessary to enter into detail here concerning them. The form of the apophysis or swollen end of the cone-scale is very important; that of its terminal portion, or umbo, not less so. In the young cones, for instance, of *P. virginiana* (*inops*) the apex of the scale is thickened and ends in a recurved point. As growth goes on, the apophysis becomes more flattened on each side of the terminal point, and thus the "umbo" becomes more distinctly marked out.

The cones which are formed in one year generally ripen in the following season, or, in some cases, not till the third year.

The characters derived from the seedling plant, the varying number of the cotyledons, the anatomy of the caulicle or hypocotyl are treated of in a former communication, Journ. Linn. Soc., Bot. vol. xxvii. (1889) pp. 236 *et seqq.*; see also Freiherr von Tubeuf, 'Samen, Früchte und Keimlinge' (1891), p. 82.

Without alluding to other characters mentioned under the head of particular species, it may be said that the genus, as now defined, is easily distinguished from the Spruces (*Picea*), the Silver Firs (*Abies*), the Cedars (*Cedrus*), the Larches (*Larix*), the Hemlock Spruces (*Tsuga*)—indeed, from all the genera which, at one time or another, have been included under *Pinus*. The nearest affinity appears to be with the Cedars and Larches, which have dimorphic shoots and tufted leaves produced on "spurs;" but in the Cedars the leaves are persistent and very numerous in each tuft, whilst in the Larches the leaves are equally numerous, but deciduous. The male flowers of Cedars and Larches are, moreover, solitary, not clustered.

Whilst the genus is readily recognizable, it is often far otherwise with the species. It is not even easy to group them satisfactorily into subgenera and sections. Reference to the standard text-books of Lambert, Endlicher, Parlatore, Engelmann, Gordon, Carrière, Beissner, Kent, and others, will suffice to show the correctness of this assertion.

The most recent attempt to deal with the whole of the species is that of Engelmann, in the Transactions of the Academy of Sciences of St. Louis, iv. p. 161 (February 1880). Beissner, 'Handbuch der Nadelholzkunde' (1891), p. 209; Sargent, 'Silva,' vol. xi. (1897); Kent in Veitch's Manual, ed. 2 (1900), p. 308, not to speak of others, have given their attention to certain species only, and not to the whole number, and they have, for the most part, followed Engelmann's arrangement. This is noteworthy for several reasons, to some of which allusion may here be made. In the first place, even Engelmann's Revision is not complete. It deals with sections and subsections, and with various minor subdivisions, but does not extend to the individual species, which are merely named under the subdivision to which they respectively belong.

Histological Characters.

In the next place, Engelmann makes use, for systematic purposes, of the position within the leaf of the resin-canals, whether marginal, *i. e.* "peripheral," or just beneath the epidermis (Pl. **20.** fig. 1); "parenchymatous," or in the substance of the leaf (Pl. **20.** fig. 2); or "internal," when they are placed in juxtaposition to the endoderm (Pl. **20.** fig. 3). Engelmann also lays some stress on the circumstance of the resin-canals being surrounded by "strengthening cells" (Pl. **20.** figs. 1 & 2) or devoid of any such investment.

Koehne, in his 'Deutsche Dendrologie' (1893), p. 28, makes further use of histological characters by dividing the genus into two sections—"Haploxylon," in which the central fibro-vascular bundle is simple (Pl. **20.** fig. 2); and "Diploxylon," in which the bundle branches into two divisions which are more or less closely approximate or separated by cellular tissue or stereome-cells

(Pl. 20. fig. 1). The branching or otherwise of the fibro-vascular bundle is a more important "character" than that furnished by the position of the resin-canals. At the same time it may be pointed out, as a fact of some possible significance as regards the phylogeny of the genus, that in the cotyledons and in the primordial leaves the fibro-vascular bundles may be unbranched (Pl. 22. fig. 8; Pl. 23. fig. 9), whilst in the adult foliage they may be branched. So, also, the resin-canals may in the primordial leaves be marginal, as in *P. Lambertiana* (Pl. 23. fig. 9), whilst in the adult foliage they are generally median.

M. Casimir de Candolle, however, in relation to the juvenile character of the leaves on adventitious shoots, says that the "caractère juvénile rentre dans la loi du développement individuel de la plante et il fait partie de l'ensemble des caractères normaux de chaque espèce. Il ne faut donc pas considérer comme un cas de variabilité régressive de l'espèce, et il n'y a pas lieu de lui attribuer, ainsi que l'on a fait quelquefois l'importance d'une indication phylogénétique" (Archiv. des Sciences physiques et naturelles, t. xvi. July 1903, p. 68). In what way we are to distinguish between what is peculiar to the individual, and what is of genealogical significance, is not apparent.

In the following notes I have availed myself of the information published by my predecessors, and of the incidental observations of Van Tieghem, Bertrand, MacNab, and others to whom reference is made in the course of this paper. It may be here pointed out that a valuable character has been hitherto almost entirely overlooked, or not accorded the importance which it deserves. I allude to the number and characteristics of the cells constituting the endoderm-layer. I have not examined this layer in all the species, nor in many specimens of each species, but in a number sufficient to enable me to form a high estimate of its value for classificatory purposes.

I have repeatedly examined the leaf-structure in the majority of the species, both in a living state and when dried; and I gratefully acknowledge the assistance I have had from the beautiful specimens of the American species prepared by Mr. King. These were described and illustrated by Messrs. Coulter and Rose *. Specimens have also been made for me

* "Synopsis of North-American Pines based upon Leaf-Anatomy," Botanical Gazette (1886), p. 256. See also Bastin and Trimble, 'A Contribution to the

by Mr. Worsdell, Mr. Fraser, and others, to whom my acknowledgments are due, as also to Mr. A. E. Smith for his photographic reproductions of several slides.

The integrity or subdivision of the fibro-vascular bundle has already been commented on as furnishing an excellent character, as indicated by Coulter & Rose and Koehne.

The position of the resin-canals is more variable; they are not always present, and in some cases (as in *P. Lambertiana*), on the same branch, they may vary in position.

The general form of the leaf, whether three-sided (Pl. **20.** fig. 3) or semicylindric (Pl. **20.** fig. 1), with the upper side concave or flattish, has, of course, attracted general attention. This form is well seen when transverse sections of the leaf are made. But the shape of the central half-cylinder or "meristele," when similarly cut across, does not always correspond to the general shape of the leaf, and has not, to my knowledge, been specially noticed. Nevertheless it affords a very good means of differentiating certain species. The "meristele," thus seen in section, may be circular, as might be expected in *P. monophylla* (Pl. **21.** fig. 4), which has cylindrically-shaped leaves; but it occurs also in numerous species, such as *P. edulis*, in which the leaves are three-sided. The meristele has an elliptic section in many species of those groups which have from 3 to 5 leaves, and also constantly in the 2-leaved section (Pl. **20.** fig. 1). A third variation exists in those species where the meristele is three-sided in section, as in *P. filifolia* (Pl. **21.** figs. 5 & 6). This triangular form is generally very distinct, but it occasionally passes gradually into the oblong or elliptic form *.

The number and the size of the endoderm-cells (see Pl. **20.** figs. 1, 2, 3, etc.) offer, as has been said, good characters, and will, it is hoped, attract the attention of students with the necessary patience and leisure.

The thickness of the hypoderm or stereome layers varies in different species, and even in the same species under varying conditions. It is usually in one or two layers, with an extra number in the corners. It is uniform, or in some species it

---

Knowledge of some North-American Coniferæ' (1897). A few plans of leaf-sections of Pines are given by Prof. Tschirch of Berne, Schweiz. Wochenschrift für Chemie und Pharmacie (1903), no. 22.

* Care must also be taken that the section be made accurately in a horizontal direction across the centre of the adult leaf.

projects inwards in thick wedge-shaped masses (Pl. 22. fig. 7). Where the tree is much exposed to wind, the hypoderm-cells are likely to become thicker, if not always more numerous than in the same species growing under less exposed conditions. In the same way they are less highly developed in the cotyledons than in the adult leaf (Pl. 22. fig. 8). But this, again, is a point which requires more attention than I have been able to bestow on it.

The occasional presence or absence of a layer of thin-walled cells, presumably containing water, just beneath the epiderm should also be noted, as well as the position and number of the rows of stomata.

An instructive comparison may, as has already been remarked, be made between the structure and conformation of the cotyledons and of the primordial leaves with those of the adult foliage. Without going into details, unnecessary for the present purpose, it may be stated that the histological structure of the temporary foliar members is of a less highly developed character than in the more permanent foliage. This is, of course, what might have been expected. The cotyledons are sometimes, as in *P. Pinea*, triangular and with a circular meristele (Pl. 22. fig. 8) and unbranched bundle, whilst in the adult leaves of the same species the stele is oblong in section and the fibro-vascular bundle divided. From a genealogical point of view, it is therefore important to note that certain characters that are common to all the species in their juvenile state may sometimes continue their juvenile characteristics in adult life with comparatively little modification. Thus the unbranched bundle, which is a common characteristic of the cotyledons and primordial leaves (Pl. 23. fig. 9) in some species, remains in the fully developed adult foliage; whilst in others the bundles, simple in the juvenile state, become branched later on. It is quite probable, therefore, that the species with branched bundles are the modified derivatives from those of simpler form. This assumption is supported by other characteristics more readily seen, such as the nature of the bud-scales and the peculiarities of the cone-scales.

The walls of the cell constituting the cortex or mesophyll of the leaf are in some species plain (Pl. 23. fig. 10); in other species thrown into folds, "plicate" or sinuous, indicating an enhanced physiological function (Pl. 22. fig. 7). There is usually no distinct palisade-layer in the leaves of *Pinus*; so that the structure is distinct in that respect from that of the leaves of *Abies* and other flat-leaved genera. In some forms of *P. Pinaster*, however (Pl. **23.** fig. 11), a palisade-layer is developed. The leaves of *Pinus Bungeana* (Pl. **23.** fig. 10) are interesting as showing a radiating arrangement of the mesophyll-cells in contact with the endoderm.

In this place I may be permitted to say something as to the value, for taxonomic purposes, of the histological characters. Briefly, they have no greater intrinsic value than any other characters. They are useful, but they are not infallible guides. For the most part they are of a physiological or adaptive nature, and therefore likely to vary according to varying conditions to a much greater extent than other characters less dependent on existing circumstances and more "fixed" by long hereditary descent.

It must also be remembered that whereas the student of the outer morphology has generally the opportunity of examining a number of specimens from various localities, and of comparing the characters as grown under varying conditions, the histological student is generally, of necessity, confined to the examination of a relatively small number of sections, taken, it may be, from the same specimen. Histological characters, moreover, are not conveniently observed in the forest or the garden, where some more ready means of discriminating are necessitated.

In the present communication I have bestowed attention almost exclusively on the taxonomic characters afforded by the inner structure of the leaf. For the structural details of other organs reference may be made to the papers of Van Tieghem, "Sur la Structure primaire et les Affinités des Pins," Journ. de Bot. t. vi. (1891) p. 265; and Penhallow, in Trans. Roy. Soc. Canada, vol. ii. (1896), sect. iv. p. 54, who shows that the genus is in regard to anatomical characters a well-defined group impossible to confound with any other. He divides the genus, so far as the N. American species are concerned, into two groups: 1st, those in which pits occur on the tangential walls of the summer wood, as in section *Strobus*; and 2ndly, those in which the pits are wanting in that situation. Radais, in Ann. Sc. Nat. sér. 7, t. xix. (1894) p. 297, tab. 8, arrives at similar conclusions. See also Dangeard, "Recherches sur les Plantules des Conifères," Le Botaniste, sér. 3, p. 191; Bertrand, "Anat. compar. des Conifères," Ann. Sc. Nat. sér. 5, t. xx. (1874), tab. 12, p. 5; and numerous papers by Van Tieghem, Baillon, and others on the structure of the female flowers.

Grouping of the Species.

The following arrangement of sections and species is drawn up with a view of facilitating the identification of particular species, and is, to a large extent, arbitrary. The main divisions and sections, however, are of a more natural character, inasmuch as they include species which are evidently closely allied structurally.

In the division TENUISQUAMÆ, including the sections Strobus and Cembra of authors, the relatively thin cone-scales constitute a character easily recognized, very constant, associated with other marked characteristics, and linking the genus, so far as the characters presented by the cones are concerned, to the other genera of the Abietineæ.

In the section Strobus the resin-canals are marginal and the seeds are distinctly winged. Penhallow (Trans. Roy. Soc. Canada, 1896, vol. ii. sect. iv. p. 34) points out that in *P. Strobus* and some of its allies there are pits on the tangential walls of the summer wood, whilst there are none in the corresponding position in the other sections into which he divides the genus.

The section Cembra comprises 5-leaved Pines, with median resin-canals and wingless or nearly wingless seeds.

The division CRASSISQUAMÆ includes all those species in which the cone-scales are notably thickened towards the apex, and are of a more distinctly woody character than in the preceding division. It is here divided into two groups—one in which the bud-scales are deciduous, loosely imbricate, and membranous *; the other in which the bud-scales are persistent and subcoriaceous. The series in which the bud-scales are thin and membranous includes two sections—one, Integrifoliæ, in which the leaves are quite entire, and the meristele circular in section; the other, Serratifoliæ, in which the leaves are serrulate or denticulate, especially towards the tip, and in which the meristele is elliptic or transversely oblong in section. Certain species, such as *flexilis* and *albicaulis*, here placed in the Crassifoliæ, are comprised by Engelmann in sect. Strobus. They are, in fact, somewhat intermediate in their characters, but on the whole they seem more closely related to the species with which they are here associated than to those in the section Strobus.

* In a manuscript list of Conifers prepared by Sir Joseph Hooker, and which I was privileged to inspect, great stress is deservedly laid upon the nature of the bud-scales for classificatory purposes.

The series in which the bud-scales are more or less persistent, tightly imbricated and subcoriaceous in texture (at least at the base), includes two principal groups, the one in which the leaves vary from 3 to 5 in a tuft and are 3-sided (Pl. **21.** fig. 6), and the other that in which the leaves are in pairs, semiterete, grooved or flattish on the upper surface, and, when cut across, presenting the outline of a section of a boat (Pl. **20.** fig. 1).

The group in which the leaves are 3-sided admits of division into the sections Indicæ (Engelmann), Ponderosæ (Engelmann), Filifoliæ (corresponding nearly to Engelmann's Pseudostrobi), and Cubenses (Engelmann's Australes).

The 2-leaved group is very distinct, but allows of subdivision into two sections—the Silvestres (Engelmann in part) and Pinaster, according as the resin-canals are marginal, as in *P. silvestris* and its allies, or median as in *P. Laricio*, etc.

The sections here proposed correspond in many particulars with those set forth by Engelmann and with some of the subdivisions adopted by the older writers, but they are grouped differently, and their constituent species are not always the same.

Further remarks on the ten sections of the genus here proposed will be included in the notes relating to individual species.

PINUS.

Division I. TENUISQUAMÆ.

Cones near the ends of the shoots; cone-scales leathery or slightly woody, not specially thickened near the apex or on either side of the terminal umbo. Bud-scales thin, membranous. Leaf-sheaths mostly deciduous, often leaving a short, persistent, frill-like ring at the base. Leaves 5, 3-sided, meristele circular in section. Fibro-vascular bundle simple.

Section 1. Strobus.

Resin-canals marginal, rarely median (as sometimes in *Lambertiana*); seeds winged .... Spp. 1–10.

Section 2. Cembra.

Resin-canals median; seeds wingless or nearly so. Spp. 11–13.

Division II. CRASSISQUAMÆ.

Cones subterminal or lateral, falling when mature or persistent on the branches; cone-scales thick, more or less woody, markedly thickened at or near the apex, on one or both sides of the terminal umbo.

A. Leaf-sheaths of thin membranous scales, deciduous except at the base.

Section 3. Integrifoliæ.

Cones near the apex of the herbaceous shoot. Leaves 1–5, entire at the edge; resin-canals marginal; meristele cylindric, circular in section; fibro-vascular bundle simple. Spp. 14–21.

Section 4. Serratifoliæ.

Cones near the middle of the herbaceous shoot. Leaves denticulate at the margin; meristele elliptic in section; resin-canals marginal or median .... Spp. 22–25.

B. Leaf-sheath of persistent convolute scales.

* *Leaves* 3–5, 3-*sided.*

Section 5. Indicæ.

Cones subterminal. Leaves in threes, elongate, slender; resin-canals marginal; anthers crested; meristele triangular or elliptic .... Spp. 26–28.

Section 6. Ponderosæ.

Cones mostly large, subterminal or lateral. Leaves mostly in threes, elongate; resin-canals median; meristele elliptic in section; fibro-vascular bundle branched ...... Spp. 29–40.

Section 7. Filifoliæ.

Cones mostly large, subterminal. Leaves in fives; resin-canals mostly median; meristele elliptic or triangular in section, rarely circular .... Spp. 41–47.

Section 8. Cubenses.

Cones lateral or subterminal. Leaves 2–5; resin-canals internal; meristele triangular or elliptic in section; fibro-vascular bundle simple or branched .... Spp. 48–52.

** *Leaves 2, semiterete, boat-shaped in section; meristele elliptic in section; fibro-vascular bundle always branched.*

Section 9. SYLVESTRES.

Cones subterminal or lateral. Resin-canals marginal. Spp. 53–62.

Section 10. PINASTER.

Cones lateral or subterminal. Resin-canals median. Spp. 63–73.

Division I. TENUISQUAMÆ.

Sect. I. STROBUS. Spp. 1–10.

I. { Cones sessile or nearly so; no dorsal stomata .... II.
Cones distinctly stalked .... III.

II. { Cones elongate-ovoid; scales oblong, flattish or slightly concave at the ends .... 1. **pentaphylla.**
Cones oblong-ovoid or subglobose; scales rounded and very concave at the ends. Leaves 5–6 cent. 2. **parviflora.**

III. { Cones very long, 20–30 cent. Young shoots covered with brownish hairs. Stomata on all sides of the leaf. 3. **Lambertiana.**
Cones not exceeding 12–15 cent. Shoots glabrous, glaucous, or purplish. Dorsal stomata absent .... IV.

IV. { Cone-scales reflexed at the tips .... V.
Cone-scales not reflexed at the tips .... VI.

V. { Seed-wing shorter than the seed. Leaves 8–10 cent. 4. **strobiformis.**
Seed-wing as long as the seed. Leaves 10–16 cent. 5. **Ayacuite.**

VI. { Cones short oblong; scales roundish, wrinkled. 6. **scipioniformis.**
Cones elongate, cylindric-conic .... VII.

VII. { Cones curved, somewhat pointed; scales rounded concave, and scoop-like at the tips; shoots ultimately glabrous. Leaves 8–10 cent. .... 7. **Strobus.**
Scales pointed, with a projecting mucro .... VIII.

VIII. { Herbaceous shoot covered with brown felted hair. Leaves 4–10 cent. .... 8. **monticola.**
Shoots glabrous .... IX.

IX. { Cones oblong-ovoid, straight. Leaves 6–8 cent. 9. **Peuke.**
Cones elongate-cylindric, obtuse, often curved. Leaves 10–12 cent. .... 10. **excelsa.**

Sect. 2. Cembra. Spp. 11–13.

X. { Cones cylindric-conic; scales gradually tapering to a point, mostly reflexed. Leaves 8–9 cent. 11. **koraiensis.**
Cones oblong; scales not reflexed except those near the base .... XI.

XI. { Cones oblong; scales pointed, basal scales recurved. Leaves 14–18 cent. .... 12. **Armandi.**
Cones barrel-shaped, obtuse; scales rounded, basal scales mostly not recurved. Leaves 4–8 cent. 13. **Cembra.**

Division II. CRASSISQUAMÆ.

A. Bud-scales membranous. Leaf-sheaths deciduous except at the extreme base; scales imbricate, often revolute.

Sect. 3. Integrifoliæ. Spp. 14–21.

XII. { Leaf solitary, cylindric; scales of male flower 6. 14. **monophylla.**
Leaves 1–5, usually 5, 3-sided, smooth-edged or nearly so; scales of male flower 4 .... XIII.

XIII. { Seed-wing short or none.................... XIV.
Seed-wing as long as, or longer than the seed; scales of male flower 4; dorsal stomata absent ...... XVIII.

XIV. { Cone-scales ultimately recurved at the tip; dorsal stomata absent .... XV.
Cone-scales not recurved; dorsal stomata present. XVI.

XV. { Apophysis deltoid at the base. Leaves 3–5 cent. 15. **Parryana.** (*quadrifolia.*)
Apophysis transversely elliptic; dorsal stomata absent. 16. **cembroides.**

XVI. { Leaf solitary. (*See* 14. **monophylla.**).
Leaves 2–3, 4 cent. long; scales of male flower 4. 17. **edulis.**
Leaves 5; scales of male flower 8–10; dorsal stomata present .... XVII.

XVII. { Male-flowers globose; cone ovoid-oblong. Leaves 5–7 cent. 18. **albicaulis.**
Male flowers oblong; cone oblong-conic. Leaves 5–7 cent. 19. **flexilis.**

XVIII. { Umbo depressed. Leaves 4–5 cent. 20. **Balfouriana.**
Umbo aristate. Leaves 4–5 cent. . . 21. **aristata.**

Sect. 4. Serratifoliæ. Spp. 22–25.

XIX. { Meristele elliptic in section; fibro-vascular bundle simple. Bark white. Resin-canal marginal. 22. **Bungeana.**
Fibro-vascular bundle branched .... XX.

XX.
- Resin-canals marginal. Leaves 6–9 cent. 23. **Gerardiana.**
- Resin-canals median. Leaves 4–7 cent. 24. **chihuahuana.**
- Resin-canals internal or median? (imperfectly known). 25. **Lumholtzii.**

B. Bud-scales tightly imbricate, subcoriaceous. Leaf-sheaths persistent; scales convolute, membranous.

* *Leaves 3–5, 3-sided.*

Sect. 5. INDICÆ. Spp. 26–28.

XXI.
- Cone ovate-conic, 6–7 cent. Resin-canals marginal; meristele elliptic in section; fibro-vascular bundle simple. 26. **insularis.**
- Fibro-vascular bundle branched .... XXII.

XXII.
- Cone ovate-conic, 10–12 cent. Resin-canals marginal; meristele elliptic .... 27. **longifolia.**
- Cone ovoid, 4–6 cent. Resin-canals marginal; meristele triangular .... 28. **Khasya.**

Sect. 6. PONDEROSÆ. Spp. 29–40.

XXIII.
- Cones subterminal, usually large .... XXIV.
- Cones lateral .... XXV.

XXIV.
- Cones oblong-cylindric; apophysis prominent, 4–5-sided; umbo straight .... 29. **canariensis.**
- Cones cylindric-conic; umbo recurved. Bark generally pale; endoderm-cells 50–60 .... 30. **ponderosa.**
- Cones broadly ovoid. Bark purplish black; endoderm-cells 40 .... 31. **ponderosa**, var. **Jeffreyi.**

XXV.
- Cones mostly large, 10–25 cent. long .... XXVI.
- Cones of medium size, less than 12 cent. long.... XXIX.

XXVI.
- Cones clustered, subsessile, persistent in many whorls along the branches. (See also 64. **muricata.**) 32. **attenuata.** (*tuberculata.*)
- Cones solitary, in pairs or in single whorls...... XXVII.

XXVII.
- Cones large, oblique, especially at the base. 33. **radiata.** (*insignis.*)
- Cones large, symmetrical.................... XXVIII.

XXVIII.
- Tips of the cone-scales passing abruptly into a stout, much-curved umbo; leaves dense, green, ascending or spreading .... 34. **Coulteri.**
- Tips of the cone-scales passing gradually into a stout subulate umbo; leaves thin, bluish, pendulous. 35. **Sabiniana.**

XXIX. Cones oblong or elongate-ovoid .... XXX.
Cones ovoid or broadly ovoid .... XXXI.

XXX. Cones 8–10 cent., oblong; umbo subulate. Leaves 18–24 cent. .... 36. **Taeda.**
Cones 4–8 cent., oblong-conic; umbo depressed, mucronate. Leaves 12–20 cent. .... 37. **Teocote.**
Cones oblong or ovate-oblong, 7–11 cent.; umbo flattish or depressed, tubercled .... 38. **patula.**

XXXI. Cones ovoid, opening early; umbo prominent, subulate, reflexed. Leaves 8–12 cent. .... 39. **rigida.**
Cones subglobose or broadly ovoid, serotinous; umbo minute. Leaves 16–20 cent. .... 40. **serotina.**

Sect. 7. Filifoliæ. Spp. 41–47.

XXXII. Resin-canals absent; meristele triangular. 41. **Donnell-Smithii.**
Resin-canals median .... XXXIII.

XXXIII. Meristele elliptic or transversely oblong ...... XXXIV.
Meristele triangular .... XXXV. & XXXVI.
Meristele circular .... XXXVII.

XXXIV. Cones ovoid or ovoid-oblong. Leaves 3–5, 10–20 cent.; sheaths short .... 42. **Hartwegi.**
Cones oblong-conic, very variable in size, etc. Leaves 5, 20–30 cent.; sheaths long. .... 43. **Montezumæ.**

XXXV. Cones 20 cent. long. Leaves 20–30 cent. 44. **filifolia.**
Cones 5–6 cent.; umbo slightly mucronate. Leaves 8–20 cent. 45. **leiophylla.**

XXXVI. Cones very large, subglobose; scales with stout subulate mucro .... 46. **Torreyana.**

XXXVII. Cones 5–7 cent. long, oblong-conic; umbo short, subulate. 47. **arizonica.**

Sect. 8. Cubenses. Spp. 48–52.

XXXVIII. Leaves 3; meristele elliptic .... XXXIX.
Leaves 5, rarely 3 (*palustris*) .... XL.

XXXIX. Cones lateral, 8–15 cent., ovoid-conic; umbo rhomboid, with a short straight mucro .... 48. **cubensis.**
Cones subterminal .... XL.

XL. Umbo terminating in a foliaceous process. Leaves 16–18 cent. 49. **occidentalis.**
Umbo not foliaceous .... XLI.

XLI.
- Cones 15–26 cent., cylindric conic; umbo with a short recurved mucro. Leaves 3, 25–35 cent. 50. **palustris.**
- Cones 10–12 cent., elongate ovoid; umbo short, deltoid. Leaves 18–30 cent. .... 51. **pseudostrobus.**
- Cones 5–10 cent., subglobose; umbo muticous. Leaves 18–25 cent. .... 52. **oocarpa.**

** *Leaves 2, semiterete.*

Sect. 9. SILVESTRES. Spp. 53–62.

XLII.
- Cones lateral .... XLIII.
- Cones subterminal .... XLIV.

XLIII.
- Cones solitary or in pairs, ovoid or usually oblong-conic, long-stalked, deflexed. Leaves 7–9 cent. 53. **halepensis.**
- Cones often clustered, broadly ovoid, subsessile, horizontal or ascending. Leaves 12–18 cent... 54. **bruttia.**

XLIV.
- Leaves more than 10 cent. long .... XLV.
- Leaves less than 10 cent. long .... XLVI.

XLV.
- Cones elongate, ovoid-conic; apophysis prominent, pyramidal. Leaves 18–20 cent. .... 55. **Merkusii.**
- Cones broadly ovoid-conic; apophysis flattened; umbo depressed. Leaves 14–18 cent., slender. 56. **Massoniana.**

XLVI.
- Low tree, generally shrubby, sometimes prostrate; leaves deep green. Cones ovoid or ovoid-conic, 3–5 cent. 57. **montana.**
- Tall trees .... XLVII.

XLVII.
- Cones 10–12 cent., broadly ovoid; apophysis prominent. Seed-wing narrow or absent .... 58. **Pinea.**
- Cones less than 10 cent. long, ovoid or ovoid-conic. Seed-wing conspicuous .... XLVIII.

XLVIII.
- Leaf-buds oblong, distinctly apiculate; apophysis transversely oblong, muticous. Leaves 10–16 cent. 59. **resinosa.**
- Leaf-buds oblong acute, shortly apiculate........ XLIX.

XLIX.
- Cones ovoid or ovoid-conic, acute; apophysis subrhomboid, flattened or prominent, upper border ovate, acute. Leaves green beneath, glaucous at the sides, 3–8 cent. long. 60. **silvestris.**
- Cones ovoid, acute or obtuse; apophysis transversely oblong, sinuous .... L.

L.
- Cones ovoid, 3–4 cent. long; apophysis cushion-shaped, striated, upper border irregularly lobed; umbo deeply depressed. Leaves 7–8 cent. .... 61. **Henryi.**
- Cones 4–5 cent.; apophysis not striated, obscurely lobed; umbo prominent. Leaves 6–10 cent. 62. **densiflora.**

Sect. 10. Pinaster. Spp. 63-73.

LI. { Cones lateral .... LII.
Cones terminal .... LVIII.

LII. { Cones serotinous .... LIII.
Cones not serotinous .... LV.

LIII. { Cones small, oblong-conic, curved, turned upwards parallel with the branches. Leaves 3–5 cent. 63. **divaricata.** (*Banksiana.*)
Cones horizontal or deflexed .... LIV.

LIV. { Cones oblong, persistent on the old branches; apophyses obscurely 4-sided, ending abruptly in a stout subulate umbo. Leaves 10–16 cent. .... 64. **muricata.**
Cones conic, persistent, often ultimately embedded in the branch; umbo deltoid-subulate. Leaves slender, 5–10 cent. .... 65. **clausa.**

LV. { Cones clustered, persistent, 12–18 cent., conic; apophysis pyramidal; umbo stout, compressed. Leaves 12–20 cent. 66. **maritima.** (*Pinaster.*)
Cones clustered, persistent, roundish oblong; apophysis tapering gradually into a stout subulate umbo. Leaves 5–6 cent. .... 67. **pungens.**
Cones not exceeding 10 cent. .... LVI.

LVI. { Cones subsessile in pairs, oblong-conic, 5–7 cent.; mucro subulate. Leaves 5–8 cent. .... 68. **virginiana.** (*inops.*)
Mucro minute .... LVII.

LVII. { Cones 4–5 cent., ovoid or oblong-ovoid. Leaves slender, 7–8 cent. .... 69. **glabra.**
Cones 6–7 cent., solitary, oblong-conic. Leaves slender, 8–10 cent. .... 70. **echinata.** (*mitis, variabilis.*)

LVIII. { Cones in pairs or solitary, rarely clustered. Leaf-buds apiculate. Leaves variable .... 71. **Laricio.**
Leaf-buds acute, not apiculate .... LIX.

LIX. { Cones 5–7 cent., ovoid-conic. Bud-scales silvery. Leaves 10–14 cent. .... 72. **Thunbergiana.**
Cones oblong-conic, 6–7 cent. Bud-scales brown. Leaves 5-6 cent. .... 73. **contorta.**

IMPERFECTLY-KNOWN SPECIES (*see post*).

P. recurvata, *Rowlee.*
P. yunnanensis, *Franchet.*
P. vermicularis, *Janke.*
P. leucosperma, *Maximowicz.*
P. eldarica, *Medwejewi.*

INCIDENTAL REMARKS ON THE SPECIES OF PINUS.

The species hereinafter referred to are for the most part named in accordance with Parlatore's monograph in De Candolle's 'Prodromus,' xvi. fasc. 2 (1868), Engelmann's "Revision" in the 'Transactions of the Academy of St. Louis' (1880), and, to a less extent, in conformity with Sargent's 'Silva' (1897). Full descriptions, synonyms, and references to figures are given in those works, which it is not necessary to repeat here. The excellent figures in Loudon's 'Encyclopædia of Trees and Shrubs' (1842) should be consulted by all students, as well as those given in the 'Journal of the Horticultural Society,' vol. i. (1846), vol. ii. (1847), vol. iv. (1849), the 'Pinetum Britannicum,' the 'Gardeners' Chronicle,' and the more recent publications of Beissner and Veitch. It is desirable to repeat that Parlatore treated the genus in a much wider sense than is here done, embracing indeed in his *Pinus* almost all the Abietineæ, so that the present remarks apply only to his subgenus *Pinus*. The additions and changes that have become necessary are given under the head of individual species. References to the more recent literature will also be found under the same headings.

1. P. PENTAPHYLLA, the Goyō Matsu of the Japanese, was first described by Mayr in his 'Monographie der Abietineen des Japanischen Reiches' (1890), tab. vi. fig. 20. It was found growing wild in the mountains of Central Japan, and is the Japanese analogue of the North-east American *P. Strobus*.

The triangular leaves have a circular or sometimes a three-sided meristele with a single fibro-vascular bundle. The endoderm-layer consists of about a dozen large cells. The resin-canals are subepidermal, *i. e.* marginal. The cones in the Abbé Faurie's specimens are about 3 inches long, subsessile, spreading, oblong-conic; scales roundish in outline, flattish. The bark is studded with black tubercles.

It never forms separate forests, but grows halfway up the mountains intermixed with deciduous trees (*Faurie* in herb. Paris).

2. Pinus parviflora, *Siebold & Zuccarini.*

A well-known Japanese species, sometimes referred to the section Cembra, but the resin-canals are marginal.

The young shoots, in the cultivated trees, are usually hairy, destitute of leaves at the base, and possess a double ring of resin-canals in the cortex. The buds are cylindric-obtuse with lanceolate brown scales. The three-sided leaves have a circular meristele and an undivided vascular bundle. The dorsal side is flattish or slightly convex, green, without stomata, the two lateral faces slightly concave, glaucous. The resin-canals are marginal, without a sheath of stereome-cells. The endoderm-layer consists of about 20 cells. Cotyledons 8–10. In cultivation it produces abundance of *Cembra*-like cones.

In addition to the older literature cited in the text-books it may be well to cite the more recent publications of Mayr, Monog. Abiet. Japan. (1890) p. 76, t. 5, and Syme in Gard. Chron. (1878) p. 624, f. 103.

3. P. Lambertiana, *Douglas*; *Sargent*, *Silva*, xi. (1897) p. 27, t. 542.

The history of the discovery of this noble Pine is given in a communication from Douglas in the 'Companion' to the Botanical Magazine, ii. pp. 92 & 130 (1836). The species had been already published in the Transactions of the Linnean Society, xv. p. 500 (1827). The type-specimen is in the Kew herbarium.

The resin-canals in the primordial leaves are marginal (Pl. 23. fig. 9), the endoderm is feebly developed, and the fibro-vascular bundle unbranched. In the adult leaves the canals are sometimes median, sometimes marginal, the endoderm-cells well-developed, about 28–32, and the fibro-vascular bundle branched. See J. D. Hooker, in Gard. Chron., Jan. 3 (1885), p. 15, f. 1.

The stomata occur on all three of the leaf-surfaces. The bracts of the male flower are 8–10 in number, according to Sargent. Cotyledons 12–15.

4. P. strobiformis, *Engelmann*; *Sargent*, *Silva*, xi. (1897) p. 33, tab. 544.

P. Ayacuite, Parlatore pro parte.

This species is distinguished from *P. Ayacuite*, by Sargent, on account of the different form of the cone-scales and the shorter seed-wing. So far as I have seen, the leaves are usually much shorter than in *P. Ayacuite*, denticulate at the edges, though figured by Sargent as entire; the cones are also shorter, obtusely cylindric rather than conic, with the cone-scales rounded obtuse at the recurved tips, and with nearly wingless seeds.

It is a native of the mountains of Northern Arizona and of Chihuahua, at elevations of from 6000–8000 ft., usually growing singly.

5. Pinus Ayacuite, *Ehrenberg*.

This is a five-leaved Pine with long slender leaves, and usually with elongated cones. The cone-scales generally taper towards the apex and are there strongly recurved. The young shoots in the cultivated trees are generally covered with down, devoid of leaves at the base, but sometimes clothed with leaf-fascicles. The resin-canals are marginal, the stereome-cells abundant beneath the epidermis and around the resin-canals. Engelmann, however, describes them as few in number and not present around the ducts. The meristele is circular in section, and the fibro-vascular bundle unbranched. The endoderm-cells are about 24 in number. The stomata are in four rows on the sides, but not on the back of the leaf. The wing of the seed is as long or longer than the seed itself. Cotyledons 12–15.

The species is a native of the mountains of Northern Mexico and perhaps to the mountains of Southern Arizona. It seems more probable, as Sargent has pointed out, that the Arizona tree is a distinct species, with very narrow wings to the seed, and which he refers to *P. strobiformis* of Engelmann.

6. P. scipioniformis (§ Strobus), *Masters, in Bull. Herb. Boissier*, April 1898, p. 270.

This is one of Dr. Henry's discoveries in Hupeh. It is one of the Strobus section, with oblong-obtuse cones, 3–5 centim. long, resembling a short stick, whence the name.

The resin-canals are subepidermal. There are 4 or 5 rows of stomata on the sides of the leaf, but none on the dorsum.

7. P. Strobus, *Linn.*; *Sargent, Silva*, xi. (1897) p. 17, t. 538; *Britton & Brown, Illustrated Flora of the N. United States, Canada, etc.*, i. (1896) p. 51, fig.; *Beissner, Handbuch*, ed. 2, p. 290.

To the description of this well-known Pine, of which an authenticated specimen is to be found in Linnæus's herbarium, there is little that need be added.

In the seedlings examined by me the caulicle or, as it is now generally called, the hypocotyl, is remarkable for tapering upwards. How far this is characteristic remains to be seen. The herbaceous shoots are slender, greenish, covered with fine white setæ, and destitute of leaves at the base. The leaves have two rows of stomata on the sides, but none on the back, they are triangular in section, with the cells of the mesophyll sinuous. The marginal resin-canals are surrounded by a sheath of stereome-cells. The meristele is circular in section, and the fibro-vascular bundle unbranched. The endoderm consists of about 20 cells.

The leaves of this species are softer and less rigid than those of *Pinus monticola*, which represents it on the Pacific side of the American continent, and they are stouter and not so long as in the Himalayan *excelsa*, to which it is also nearly allied.

The scales of the cone are scoop-like at the tips, more so than in either *P. monticola* or *P. excelsa*, and the lowermost cone-scales are often more or less recurved.

The cotyledons vary in number from 7 to 14.

In the Natural History Museum (British Museum) is a specimen from N. California collected by Lemmon and named *monticola*. The size and shape of the cone are indeed those of *monticola*, but the tips of the scales are rounded and recurved, resembling in this particular the *P. strobiformis* of Sargent from Arizona (see *ante*, p. 578).

8. Pinus monticola, *D. Don*; *Sargent, Silva*, xi. (1897) p. 23, tabb. 540, 541.

In the herbaceous shoots of this species, whitish, capitate, glandular hairs are intermingled with the whitish or brownish setæ which beset the brownish surface.

Engelmann describes the resin-canals as peripheral and not encircled by strengthening cells, but in some of the wild specimens examined by me I have seen stereome-cells surrounding the canals.

The leaves are triangular in section, with a circular meristele separated from the cortex by an endoderm-layer of 25–28 cells. The fibro-vascular bundle is unbranched. There are three rows of stomata on the sides of the leaf. The cone-scales are flatter and less scoop-like than in *P. Strobus*. Cotyledons 6–9.

9. Pinus Peuke, *Grisebach, Spicil. Fl. Rumel.* ii. p. 349 (1843); *Boissier, Fl. Orient.* v. (1884) p. 608.

This species, native to the mountains of Macedonia, Montenegro, Servia, and Bulgaria, where it occurs scattered among Spruce Firs, was at first considered to be conspecific with the Himalayan *P. excelsa*. The evidence that they may have originated from the same stock is strong, but the shorter leaves, shorter cone-stalks, thicker shorter cones, and sinuously-veined seed-wings of *P. Peuke* now suffice to distinguish it from *P. excelsa*. (See Masters, in Gard. Chron., Feb. 24, 1883, p. 244, f. 34.)

The young shoots are glabrous, green, and destitute of leaves near the base. The primordial leaves are membranous, brown, lanceolate-acuminate. The adult leaves are aggregated into ascending, wedge-shaped tufts, whilst those of *excelsa* are usually decurved. The resin-canals are marginal, surrounded by stereome-cells, and have the same structure as in *P. excelsa*. The leaves are three-sided, with no stomata on the convex dorsum, and with a circular meristele (in section). The resinous buds are ovate-acuminate. The male flowers, hitherto undescribed, are arranged in clusters. Each is about 8–10 mill. long, 3 mill. broad, orange-yellow flushed with pink. Anthers shortly mucronate or muticous, devoid of the laciniate crest which characterizes the anthers of *P. excelsa*. The cones, which Grisebach describes as erect, are only so in the young state, when mature they are deflexed. The cone-scales are rounded, with a small blunt point, and the wing of the seed is longer than the seed itself and traversed with sinuous veins. Grisebach, probably by inadvertence, described the seeds as exalate. Cotyledons 9–10.

10. P. excelsa, *Wallich*; *Hooker, Fl. Brit. India*, v. (1890) p. 651; *Collett, Flora Simlensis* (1902), p. 485, fig. 157; *Brandis, Forest Flora*, p. 510; *Gamble, Manual of Indian Timbers*, ed. 2 (1902), p. 704.

A tree, very variable in habit as seen in cultivation. The herbaceous shoots are glabrous, naked at the base, and the cone-scales are remarkably broad near the apex. It is described in almost all the text-books and is well figured in the 'Gardeners' Chronicle,' February 24, 1883. The seed-wing is twice the length of the seed itself. The leaves are three-sided with marginal resin-canals, meristele circular in section, and the fibro-vascular bundle unbranched. There are five rows of stomata on the two sides of the leaf and none on the dorsum. The cells of the mesophyll have plicated walls. Cotyledons 8–12.

It extends, with few interruptions, along the Himalayas from Afghanistan to Bhutan, and its value as a timber tree is well brought out by Gamble, *l. c.*

11. PINUS KORAIENSIS, *Sieb. et Zucc.*; *Mayr*, *Mon. Abiet. Jap.* (1890) p. 73, t. 5, t. 6. f. 18; *Gard. Chron.* 1903; *Beissner*, *Handbuch*, p. 280, fig. 68.

A Pine of the Cembra section, native of Corea, Central China, Japan ?, and Kamtschatka. It has been confounded in books and herbaria with *P. parviflora*; but the resin-canals are median, and the cones are more elongate, with the scales tapering towards the ends and often recurved. The herbaceous shoots are somewhat woolly, devoid of leaves at the base. The leaves are three-sided, with no stomata on the dorsum, with little or no hypoderm, the meristele roundish or obscurely triangular, the endoderm-layer of about 20 cells, and the fibro-vascular bundle unbranched. The cells of the mesophyll are plicate.

The male flowers are in clusters, each ovoid-oblong, about 2 cent. long, pinkish violet; anther-lobes not crested. The young female flowers are purple; the seeds wingless or nearly so.

It has been lately introduced from West Hupeh by Wilson, no. 597! and is figured in the 'Gardeners' Chronicle' (1903), i. figs. 18, 19, p. 34.

12. P. ARMANDI, *Franchet*, *in Nouv. Archiv. du Muséum*, tom. vii. (1884) tab. 12, p. 285.

"This is a five-leaved Pine of the Cembra section, with smooth bark, slender leaves, and oblong cones. It differs from *P. koraiensis* in the cones being broader in proportion to their length and in the cone-scales not being reflexed at the tips. From *P. parviflora* it differs in its longer leaves, larger cones, and wingless seeds.

"The branches are smooth, greyish in colour, the pale green leaves in tufts of five, with a very short deciduous sheath. Each leaf is about 14 to 15 cent. in length, three-sided, serrulate, triangular in section, with the resin-canals median. There are no stomata on the dorsum. The section of the central vascular cylinder or meristele is circular, and the fibro-vascular bundle is unbranched. The endoderm-cells are about 26 in number. The male flowers figured by Beissner are cylindric-oblong, each about 2 cent. long. The anther-scale is notched. The stalked cones are 10 to 11 cent. long, 4 to 5 cent. broad, oblong-obtuse, not tapering much either at the base or at the apex. The cone-scales increase in size gradually from the base to the middle of the cone, are slightly thickened at the tips, the upper exposed portions broadly ovate-acute, somewhat triangular, slightly pointed, and not reflexed. The seeds are wingless and edible. The whole cone has much the appearance of that of the N.W. American *P. flexilis*.

"This Pine has been met with in Chensi, the Tsinling Mountains, *David*! Szechuen, *Farges*! Yunnan, *Delavay*! *Wilson*! but, so far as is at present known, does not occur in Japan.

"Franchet suggests, and not without reason, that the cone figured as that of *P. parviflora* by Murray in 'The Pines and Firs of Japan' (1863), p. 12, fig. 13, may really have belonged to the species now known as *P. Armandi*."—Mast. in Gard. Chron. 1903, Jan. 31, p. 66, figs. 30, 31.

13. Pinus Cembra, *Linnæus*.

There is little to be added to the description of this well-known species, a specimen of which is preserved in the Linnæan herbarium. It is interesting to compare the form of the cotyledons and the primordial leaves with that of the adult leaves. In the cotyledons the section is triangular, two sides being much longer than the base, there is little or no hypoderm, and the resin-canals are near to the margins. The primordial leaf is three-sided, with the base of the triangle as long as the two other sides, and the resin-canals distinctly median. In the adult form the leaf-section is triangular with equal sides, but the dorsum is more convex than the sides and has no stomata. The section of the meristele is circular and the resin-canals are median. The cells of the endoderm number about 20. The cells of the mesophyll are only slightly or not plicated (see Pl. **20**. fig. 2).

The herbaceous shoots are greenish, puberulous, or in native specimens even shaggy, with fawn-coloured hairs, and clothed to the base with leaf-fascicles.

The anthers are muticous and their colour, like that of the perulæ, is variable, ranging from whitish to reddish violet.

In the young cones the bracts are almost quite distinct from the scale, although a single fibro-vascular bundle supplies both by branching above and sending one branch to the bract, whilst the other enters the scale. The central woody core of the ripe cone is spindle-shaped. Cotyledons 8–14.

In some parts of the Swiss Alps, as near Zermatt, where the tree reaches to within a short distance of the snow-line, this species appears to be gradually dying out, and no steps seem to be taken to preserve so valuable a tree.

The species has a very wide distribution; but it is possible that some forms usually included within its limitations are really distinct. Thus, Mayr says that the var. *pumila* is a distinct species having marginal, not central resin-canals; whilst the *Pinus mandshurica* of Ruprecht, also referred to this species, is considered by Maximowicz to be referable to *P. koraiensis* (see Mélanges Biolog. xi.).

14. Pinus monophylla, *Torrey*; *Sargent*, *Silva*, xi. (1897) p. 51, t. 551.

This, which is equivalent to the *P. Fremontiana* of Endlicher, is a native of Nevada, Utah, San Diego, California, Arizona, and the northern slopes of the San Bernardino Mts. It is remarkable for its leaves standing singly, and not in tufts. Various explanations have been offered of this peculiarity. In the 'Annals of Botany,' ii. (1888), I have given reasons for supposing that the single leaf is truly a leaf in structure and position, and that its isolation is due to the arrested development of its companion leaf. Occasionally this second leaf passes on to its full development, when a two-leaved fascicle results.

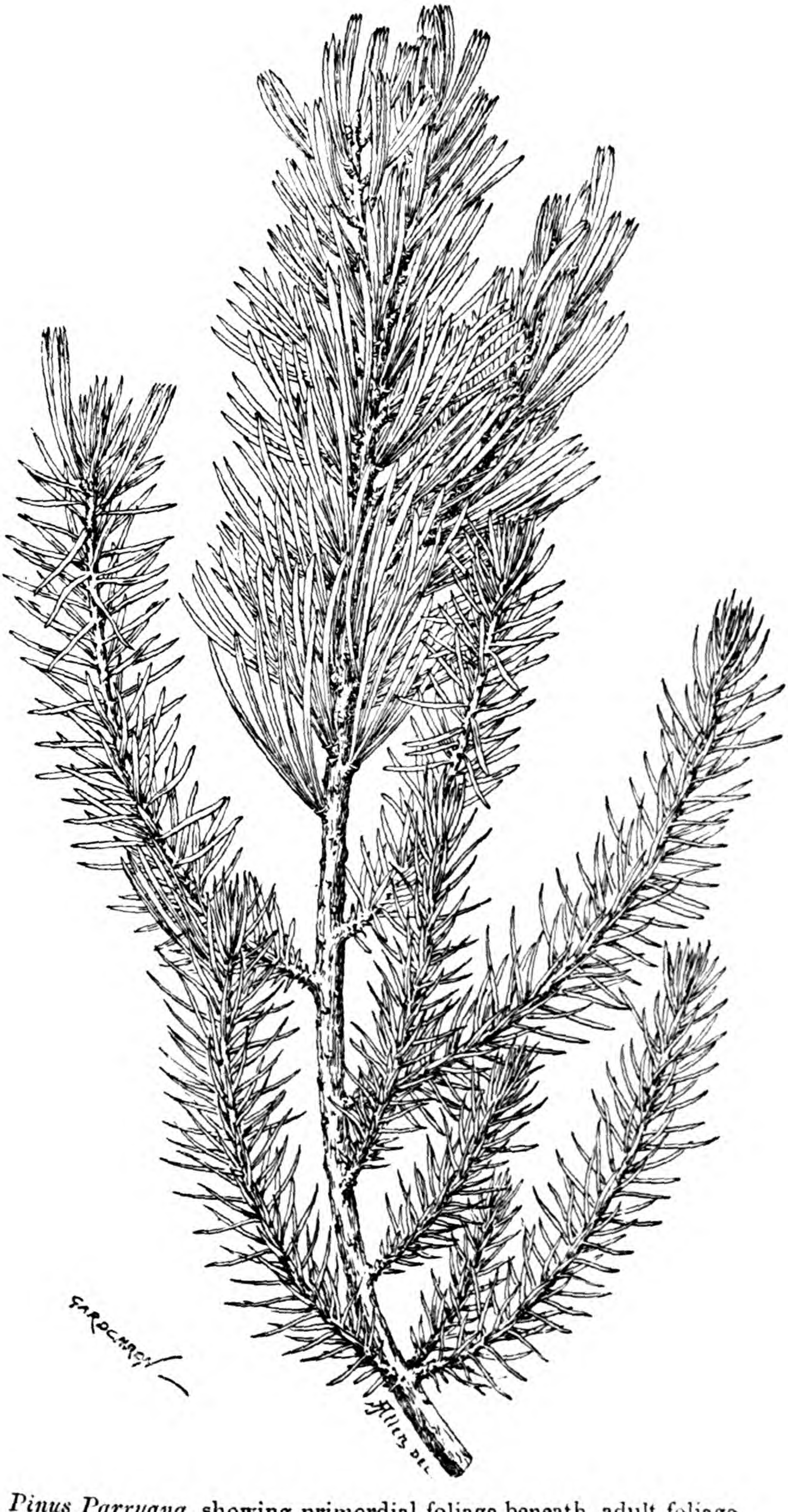
The cells of the mesophyll have infolded undulating processes. The resin-canals are marginal, surrounded by strengthening cells, and the meristele is circular in section, with an unbranched fibro-vascular bundle. The endoderm-layer consists of about 50 cells (Pl. **21**. fig. 4). The cylindrical form of the leaf and of the stele are evidently due to the development of the leaf when not restricted by contact with its fellow leaf. The bracts surrounding the male flowers are six in number (*Sargent*).

The apophysis of the cone-scales is convex, shining chestnut-brown, with an elliptical grey umbo. Cotyledons 8–10.

In cultivation adventitious shoots or "novelli," bearing flattish primordial leaves sometimes called *squamæ fulcrantes*, are occasionally produced from the lower branches.

An interesting account, with illustrations, was given of this

Fig. 1.



Pinus Parryana, showing primordial foliage beneath, adult foliage above: much reduced.

tree as growing on the mountains of Nevada, by Sir Joseph Hooker in the 'Gardeners' Chronicle,' July 31, 1886.

It has been considered by some that *Pinus monophylla* and *P. edulis* constitute one species, and that *P. monophylla* is a dwarf and depauperate form of *P. edulis* (see Meehan in 'Bulletin of the Torrey Botanical Club,' August 1885, p. 81). But, for reasons given in Sargent's 'Silva,' xi. (1897) p. 51, it seems better to keep the two distinct, as they grow for the most part in different districts and no intermediate forms have been discovered.

15. PINUS PARRYANA, *Engelmann* (1862), not of *Gordon*.

This species is called by Sargent (Silva, xi. (1897) p. 43, tab. 549) *P. quadrifolia*, thus adopting the name applied by Sudworth in 1897. The three-sided leaves have marginal resin-canals, no dorsal stomata, a circular meristele surrounded by an endoderm-layer of 20 or more cells, and the fibro-vascular bundle is unbranched. The mesophyll-cells have plicate walls. The bracts of the male flower are only four in number, according to Sargent.

It is remarkable for the abundance and long duration of the primordial leaves and their beautiful bluish colour. (See fig. 1, p. 585.)

The apophyses of the ripe cone are strongly revolute and the seeds wingless. Cotyledons 8.

It is a native of the arid mountain districts of Southern California near the Mexican frontier.

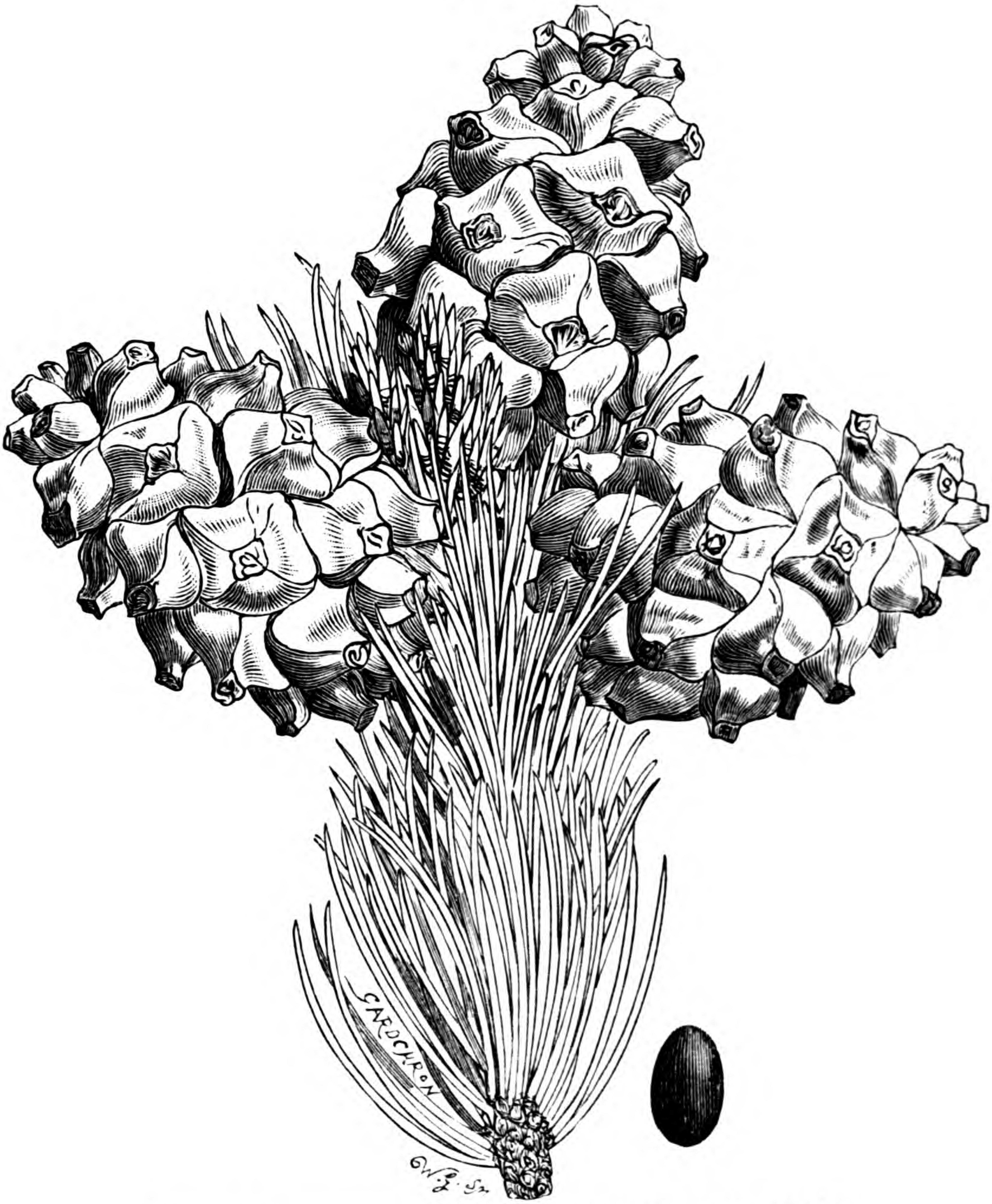
The *P. Parryana* of Gordon is a form of *P. ponderosa*.

16. P. CEMBROIDES, *Zuccarini* (1832); *Sargent, Silva*, xi. (1897) p. 47, tab. 550.

In this species the caulicle is very stout, about 75 mill. long, erect, greyish brown. The primary leaves are crowded, spreading, linear, 25–35 mill. long, mucronate, obscurely serrulate. The three-sided leaves have marginal resin-canals and no dorsal stomata. The endoderm consists of about 16–20 cells surrounding a circular meristele with a single fibro-vascular bundle. The cells of the mesophyll have plicated walls. The shoots are glaucous and not fluted, clothed to the base with leaf-fascicles. The buds, which are ovoid-oblong, pointed, are late to expand in spring. The male flowers are in racemose clusters, each flower being surrounded by four bracts only, and the seeds devoid of wings. The apophyses are recurved, but not so much so as in *Pinus Parryana*. It is the *P. Llaveana* of Schlechtendal (1838). Cotyledons 8–12.

It is a native of the mountains of Arizona, Lower California, and Northern Mexico, growing in hot arid situations.

Fig. 2.



Pinus edulis, showing cone, foliage, and wingless seed: nat. size.

17. Pinus edulis, *Engelmann*; *Sargent*.

This species differs from *P. cembroides*, to which it is very closely allied, in its shorter, thicker leaves which bear stomata on the dorsal side. It is, indeed, so near to *Pinus cembroides* that I should have included it under that species, but that those who have had the opportunity of seeing both species in their native localities keep them distinct. Newberry and Meehan, in the 'Bulletin of the Torrey Botanical Club' (1885), vol. xii. pp. 50, 81, consider *P. monophylla* (*ante*, p. 584) to be a dwarfed and depauperate form of *P. edulis*, but in this opinion I find it hard to concur. See Masters in 'Gardeners' Chronicle' (Nov. 5, 1892) p. 563.

The leaves are three-sided, with a thick hypoderm, mesophyll-cells plicated, marginal resin-canals, a circular meristele surrounded by an endoderm-layer of about 18–20 cells. The fibro-vascular bundle is unbranched. The male inflorescence is subglobose or oblong, the individual flowers 5–7 mill. long, each protected by four bracts. In the young cone the apophysis is convex, with a prominent umbo. The cotyledons number from 7–10.

18. PINUS ALBICAULIS, *Engelmann*; *Sargent*, *Silva*, xi. (1897) p. 39, t. 548.

This species is a native of the Rocky Mountains, British Columbia, Oregon, and California as far south as the San Bernardino Mountains (*Sargent*). The leaves have dorsal stomata and a double layer of hypoderm, which affords protection in the exposed situations in which it grows. The resin-canals are marginal; the mesophyll-cells are plicated. The endoderm consists of about 30 cells, and the meristele is circular in section. The male flowers have 8–10 bracts at the base (*Engelmann*). The connective of the anther is revolute, laciniate or reduced to a simple point.

Engelmann at one time considered it a form of *P. flexilis*, but this grows at lower elevations and in different districts. The male flowers of *P. albicaulis*, moreover, are thicker and rounder than in *flexilis*, and the cone-scales are thicker at the tips and more abruptly subulate-mucronate. Both have nearly wingless seeds. Sir Joseph Hooker, in the 'Gardeners' Chronicle,' June 27, 1885, describes and figures the remarkable effect of the blasts of sand in scoring and polishing the exposed wood of this tree.

19. Pinus flexilis, *James* (1823); *Sargent, Silva*, xi. (1897) p. 35, t. 546.

A mountain Pine, occupying a vast area on the eastward slope of the Rocky Mountains, extending to New Mexico, Texas, Arizona, &c. The herbaceous shoots, as seen in cultivated specimens, are terete, purplish, glabrous, or beset with glandular hairs, and having a single row of resin-canals in the cortex. The resin-canals of the leaves are described and figured as marginal, but they are sometimes to be found in the mesophyll. The endoderm-layer consists of about 30 cells; the meristele is circular, with an unbranched fibro-vascular bundle. The cells of the mesophyll have folded walls. Stomata occur on the dorsum of the leaf.

A young cone is figured in the 'Gardeners' Chronicle' (1875), p. 356. The male flowers are surrounded by 8–10 bracts (*Engelmann*).

The cones at first spread horizontally, but ultimately become deflected. In the mature condition the scales, like those of *P. Lambertiana*, are equally thickened on both sides near the tip, and spread horizontally.

This species is intermediate, in some respects, between the Strobus and Cembra sections, having (usually) the marginal resin-canals of *Strobus* and the nearly wingless seeds of *Cembra*. The woody core, or axis of the cone, is narrower and more elongate than in the European *Cembra*. Cotyledons 8–9.

20. P. Balfouriana, *A. Murray*; *Sargent, Silva*, xi. (1897) p. 59, t. 553.

This species occurs on the mountains of North California. and is remarkable for its dense tufts of foliage. The leaves are short, curved, three-sided, with no stomata on the dorsum, they have a double layer of hypoderm, marginal resin-canals, and an endoderm layer of about 20 cells, encircling a single bundle traversing a circular meristele. The mesophyll-cells are plicate. The male flowers, according to Sargent, have only four scales at the base. The cones are pendent, about 12 cent. long, elongate, conic, curved; apophysis rhomboid, convex; umbo depressed, almost muticous. Seeds marked with violet spots. Wing of seed obliquely oblong, much exceeding the seed itself. (See Gard. Chron., March 11, 1876, p. 332.) Cotyledons 5.

21. PINUS ARISTATA, *Engelmann*; *Sargent, Silva*, xi. (1897) p. 63, tab. 554.

The principal difference between this species, if species it be, and *P. Balfouriana* resides in the cones, which are somewhat smaller, ovoid-conic rather than oblong-conic, their apophyses less prominent, and provided with a long, slender awn. The seed-wings also are smaller and less oblique. In *P. aristata* there is usually only one resin-canal immediately beneath the epidermis in the centre of the dorsum of the leaf, whilst in *Balfouriana* there are two, in the centre of the mesophyll, or beneath the epidermis. [See also A. Murray, in Gard. Chron., Oct. 30, 1875.] The cotyledons are 6–8.

22. P. BUNGEANA, *Zuccarini*. *Cfr.* Masters, in Journ. Linn. Soc., Bot. vol. xxvi. (1902) p. 549, for bibliographical references.

A curious species occurring on the mountains of North China and also in Hupeh and Shensi.

The bark of mature specimens is milky-white. The leaf-sheaths are deciduous; the leaves in tufts of 3, each 6–8 cent. long, three-sided, obscurely serrulated, dorsum convex, without stomata, sides flattish, with 4–5 rows of stomata; transverse section elliptic, slightly keeled anteriorly, acute at the angles; hypoderm in a single layer; cortex or mesophyll of several layers of straight walled (not infolded) cells, the innermost oblong, radiating from the centre; endoderm-cells about 22, oblong; resin-canals marginal, surrounded by stereome-cells, meristele elliptic in section, fibro-vascular bundle unbranched (see Pl. 23. fig. 10). Cones oblong-conic, apophysis wrinkled, umbo curved, subulate. Male flowers capitate, each flower about 25 mill. long. Cotyledons 11–12.

The tree is cultivated at Kew, where it has produced cones.

23. P. GERARDIANA, *Wallich*; *Parlatore, in DC. Prod.* xvi.[2] p. 391; *Brandis, Forest Flora*, t. 67; *Hook. f. in Flora Brit. India*, v. p. 652; *Gamble, Indian Timbers*, ed. 2 (1902), p. 709.

In this curious Pine the bark flakes off in irregular slabs, as in the Plane-tree (*Platanus*). Its edible nuts are largely used as food by the natives of Afghanistan. Reference to it will be found in the late Surgeon-Major Aitchison's paper on the Flora of the Kuram Valley, in the Journal of the Linnean Society, vol. xviii.; and in Duthie's Report of a Tour in Kashmir (1893).

The leaves are in threes, each 3-sided, dorsum convex, without stomata, sides concave, with 4–5 rows of stomata, resin-canals marginal; meristele elliptic or circular in section, with an unbranched vascular bundle. The number of the cotyledons varies from 3 to 8.

24. PINUS CHIHUAHUANA, *Engelmann*; *Sargent, Silva*, xi. (1897) p. 85, t. 566.

This tree is a native of the mountains of Northern Mexico, as well as New Mexico and Arizona. The leaves are in groups of three, with median resin-canals. The endoderm-layer consists of 30–40 cells, and the circular or elliptical meristele comprises a branched bundle. The mesophyll-cells are plicated. The sheaths are deciduous. The male flowers racemose. The ripe cones are oblong-ovoid or ovoid-conic, not unlike those of *P. Laricio*. The apophyses are flattish, grey, with the upper edge lancet-shaped. The umbo is depressed, at first mucronulate. Engelmann notes that this species matures its cones only in the third year, a peculiarity which it shares with the Stone-Pine (*P. Pinea*) of the Mediterranean district.

25. P. LUMHOLTZII, *B. L. Robinson & M. L. Fernald, Proceedings of the American Academy of Arts and Sciences*, vol. xxx. August 27 (1894), p. 122; *Scribner's Magazine*, xvi. p. 38.

Of this species I have seen only incomplete specimens. It was collected near Coloradas in the course of an archæological expedition to N.W. Mexico. The pendulous leaves are said to be in groups of three with the sheaths quite obsolete. The cones were not seen. In section the leaves are three-sided, dorsum convex, sides concave. Resin-canal median. Meristele oblong in section.

26. P. INSULARIS, *Endlicher*; *F. Villar, in Blanco, Fl. Filip.* ed. 3, *Nov. App.* p. 212, t. 453; *Vidal, Sinops. Fam. y Gen. Pl. Lenos Filip., Atlas*, t. 98. fig. C.

A species native of the Philippines, with long slender leaves, 3 in a sheath, the scales of which are thin and membranous but persistent, the innermost are deeply fringed. In section the leaves are three-sided, with a convex dorsum and two concave lateral surfaces meeting anteriorly in a prominent ridge. There is a single layer of hypoderm, in contact with which are two resin-canals. The cells of the mesophyll have infolded walls.

The meristele is elliptic, or slightly three-sided, with an unbranched bundle. The cones are shortly stalked, deflexed, oblong-conic, 5–7 cent. long; the scales have a tumid apophysis and an elliptic umbo.

27. PINUS LONGIFOLIA, *Roxburgh*; *J. D. Hooker, in Fl. Brit. Ind.* v. p. 652, and in *Himalayan Journals*, i. p. 100; *Gamble, Man. Ind. Timbers*, ed. 2, p. 706; *Collett, Fl. Simlensis* (1902), p. 485, fig. 158.

A species native of the North-West Himalaya and Sikkim, but not extending into Afghanistan according to Aitchison (Journal of Linnean Society, Bot. xix. pt. 2, p. 142).

The very long, decurved leaves are arranged in tufts of 3; in section they are seen to be three-sided, with a convex dorsum and two flattish or slightly concave sides meeting in a prominent anterior ridge. The hypoderm is in two rows, with wedge-shaped projections, and the resin-canals, when present, which is not always the case, marginal. The cell-walls of the mesophyll are slightly infolded. The endoderm-cells, about 40 in number, are large and ovoid; the meristele is elliptic or subtriangular in section, enclosing a branched vascular bundle. The male flowers are cylindric-oblong, arranged in corymbose clusters. The cones resemble those of *P. canariensis* or *P. Pinaster*, with tumid, recurved apophyses, and an umbo with a short slender curved mucro. The seeds are 10–12 mill. long, elliptic, greyish with lilac-coloured stripes. The long oblong wing soon falls off.

28. P. KHASYA, *Royle*; *Hook. f. in Fl. Brit. Ind.* v. p. 652 (1888); *Brandis, Forest Flora*, p. 508; *Gamble, Man. Indian Timbers*, ed. 2 (1902), p. 708.

A three-leaved species. The leaf-section shows a convex dorsum and two concave sides meeting in a sharp ridge. In the specimen examined there was no hypoderm, but this point requires further examination. The resin-canals are marginal, the meristele triangular in section with a branched fibro-vascular bundle.

The small oblong male flowers are in loose spikes.

The cones are shortly stalked, deflexed, ovoid-conic. The cone-scales are rugose, the free border elliptic, and the umbo rhomboid.

The species is a native of the Khasya Hills, Chittagong, and Burma (*Hooker*).

29. Pinus canariensis, *Chr. Smith, in Webb & Berthelot, Hist. Nat. des Iles Canaries*, vol. iii. (1836) p. 280; *Masters, in Gard. Chron.* June 9, 1888, fig. 94.

This tree is well-described and figured in the above-mentioned work. It may here be added that the leaves have a marked hypoderm, and that the resin-canals are imbedded in the cortical substance of the leaf. The meristele is elliptic in section and the vascular bundle is divided.

The cotyledons are 6–8 in number, triangular in form, destitute of any proper epidermis and hypodermis. The cells of the cortex or mesophyll are polygonal, the endoderm-cells are not well-marked. The central bundle is undivided. The cone is similar to that of *P. maritima* (*Pinaster*), to which species it is nearly allied.

30–31. P. ponderosa, *Douglas*; *Sargent, Silva*, xi. (1897) p. 77; *Britton & Brown*, i. p. 51; *Beissner*, p. 262, fig. 61.

A Pine with a very wide distribution in Western America, from British Columbia in the north to the Mexican boundary on the south, and from the western slopes of the Sierra Nevada to Dakota, Nebraska, and Western Texas. "A tree of such enormous range over a region of so many different climates has naturally developed many forms, and no other American pine-tree varies more in size and habit and the character of its bark, length of leaves, and size of cones.... One hundred photographs would not be too many to properly illustrate the appearance of *P. ponderosa* ... and an attempt to describe its different forms with any words at our command would be hopeless."—*Sargent*, in 'Garden and Forest,' Oct. 2, 1895, p. 392.

A peculiar feature of this species consists in the circumstance that the cones break off when ripe near to, but not quite at the base, so that a few scales are left on the bough while the bulk of the cone falls to the ground; hence the term Broken-Cone Pine given to it by Mr. Lemmon. The constancy of this peculiarity is open to further investigation. An illustrated description is given in the 'Gardeners' Chronicle,' Nov. 15, 1890, p. 557.

The base of the scale tapers gradually to a short stalk-like process which is flattened from side to side. This peculiar form may in some way be concerned in the detachment of the scales.

Pinus ponderosa was, according to Sargent, first alluded to in the Journal of Lewis and Clark, 1804. It was afterwards found by Douglas, in 1826; but it was not till 1836 that the name *ponderosa* was published in the 'Companion' to the Botanical Magazine, ii. p. 111, where Douglas says:—"I also saw a new Pine (*Pinus ponderosa*)." This was on the hills between Colombia and Spokan rivers.

For an account of the numerous varieties reference may be made to Sargent's work, p. 80. Some of them, like *P. Jeffreyi*, *latifolia*, *Engelmanni* of Lemmon, *Mayriana* of Sudworth, *Apacheca* of Lemmon, *scopulorum*, Lemmon, have been considered to be worthy of specific rank, but Sargent concludes that the forms mingle so as to be indistinguishable.

In the 'Silva' figures are given not only of the type but of the var. *Jeffreyi*, tab. 563, and var. *scopulorum*, tab. 564.

P. Jeffreyi is also discussed by Sargent in 'Garden and Forest,' Sept. 30, 1891, p. 457, and a good figure is given in the 'Gardeners' Chronicle,' March 23, 1889, p. 360. It was the subject of an interesting note by Sir Joseph Hooker in the same periodical, Dec. 27, 1884, p. 814.

In the germinating seedling the radicle is tapering, the caulicle is cylindric, glaucous.

The cotyledons are 10 in number, but from 6–11 are recorded, triangular in section, with lines of stomata on the two lateral faces.

In the three-sided leaves there is often a layer of water-cells beneath the epidermis and a double layer of hypoderm. The walls in the cells of the leaf-cortex are sinuous, the resin-canals parenchymatous. The meristele is oval, or slightly triangular in outline, and surrounded by the endoderm-layer of 50–60 cells, thickened on the outer faces. The fibro-vascular strand is divided, the two divisions being separated by stereome-cells.

P. Jeffreyi has essentially the same structure, but Coulter and Rose remark that the thin-walled subepidermal layer is wanting in *Jeffreyi*, but then it is not constant in *ponderosa*!

The male flowers are 12–15 mill. long, sometimes twisted, each surrounded by about 10 scales.

32. Pinus attenuata, *Lemmon* (1892); *Sargent, Silva*, xi. (1897) p. 107.—P. tuberculata, *Gordon*; *Masters, in Gard. Chron.* Dec. 19, 1885, fig. 184.

This is the species usually known as *P. tuberculata* of Gordon (1849) (not of D. Don (1836), which is = *P. radiata*).

It grows on the sun-burnt slopes of the mountains of Oregon, the Cascade Mountains, the western side of the Sierra Nevada, the coast-range of California, and the southern slopes of the San Bernardino Mountains (*Sargent*).

"The closed cones of this tree, preserving the vitality of the seeds for years, seem an admirable adaptation to the peculiarly severe conditions of its surroundings, enabling it to survive the fires which constantly sweep over the dry slopes where alone it grows. When the trees are killed by fire, as is almost invariably the case every few years, all the seeds produced during their lives are scattered at the same time over the ground, and growing rapidly, soon produce an abundant crop of seedlings; in the same groves the trees are almost invariably of the same age and size, there being no seedlings or younger plants among them to perish with the older trees, and thus to diminish the chances of reproduction and perpetuity."—*Muir*, *ex Sargent*, *Silva*, xi. p. 107.

The young cones are stipitate and spread horizontally. They issue from the main branches, from which they are never detached save by fire. The buds are slender, cylindric-conic, of a reddish-brown colour. The leafy shoots are reddish-brown, with a single row of resin-canals, and destitute of leaf-buds at the base. The leaves are in threes, three-sided in section, with a convex dorsum and two concave sides. Stomata are present on all the faces. Beneath the epidermis is a layer of thin-walled water-cells overlying the thick hypoderm. The cells of the mesophyll have infolded walls, and the resin-canals are median and surrounded by stereome-cells. The meristele is oblong in section, rounded at the ends, and slightly depressed on the upper surface. The fibro-vascular bundle is branched, the branches separating rather widely. The endoderm-layer consists of about 46–50 cells.

The cotyledons are 5–8 in number.

33. Pinus radiata, *D. Don* (1836); *Sargent*, *Silva*, xi. (1897) p. 103; *Lemmon*, *Novitates Occidentales* (1893); also in *Garden & Forest*, Feb. 10, 1892; *Masters*, *in Gard. Chron.* March 14, 1891, p. 337, and Jan. 26, 1878, p. 108, fig. 22 (as *insignis*).

A species occurring over a very limited area on the coast of California to the south of Monterey.

It is probably the tree called *P. californica* by Loiseleur in Nouv. Duhamel, v. p. 243 (1812), where it is thus described:—"*P.* foliis geminis ternisve gracilibus, strobilis folio multo longioribus." The *P. adunca* of Poiret, in Lam. Dict., Suppl.

iv. p. 418, is also referred here, but the description is even more incomplete.

Lemmon and Sargent place the *Pinus insignis* of Don (1838) under this heading. *P. tuberculata* of D. Don (1836) (not of Gordon) is also considered identical with Don's *P. radiata*. Carrière, Traité Général, ed. 2 (1867), p. 440, arranges the species thus:—

"*P. insignis*, Douglas ex Loudon Arboretum, iv. 2265, et auct." Var. *macrocarpa*, Hartweg, Journal Hort. Soc. iii. p. 226 =*P. radiata*, Don et auct.

The variety differs from the species by the cones, which are a little larger, whilst the apophyses are more developed and turned down towards the base of the cone. In British gardens the tree is found to do well near the coast, but there are differences in habit and in degree of hardihood which suggest the existence of distinct varieties, if not of the existence of two species under one name.

To Dr. Franceschi I am indebted for a specimen of the var. *binata* from Guadeloupe Island, off the S. coast of California. In this variety there are but two leaves to the tuft. See Watson, Proc. Amer. Acad. xi. p. 119 (1876), and Bot. Calif. ii. p. 128.

The seedling plants are distinct in character, and show forecasts of the future habits of the tree, its bushy habit when young being indicated by the numerous side-shoots that spring from the young plant just above the cotyledons, whilst the bare trunk of adult years is indicated by the long unbranched stem, which the seedling plant at first presents. The primordial leaves are very long and narrow, and, at rather wide intervals, finely toothed at the margins. As has been said, the young stem acquires considerable length (6 to 8 inches) before the primary leaves are replaced by the tufted leaves characteristic of the tree at a more advanced stage. The seedlings are strongly tap-rooted, with horizontally-spreading side branches. The leaves are three-sided, with stomata on all sides, and with a layer of thin-walled water-cells beneath the epidermis. The hypoderm is in one layer with occasional thickenings. The cortical cells have infolded walls, and the resin-canals are median and surrounded by stereome-cells. The endoderm-cells number about 30–40; the meristele is oblong, or somewhat triangular, with a branching fibro-vascular bundle.

The cotyledons vary from 6–9 in number.

34. Pinus Coulteri, *D. Don*; *Sargent*, *Silva*, xi. (1897) p. 99; *Masters*, *in Gard. Chron.* March 28, 1885, p. 415, figs. 73, 74.

A noble Californian Pine of pyramidal habit, growing on the mountains near the coast. The old bark flakes off in irregular, thin, smoky-brown plates. The herbaceous shoots are glaucous green flushed with pink, and traversed with numerous resin-canals; they are clothed nearly to the base with leaf-tufts. The buds are very large, reddish-brown, ovate-oblong. The leaves are three-sided, with stomata on all sides. The hypoderm-layers are very thick, projecting inwards in wedge-shaped masses, and a similar layer of stereome-cells surrounds the resin-canals in the substance of the leaf. The endoderm-layer consists of about 60–70 cells, rarely fewer, much thickened on the outer walls. The meristele is elliptic in section, with a thick band of stereome-cells separating the two divisions of the fibro-vascular bundle. The mesophyll-cells are plicated (see Pl. 22. fig. 7). The cones are usually very large.

In our museums there appear to be two forms of this species, the cones of which differ. In the one case (the true *P. Coulteri*) the strongly beaked scales are very prominent and more or less spreading; whilst in the other the apophyses are much less prominent, and the beaked extremity much smaller. As I have only seen detached cones, I am not able to form a definite opinion whether or not the cones with the smaller scales and less prominent tips belong to a distinct species or not, but they probably belong to a form of *ponderosa*.

In the young cones of *P. Coulteri* the apophysis tapers gradually into the curved spur-like umbo. The cotyledons vary in number from 10–14.

35. P. Sabiniana, *Douglas*; *Sargent*, *Silva*, xi. (1897) p. 95; *Masters*, *in Gard. Chron.* July 14, 1888, p. 36.

A tree discovered by Douglas in 1826, but the specimens and notes relating to which were lost when crossing a stream. (See 'Companion' to the Botanical Magazine, ii., Nov. 1831.) It is a native of the dry foot-hills of Western California.

It is a well-defined species, in the happy position of having no synonyms. The herbaceous shoots are glaucous, devoid of leaves near the base, and they contain a double row of resin-canals. The leaf-section is three-sided, dorsum convex, sides concave, with stomata on all surfaces. The hypoderm is continuous and projects into the mesophyll in the form of wedge-shaped masses. The cells of the mesophyll have infolded walls, and the resin-canals are median and surrounded by stereome-cells. The endoderm consists of from 45–50 cells, thick-walled externally. The meristele is oblong or subtriangular in section, with a branched fibro-vascular bundle and a band of stereome-cells between the subdivisions. The male flowers are each surrounded by 10–15 spirally imbricated scales (*Engelmann*).

The cotyledons vary in number from 12–18.

36. PINUS TAEDA, *Linnæus*; *Sargent, Silva*, xi. (1897) p. 111; *Britton & Brown*, i. p. 53, fig.

A species of which an authentic specimen may be seen in the herbarium of Linnæus. It is widely distributed from New Jersey to the Gulf States and Texas. The buds are oblong-conic, the male flowers cylindric, curved, arranged in corymbose clusters. The cones are about 12 cent. long, sessile, spreading, oblong-conic; apophysis tumid, dark brown, with a small deflexed subulate mucro.

The leaf-section is three-sided with uniform hypoderm; the cells of the mesophyll have projecting walls, and the median resin-canals are surrounded by stereome-cells. The endoderm-cells are about 50 in number. The meristele is triangular, and the fibro-vascular bundle branched, with the branches either separate or sometimes approximate.

The cotyledons are 5–8.

37. P. TEOCOTE, *Chamisso et Schlechtendal, ex Parlatore, in DC. Prod.* xvi.^{2} p. 396.

A Mexican species, of which little or nothing is known beyond what has been published in the text-books. The cones are stalked or subsessile, deflexed, elongate, cylindric-conic, slightly curved; the apophysis rather tumid, with a small central deltoid umbo.

38. P. PATULA, *Schiede & Deppe*; *Parlatore, in DC. Prod.* xvi.^{2} p. 397; *Masters, in Gard. Chron.* Jan. 24, 1885, fig. 20.

The young shoots of this Mexican species are olive-brown covered with a glaucous bloom or, in some cases, slightly hirtellous. The buds are cylindric-conic, sharply pointed. The leaves are three-sided, with the dorsal side convex, the lateral ones concave, all stomatiferous. The section is triangular with an elliptical meristele. The hypoderm is in two rows. The resin-canals are in the centre of the mesophyll. The stalked deflexed cones are in whorls. In the young cone the apophysis is convex on both sides of the terminal subulate mucro, but in the older cones the umbo becomes shrivelled and depressed.

39. Pinus rigida, *Miller*, *Dict.* (1768); *Sargent*, *Silva*, xi. (1897) p. 115; *Beissner*, *Handbuch*, p. 268, fig. 64 (1891).

A native of the Atlantic States of North America, in sandy plains and dry gravelly uplands as well as on the coast.

The leaves are in threes, each 8–14 cent., three-sided, the dorsum convex, the lateral faces concave and meeting in a prominent keel. Stomata are distributed all over the leaf. The leaf-section is three-sided, and shows a layer of thin-walled water-cells beneath the epidermis, between it and the hypoderm. The cell-walls in the mesophyll are infolded, and the resin-canals median. The endoderm consists of about 40–50 cells. The meristele is oblong, and the fibro-vascular bundle branched, with bands of stereome-cells connecting the two phloem masses.

The male flowers are slender, capitate, about 25 mill. long, each surrounded at the base by 6–8 scales. The cones are sessile, solitary or clustered, ovoid-oblong, with the free part of the apophysis somewhat triangular, slightly convex, dull brown.

The cotyledons are 5.

The species is very variable in the size and form of the cones, which, in some cases, so much resemble those of *P. serotina*, that some botanists have considered them to constitute a single species.

P. rigida has the power of producing adventitious shoots from the old trunks, a peculiarity which it shares with *P. serotina*.

40. P. serotina, *Michaux*; *Sargent*, *Silva*, xi. (1897) p. 119.

A species distributed from South Carolina to Florida (*Sargent*).

In the living plants at Kew the herbaceous shoots are angular, deeply furrowed, glaucous, and clothed with leaves to the base. In the cortex is a single row of resin-canals. In the native specimens the male flowers are capitate, with 6–8 scales at the base of each. The cones are sessile, spreading, broadly ovoid; the apophysis slightly tumid, with a small deltoid mucro.

The triangular leaves have median resin-canals, an oblong meristele, and a branched fibro-vascular bundle. The hypoderm is very thick, and the resin-canals are also provided with a sheath of stereome-cells. For the most part they are median, but occasionally peripheral. The cells of the mesophyll have infolded walls. The endoderm-cells (about 54 in number) are much thickened. The stomata are distributed on all sides of the leaf.

41. PINUS DONNELL-SMITHII, *Masters, in Botanical Gazette*, xvi. (1891) p. 199 (Pirus), *et* xix. (1894) p. 13, t. 2.

This species was found by Mr. Godman, and subsequently by Capt. Donnell-Smith. It forms a complete belt around the Volcan de Fuego, commencing at about 10,000 feet, and in the Volcan d'Agua extends to the summit. It is curious to see, writes Mr. Godman, how abruptly the mixed forest of *Cheirostemon* and other trees ceases at about 10,000 feet, and how you step suddenly out of it into the more open pine-belt, where the only undergrowth is a coarse grass (*Godman in litt.*).

Capt. Donnell-Smith furnishes similar information, and states that he collected his specimens at the very top of the Volcan d'Agua, at a height of 12,300 ft., along the crest of the extinct volcano, where it formed a stunted tree 10–15 ft. high, but well furnished with cones.

P. Donnell-Smithii resembles *P. Hartwegi*, but differs in its smaller cone-scales with less prominent apophyses. It is a 5-leaved species with fimbriate bud-scales and three-sided leaves. The hypoderm is well marked, and there are also wedge-shaped masses of stereome-cells to add to the rigidity of the leaf. The cells of the leaf-cortex are sinuous, and the two branches of the fibro-vascular strand are separated by stereome-cells. The section of the meristele is triangular in outline. The resin-canals appear to be absent (see Pl. **21**. fig. 5). The cones are about 10 cent. long, oblong-obtuse, thick, the scales with thickened apophyses and winged seeds.

42. P. HARTWEGI, *Lindley, Bot. Reg.* (1839); *Parlatore, in DC. Prod.* xvi.[2] p. 399.

A Mexican species apparently very variable, and confused in collections with *P. Montezumæ*. Like other mountain species from Mexico, it needs careful study on the spot.

43. P. MONTEZUMÆ, *Lambert*; *Parlatore, in DC. Prod.* xvi.[2] p. 398; *Gard. Chron.*, Oct. 25, 1890, March 3, 1894, March 11, 1899, cum ic.

A Mexican species so variable that no fewer than 70 synonyms are attached to it. On the same branch of a specimen labelled by Engelmann some of the leaves are 12–14 inches long, others only 5 inches in length. Comparative study in its native locality can alone suffice to determine the limitations and characteristics of this species. In the variety *Lindleyana* I find a layer of thin-walled water-cells beneath the epiderm; cells of the mesophyll with infolded walls, median resin-canals surrounded by a stereome-sheath. The endoderm-layer consists of 25–30 oblong cells. The meristele is oblong in section, with a branched vascular bundle.

The male inflorescence is capitate.

It may be noted that in most, if not all, the cones examined by me under various names the upper border of the apophysis is lancet-shaped and acute at the extreme tip.

44. Pinus filifolia, *Lindley* (1840); *Parlatore, in DC. Prod.* xvi.^{2} p. 400.

A species collected by Hartweg in Guatemala, concerning which little is known beyond what is published in the works above cited. The leaves are in fives, very long and slender (22–30 cent. long). In section they are triangular, with thick hypoderm projecting inwards in wedge-shaped masses. The cells of the mesophyll have infolded walls. The resin-canals are median and surrounded by a sheath of stereome-cells. The endoderm consists of 30–40 large oblong cells. The meristele is triangular in section, with the two branches coherent in a single fibro-vascular bundle (see Pl. **21**. fig. 6).

The cones are pendulous, 21–22 cent. long, conic, slightly curved, the apophyses rhomboid with a prominent umbo. Seed speckled, much shorter than the obliquely oblong wing.

I have specimens from Tolucca, Nelson 5!, and from Capt. Donnell-Smith, 2662!

45. P. leiophylla, *Schiede & Deppe*; *Parlatore, in DC. Prod.* xvi.^{2} p. 401.

A Mexican species extending into Guatemala, with leaves in tufts of five, slender, three-sided, triangular in section, the dorsum convex, sides concave, meeting anteriorly in a prominent ridge. The hypoderm forms a single layer, the cells of the mesophyll are not sinuous, the resin-canals are median surrounded by stereome-cells. The endoderm consists of 18–20 large ovoid cells thickened on the outer side. The meristele is triangular in section, and the fibro-vascular bundle divided. The male flowers are racemose, the cones about 5 cent. long, ovoid-conic; apophyses flat, rounded or slightly pointed at the upper border; umbo depressed, rhomboid mucronate.

To this species I refer—Nelson 1!, gathered on Tolucca, and Donnell-Smith (Guatemala), 2633 & 3156!

46. Pinus Torreyana, *Parry*, *Bot. Mex. Bound.* p. 210, tt. 58, 59 (1859); *Sargent*, *Silva*, xi. (1897) p. 71, t. 557.

A distinct Pine, very limited in its range, growing only, so far as is known, in South California, near the mouth of the Saledad River, along the coast and on Santa Rosa Island, 34° N. lat. For fine specimens of its cones I am indebted to Dr. Franceschi.

The seedling plants observed at Kew are robust, with a long, tapering radicle, and a stout cylindric caulicle, with five resin-canals between as many vascular bundles. The cotyledons are about 12, linear, flattish. The primary leaves are elliptic in section, pointed at the angles with a prominent keel. The resin-canals are median, the meristele elliptic with a branched fibro-vascular bundle. The adult leaves are 20–30 cent. in length, markedly triangular in section, stomatiferous on all sides. The hypoderm is in thick wedge-shaped masses in the intervals between the stomata. Cortical cells with infolded walls; resin-canals median, surrounded by a stereome-sheath; endoderm of about 40 cells, much thickened outwardly; meristele triangular; fibro-vascular bundle branched, more or less completely surrounded by stereome-cells. The male flowers are in clusters, each 5–7 cent. long, surrounded at the base by as many as 14 or 15 scales. The cones are subsessile, 13–15 cent. long, broadly ovoid, with very prominent apophyses and stout pyramidal umbos.

47. P. arizonica, *Engelmann*, *Sargent*; *Silva*, xi. (1897) p. 75, t. 559.

A five-leaved Pine, native of the mountains of Southern Arizona, at altitudes of 7000 feet.

The leaves are three-sided, with stomata on all sides, with a double layer of hypoderm thickened at the angles. The cells of the mesophyll have infolded walls. The resin-canals are median, surrounded by a stereome-sheath. The endoderm consists of 35–40 cells much thickened on their outer walls. The section of the meristele is triangular, with somewhat truncated angles. The fibro-vascular bundle is branched, the branches surrounded by many stereome-cells. The male flowers are corymbose, oblong-obtuse, about 2 cent. long. The cones resemble those of *P. patula*, and are subsessile, spreading, about 6 cent. long, 3–4 cent. broad, oblong-ovoid, tapering to both ends, the apophyses prominent, upper border somewhat rounded; umbo stout, pyramidal, mucro deflexed; seed ovoid, much shorter than the obliquely oblong wing.

P. arizonica has been thought to be a form of *ponderosa* (which occasionally has 5 leaves in a tuft), but the young shoots are glaucous, and its cones are shorter and thicker (*Engelmann*).

48. Pinus cubensis, *Grisebach* (1863); = *P. heterophylla*, Sudworth (1893), *ex* Sargent, Silva, xi. (1897) t. 591.

The first botanist to deal with this plant was Elliott, who, in his 'Sketch of the Botany of S. Carolina and Georgia' (1824), referred it to *P. Taeda* as var. *heterophylla*. It is now generally acknowledged that it is quite distinct from *P. Taeda*, and, therefore, it would seem that the next appropriate name, in order of time, should be selected, viz. *cubensis*. This plan, however, does not commend itself to the American botanists, who have adopted the old varietal name as that of the species. *P. bahamensis* of Grisebach, *P. cubensis* var. *terthrocarpa*, Grisebach, and *P. Elliotti* of Engelmann are all referred here, though not without hesitation. The species occurs in the Southern States of N. America, in some of the West India islands, and in the forests of Central America and Honduras (see Morris, 'The Colony of British Honduras' (1883), p. 57; Belt, 'Naturalist in Nicaragua' (1874), p. 236). The three-sided leaves are in clusters of 2–3, with a layer of thin-walled cells beneath the epidermis. The hypoderm forms a double layer with projecting wedge-shaped masses, and a similar sheath surrounds the resin-ducts. These latter are in contact with the meristele, which is elliptic or more or less triangular in transverse section, and has a simple or (sometimes branched ?) fibro-vascular bundle. The endoderm-cells are about 40–48 in number (Pl. **20**. fig. 3). As in the case of *P. australis*, the bud-scales are silvery-white. The male flowers are capitate, each flower about 30–40 mill. long, and surrounded by oblong coriaceous chestnut-coloured scales with a white membranous, slightly fimbriate border.

I am indebted to Dr. Mellichamp for specimens from S. Carolina, in which the catkins are partly male, partly female, the female flowers occupying the upper part of the catkin or male flower. The foliage of *Pinus cubensis* is more slender than that of *P. palustris*, and all the sheaths surrounding the leaves of *P. cubensis* are much shorter than those of *P. palustris*.

It is possible that *P. bahamensis*, referred to this species by Sargent, should be kept distinct, for whilst *P. cubensis* has distinctly internal resin-canals, *P. bahamensis*, so far as I have seen, has marginal canals; but further examination of authentic specimens is requisite to clear up the doubt.

A cone of *P. bahamensis*, collected by Eggers and in the Natural History Museum (British Museum), is about 13 cent. long by 10 cent. broad, cylindric-oblong; apophysis slightly convex, transversely elliptic narrow, shining chestnut-brown; umbo subulate, reflexed. Other specimens are in the Museum at Kew.

Rowlee, 'Notes on Antillean Pines' in the Bulletin of the Torrey Botanical Club (1903), p. 107, states that *P. heterophylla* is not identical with Grisebach's *P. cubensis*. The cones of the Florida species (*heterophylla*) are very different from those of the Cuban Pine, which more nearly resembles *P. Taeda* than *P. heterophylla*.

Rowlee also describes a monstrosity of *P. cubensis*, which he calls var. *anomala*, in which the scales [query, bracts?] have reverted to the primitive form of the primary leaf.

49. Pinus occidentalis, *Swartz*; *Parlatore, in DC. Prod.* xvi.[2] p. 402.

A West Indian species with 3, 4, or generally 5 three-sided leaves, ridged in front. The hypoderm-layer is continuous. The cells of the mesophyll have infolded walls, and the resin-canals are in juxtaposition to the angles of the triangular meristele. The fibro-vascular bundle is undivided, and within the pericycle are numerous stereome-cells. The cones are elongate-ovoid, 4–6 cent. long. The apophysis is flattish, with a rhomboid umbo terminating in a reflexed subulate mucro.

50. P. palustris, *Miller, Dict.* (1768); *Sargent, Silva*, xi. (1897) p. 151, tab. 589; *Trimble*, fig. 14.

A three-leaved Pine, better known under the name of *australis* (1810), and of special economic importance. It ranges from Virginia to Florida near the coast, and inland to the Appalachian Mountains and Texas (*Sargent*). The bud-scales are silvery-white, fimbriate at the edges. The leaves are in threes with three sides, dorsum convex, lateral faces concave. Stomata are seen on all surfaces. There is a layer of thin-walled cells between the epidermis and the hypodermis, which latter is thick and strengthened at the corners. The cells of the mesophyll have infolded walls; the resin-canals, when present, are in juxtaposition to the elliptic meristele (as seen in section), and are surrounded by stereome-cells. The endoderm-cells are about 50 in number, oblong, thickened on the outer side. The fibro-vascular bundle is double, a band of stereome-cells connecting the bases of the two phloem masses. The male flowers are capitate-corymbose, ascending, linear-oblong, 6–8 cent. long. The cones are shortly stalked, elongate-conic, slightly curved. The apophysis is convex on both sides of the umbo. Cotyledons 7–10.

An interesting account of this tree, showing its value for resin and timber, is to be seen in an article by Karl Mohr in 'Garden and Forest' (1888), p. 261. Maurice de Vilmorin, in the same Journal, March 24, 1897, speaks of the tree as growing in Western France; and even at Kew a tall specimen braves the untoward conditions in which it is placed.

51. PINUS PSEUDOSTROBUS, *Lindley* (1839); *Parlatore, in DC. Prod.* xvi.[2] p. 401.

A five-leaved Mexican species growing at elevations of 8000–10,000 feet. The leaves are three-sided, provided with hypoderm. The mesophyll-cells have infolded walls, and the resin-canals are adjacent to the angles of the triangular meristele, and each is surrounded by a sheath of stereome-cells. The fibro-vascular bundle is undivided. The cones are about 10–15 cent. long, ovoid-acute, or oblong conic; the apophysis convex, rugose, with the upper edge semilunar or elliptic, rarely somewhat truncated; umbo deltoid, short, reflexed, sometimes depressed.

52. P. OOCARPA, *Schiede*; *Parlatore, in DC. Prod.* xvi.[2] p. 401; *Palmer, in Contrib. U.S. Nat. Herbarium Dep. of Agriculture*, I. No. iv. June 30 (1891), p. 115.

This tree is described as abundant in the mountains of Mexico, where it attains a height of 40–50 ft., with an ample, spreading head and rather pendulous branches. The leaves are in fives. Dr. Palmer (*l. c.*) says that "on each side of the leaf are two ducts which, with the surrounding strengthening cells, completely separate the parenchyma tissue into distinct regions; the ducts extend from the fibro-vascular bundle to the epidermis or its underlying strengthening cells. These ducts have the paradoxical position of being both peripheral and internal. Dr. Engelmann . . . places the species in the section with internal ducts, but says he occasionally found parenchymatous ones."

In the leaves from one of Hartweg's specimens I found them three-sided with a convex dorsum. On section the hypoderm was seen to be specially thick at the corners, the resin-canals subepidermal or absent, the mesophyll-cells not infolded, and with occasional patches of areolar tissue. The meristele was triangular, and the fibro-vascular bundle branched. In one of Dr. Palmer's specimens the structure was substantially the same, but there were resin-canals in the centre of the mesophyll not surrounded by strengthening cells. It is desirable that further observations on fresh specimens should be made.

The most striking feature of this species consists in the cones, which are placed on rather long stalks. They are solitary (not clustered), 7–8 cent. long., 6–7 cent. wide, broadly ovoid-conic. The apophysis is shining, convex, carinate; umbo depressed, mucronate.

53. Pinus halepensis, *Miller, Dict.* (1768) = *P. hierosolymitana*, Duhamel (1755).

P. maritima, Lambert, partly; Sibthorp, Flora Græca; Desfontaines, Fl. Atlantica, tom. ii. (1800) p. 352; Mouillefert, Traité des Arbres et Arbustes, tom. ii. (1892) p. 1303.

The Aleppo Pine was known to the Greeks, as well as to the botanists of the Middle Ages, according to Bubani, Flor. Pyrenaic. p. 39 (1897).

Miller's name, above adopted, is the one now most generally, if not universally, employed, although, as a matter of strict priority, that of Duhamel has precedence. It is a native of both shores of the Mediterranean, extending into Asia Minor, Persia, and, perhaps, Afghanistan, occurring from the coast-line up to a height of 3000 ft., generally on limestone soil. Like most species it is subject to considerable variation. In consequence the synonymy has become greatly involved, so that, both in books and in herbaria, *P. halepensis*, as here understood, is mixed up with *P. brutia* and with forms of *P. Laricio*, from which latter it may be at once distinguished by its marginal (not median) resin-canals. Owing to the difficulty of identification of this and allied species a description of the true *halepensis* is here given. The branches are usually ashen-gray, cracked vertically, and marked with oblong obtuse projecting phyllules. The smaller branches are slender, pliant, subangular, destitute of leaves except near the extremities. The free portion of the pulvinus, or phyllule, is often more or less orange-coloured, the persistent part adnate, oblong, with a rounded end, a prominent midrib, and a deep furrow on either side separating it from the adjacent leaf-scar. The upper part of the primary leaves is membranous, revolute, and deciduous. The lower part of the scales constituting the leaf-sheath are persistent, convolute, coriaceous, the upper portions membranous and deciduous, leaving, after their fall, a truncated edge. The leaf-buds are small, slender, cylindric-conic, their scales deltoid acuminate, chestnut-brown, lacerate at the edges. The leaves are slender, arranged in pairs, and of varying length in different specimens. The boat-shaped leaf-section shows a very thick hypoderm with marginal resin-canals surrounded by a sheath of stereome. The meristele is transversely oblong, and the fibro-vascular bundle branched, with a mass of thin-walled cells between the subdivisions. The endoderm-cells are about 36 in number. The male flowers are congested in globose or racemose heads, each flower 7–8 mill. long, oblong-obtuse, orange-coloured or pale yellow; connective suborbicular, crenulate. Cones in pairs or solitary, on thick, deflexed stalks, each cone about 7–8 cent. long, oblong-conic, chestnut-brown or greyish; apophysis either prominent or flattish, with radiating lines and a prominent rhomboid transversely keeled umbo. Cotyledons 6–9.

The preceding notes are, with the exception of that relating to the cotyledons, taken from a wild specimen forwarded to me by the late M. Naudin from Antibes, with the intimation that it grew on "terrains calcaires et rocailleux des environs de la Méditerranée." From the same source other specimens labelled *P. maritima*, Lambert, from the "sables maritimes près d'Antibes," were received. These differ from the *halepensis* above described in their longer, less slender foliage, and in their male flowers being in long dense spikes or racemes. Unfortunately no cones were sent with this latter form.

Tenore, Flora Napol. v. p. 267, describes two varieties—one with oblong cones and flattish scales, the other with ovate-conic, blackish cones and prominent apophysis. To this latter he refers the *Pinus maritima* of Lambert, vol. ii. t. 10. The flat-scaled variety is probably the same as that called var. *β. minor* by Lange. To this may be referred Spanish specimens from *Huter*, n. 889 !, Syrian specimens from *Kotschy*, 440 !, and others, Greek representatives from *Heldreich*, 1300 !, etc.

Among the forms with prominent apophyses are specimens from Spain, *Bourgeau*, 884 !, Persia, Greece, Dalmatia, Macedonia, Provence, Sicily, Morocco, and elsewhere. Specimens from Afghanistan, taken from cultivated trees by the late Dr. Aitchison and referred to this species, differ in their subsessile ascending cones. In the Paris herbarium are specimens of *P. halepensis* collected in Valencia by Bourgeau, without number, but to which the name var. *macrocarpa* is attached. The cones measure 4 inches in length. From Heldreich n. 1300 there are also specimens with large cones and flat apophyses, collected in Greece. For some remarks on the tree figured by Miller, Dictionary, 1760, t. 208, as the Aleppo Pine, see under *P. Laricio*, which it most resembles in form of cone and apophysis, although it may be the form mentioned by Tenore as *P. halepensis*, var. *β. squamis convexis*, to which the *P. maritima* of Lambert has been, in part, referred. Miller's statement in the text refers evidently to *P. halepensis*, but it is possible that some permutation of labels may have taken place, and that the illustration and the text do not apply to the same species.

P. h. Pithyusa, *P. h. syriaca*, *P. h. abchasica*, and *P. persica* are referred to this species as varieties.

From the late Baron von Mueller I received specimens from trees cultivated in S. Australia with androgynous catkins, the male flowers being at the base, the female flowers in clusters near the tips.

54. Pinus bruttia, *Tenore, Sylloge Plant. Vasc. Neapol.* (1831) p. 47, and *Flora Nap.* v. p. 266, t. 200 (1835); *Boissier, Flora Orient.* v. p. 605.

This tree is said to be a native of the forests of Central and South-Eastern Spain, the mountains of Calabria, the islands of Cyprus and Crete, the Caramanian Taurus, Syria, and Bithynia. Some of these localities are open to doubt, because the species has been confounded with *P. halepensis* and with *P. Laricio*, var. *pyrenaica*. The name *pyrenaica* was given to a Pine by Lapeyrouse, Hist. abrégée des plant. des Pyrénées, p. 146

(1813), but, in the Supplement to that work, Lapeyrouse acknowledged his mistake, stated that no such Pine as he had described existed in the Pyrenees, and substituted for it a description of another "pyrenaica," which is now known as *P. Laricio*, var. *pyrenaica*. I am indebted to Prof. Clos for the information that no specimen answering to either of his descriptions exists in Lapeyrouse's herbarium at Toulouse. The late Henry de Vilmorin, for the purpose of elucidating this matter, made five separate journeys to the Pyrenees, including a visit to one of the localities mentioned by Lapeyrouse, but nowhere did he find anything corresponding to *P. bruttia*, which has been considered identical with Lapeyrouse's original *pyrenaica*. What he did find was, in every case, the variety of *P. Laricio* now known as var. *pyrenaica*, and which has also received other names (see H. de Vilmorin, Bull. Soc. Bot. France, xl., 1893), which will be further considered under the head of *P. Laricio*. If we abandon Lapeyrouse's name *pyrenaica* and go back to the first name given, we must cite *P. resinosa* of Loiseleur; but this, as Carrière has pointed out, was forestalled by the very different *P. resinosa* of Solander. Accordingly Carrière, in 1855, called this Pine *P. Loiseleuriana*, which he considered different from *P. bruttia*. This opinion has not been generally adopted, and in these circumstances Tenore's name, *bruttia* (1831), claims precedence.

The *P. Paroliniana* of Webb appears to be a MS. name only, and the *P. Parolinii* of Visiani dates from 1841. In former notes on this species I followed the nomenclature and synonymy given by Parlatore.

The following descriptive note was published in the 'Gardeners' Chronicle,' with an illustration, Sept. 8, 1888, p. 267, under the name of *P. pyrenaica vera*, which I now propose to abandon for the reasons already alleged. I transcribe the notes taken from a specimen forwarded by the late M. Naudin, which has been compared with the specimens in the Kew Herbarium and Museum and in the British Museum, and in particular with the type-specimens of *P. bruttia* of Tenore.

Bark grey. Herbaceous shoots green, naked at the base, marked with prominent pulvini.

Leaves two, in a very short sheath, 4½ inches long (12 cent.), linear-pointed, concavo-convex, serrulate, with stomata on all sides. In section the leaf is boat-shaped with an epiderm of cuboidal cells, beneath which is a very thick layer of hypoderm (which must give great resisting power to the leaf and adapt it to windy localities). The leaf-substance consists of sinuous cells filled with chlorophyll; through its centre passes the double vascular bundle surrounded by an elliptical bundle-sheath or endoderm of about 50 oval cells filled with starch, and enclosing a "pericycle" of cellular tissue with masses of woody cells separating the two fibro-vascular bundles. Two resin-canals traverse the leaf-substance just beneath the hypoderm on the upper surface. This structure is identical with that of Tenore's *Pinus bruttia* and of Visiani's *P. Paroliniana* and of Kotschy, n. 420. It is also the same as in *P. halepensis*, but differs from that of *P. Pinaster* (*maritima*) and *P. Laricio*, with which it has been confounded, but from which the mere inspection of the leaf-section will enable the observer to distinguish it.

The male catkins are clustered, rarely solitary, erect, oblong, about half an inch long, orange-coloured; anther-crest orbicular, crenulate.

Cones lateral, solitary or in groups of three (Tenore's specimen, showing a large number in a cluster, is accidental), each shortly stalked or nearly sessile, spreading more or less horizontally; ovoid-conic, acute, rich shining chestnut-brown, $3\frac{1}{2}$ inches long by $2\frac{1}{4}$ in breadth. Scales woody; apophyses rhomboid, flattish, with a slight transverse ridge and a rather short pyramidal umbo. In the fully-developed cone the upper angle of the scale is often prolonged into a short blunt process.

In the Paris herbarium are specimens from Crete, *Raulin*, 747! and from Calabria, *Tenore*.

Boissier (Flora Orient. v. p. 605) points out that this species differs from *P. halepensis* in its thicker and more rigid leaves, in the larger size of the male flowers, in the sessile cones which are thicker and not pendulous, congested not solitary or twin.

55. Pinus Merkusii, *Junghuhn & De Vriese*; *Parlatore, in DC. Prod.* xvi.[2] p. 389; *Vidal, Sinops. Plant. Filip.*, Atlas, t. 98. fig. C.

Specimens from the Philippines, collected by Vidal, show this to be a two-leaved Pine, with semiterete leaves, concave on the anterior side, provided with hypoderm, cells of the mesophyll with infolded walls, and subepidermal resin-canals. The meristele is elliptic in section, with a branched fibro-vascular bundle, and an epiderm-layer of 20–30 cells.

The cones are 6–7 cent. long, cylindric-oblong, apophysis convex with radiating lines, umbo rhomboidal depressed.

It was originally described from Sumatra in Junghuhn & De Vriese, Plant. Nov. Ind. Batav. ii. p. 5, and has since been found in Borneo and the Philippines. It is said also to occur at elevations of from 1700–5000 ft. in the Shan States.

56. Pinus Massoniana, *Lambert, Pinetum*, ed. i. (1803), t. 12; *Pin.* ed. 2, p. 16, t. 8; *Parlatore, in DC. Prod.* xvi.[2] p. 389.

P. sinensis, Lambert.

This was first made known by a drawing taken from a plant in the Banksian Herbarium "brought by Mr. Francis Masson from the Cape."

The tree is a native of China, and is very distinct in its characteristics. The leaves are in pairs, very long and slender. In section they are semiterete or somewhat elliptical, concave on the ventral side, with one row of hypoderm-cells beneath the epidermis. The resin-canals are numerous beneath the margin of the leaf, each is surrounded by a sheath of stereome-cells. The endoderm consists of about 30–40 cells. The meristele is elliptic in section, and has a branched fibro-vascular bundle. The mesophyll is unusually thin, consisting of only two layers of cells outside the endoderm.

The *P. Massoniana* of Siebold and Zuccarini has been referred by Parlatore to *P. Thunbergii*.

Germinating seedlings observed at Kew showed a simple radicle, an erect caulicle reddish in colour, 6 cotyledons 1¼ in. long, linear. Primordial leaves linear, about the same length as the cotyledons, remotely serrulate, with stomata on the upper surface. The primary stem is glaucous, ridged and furrowed or fluted from the "decurrence" of the primordial leaves. Unfortunately it is not certain whether these seedlings were those of the true *Massoniana* or whether, as is most probable, they belonged to *P. Thunbergii*.

57. P. montana, *Miller, Gard. Dict.* ed. viii. (1768); *Willkomm, Forstliche Flora* (1887), p. 209; *Beissner, Handbuch d. Nadelholzkunde* (1891), p. 233; *Kent, in Veitch's Manual*, ed. 2 (1900),

p. 343; *Mottet, Conif. et Taxac.* 1902 (216); *Gremli, Flora of Switzerland*, English Edition, by Paitson (1889), p. 425.

This species, taken in the sense adopted by Parlatore and most modern authorities, is a low-growing tree or bush, native to the Alps of Central and Southern Europe.

The leaves of *Pinus montana* are usually bright green, the buds obtuse or shortly acuminate. The male flowers vary from lemon-yellow to deep orange in colour. In the cones the apophysis is greyish-brown, with a blackish ring surrounding the umbo.

In section the leaves are semiterete, flattish on the ventral side, with a row of small, thin-walled water-cells and a thick layer of hypoderm. The resin-canals are submarginal and surrounded by strengthening cells. The mesophyll consists of three or four layers of cells with infolded walls. The endoderm-cells are oblong, about 44 in number. The meristele is oblong in section, depressed on the upper surface; the fibro-vascular bundle branched, the branches separated by fine cellular tissue.

This structure I find to be substantially the same in the varieties *uncinata*, *Mughus*, *Pumilio*, and *Fischeri*.

Koehne notes that in all forms of *P. montana* the epidermal cells are twice the thickness of those in any other (European) species and have only linear cavities. The relative absence of stereome-cells between the two branches of the fibro-vascular bundle is also commented on by this observer.

The cones of this species are exceedingly variable, especially in the form of the apophysis, whence several varieties have been described under separate names. Parlatore, however, states "Omnes strobilorum et squamarum formas vidi ipsa in arbore."

In the variety *uncinata* the cones are unsymmetrical and the cone-scales recurved and hook-like.

In the var. *Pumilio*, to which *P. uliginosa* is referred, the cone-scales are not recurved, although somewhat prominent.

In var. *Mughus* or *Mugho* the apophysis is flattened, with a central umbo.

Willkomm (Forstl. Fl. p. 209) enters into much detail concerning the several varieties, which he classifies as follows:—

A. *P. uncinata*, including *rostrata*, *macrocarpa*, *pendula*, *castanea*, *versicolor*, *rotundata*, *pyramidata*, *gibba*, *mughoides*, and *pseudo-pumilio*. (See Mouillefert, Arb. tab. 28 *bis*.)

B. *P. Pumilio*, comprising *Pumilio*, *gibba* (sic), *applanata*.

C. *P. Mughus*.

The same author gives numerous bibliographical references, pp. 211, 212, 215, which it is not necessary to repeat in this place.

In the germinating seeds of *P. montana* I have observed a slender caulicle bearing five incurved, somewhat three-sided cotyledons.

P. majellensis of Schouw, Conif. d'Italie (1845), from La Maiella in Southern Italy, is referred by Parlatore to *P. Laricio*; but the resin-canals are distinctly marginal in a specimen given me by the late Mr. Groves of Florence, who collected it in the originally cited locality.

58. Pinus Pinea, *Linn.*

A well-known species inhabiting the Mediterranean region and observed also in Croatia and Syria. In altitude it occurs from the sea-level to 3000 ft. Bubani, in his 'Flora Pyrenaica,' cites numerous references to this Pine from Homer to Dodoens. By some of the older writers it was named *P. domestica*, by others, as by Bauhin, *P. sativa*. There is a specimen in the herbarium of Linnæus.

The famous forest near Ravenna, consisting of this species, was destroyed by frost in 1879, as graphically described in the 'Gardeners' Chronicle,' n. s. xv. (1881) p. 736.

The peculiar round-headed habit of this tree is familiar to Italian travellers and is well exemplified in a tree at Kew. The buds are elongate apiculate, pinkish; the bark of the trunk pinkish-brown, much cracked and separating in irregular oblong flakes. The young rind is pale pink. The male flowers are in cylindrical racemes, each about 15 mill. long, orange-coloured, surrounded at the base by persistent, subcoriaceous, lanceolate perulæ fringed at the margins. The young cones are clavate-pyramidal, the apophysis obscurely 4–5-sided with a rhomboid apophysis and a deflexed, deltoid, compressed umbo. The edible seeds are very large, with a very narrow wing, and the testa covered with a purplish powder. The radicle is stout, the caulicle erect cylindric. Cotyledons 11, three-sided, smooth but with marginal setæ. Primotinous leaves adnate, cylindric or awl-shaped.

The histology of the leaf is interesting. In the primordial leaves the transverse section is boat-shaped. There is a single layer of hypodermal cells beneath the epidermis thickened at the corners, the pericycle is obscurely differentiated, and the fibro-vascular bundle is unbranched, with the phloem in one concentric mass encircling the base of the wedge-shaped mass of xylem. In the adult leaf the section is boat-shaped, the hypoderm is well developed, especially at the corners of the leaf, the mesophyll consists of cells with sinuously folded walls; the endoderm-cells are well marked, about 40 in number; the fibro-vascular bundles branched. The resin-canals are numerous just within the epidermis.

The cotyledon is triangular in section, with an epithelial epidermis, no hypoderm, a mesophyll of spheroidal cells destitute of folds, with an imperfectly developed endoderm. The fibro-vascular bundle is unbranched, and there are no resin-canals.

In the Kew Museum is a specimen in which the axis of the cone has lengthened out into a leaf-bearing shoot; and for a photograph of a similar outgrowth I am indebted to Sir W. T. Thiselton-Dyer, who contributed a note on the subject to the 'Annals of Botany,' xvii. t. 40.

59. PINUS RESINOSA, *Solander*; *Sargent, Silva*, xi. (1897) p. 67, tab. 565; *Britton & Brown*, i. (1896) p. 51, fig. 111.

This species is so well known that little beyond reference to the standard works need be given.

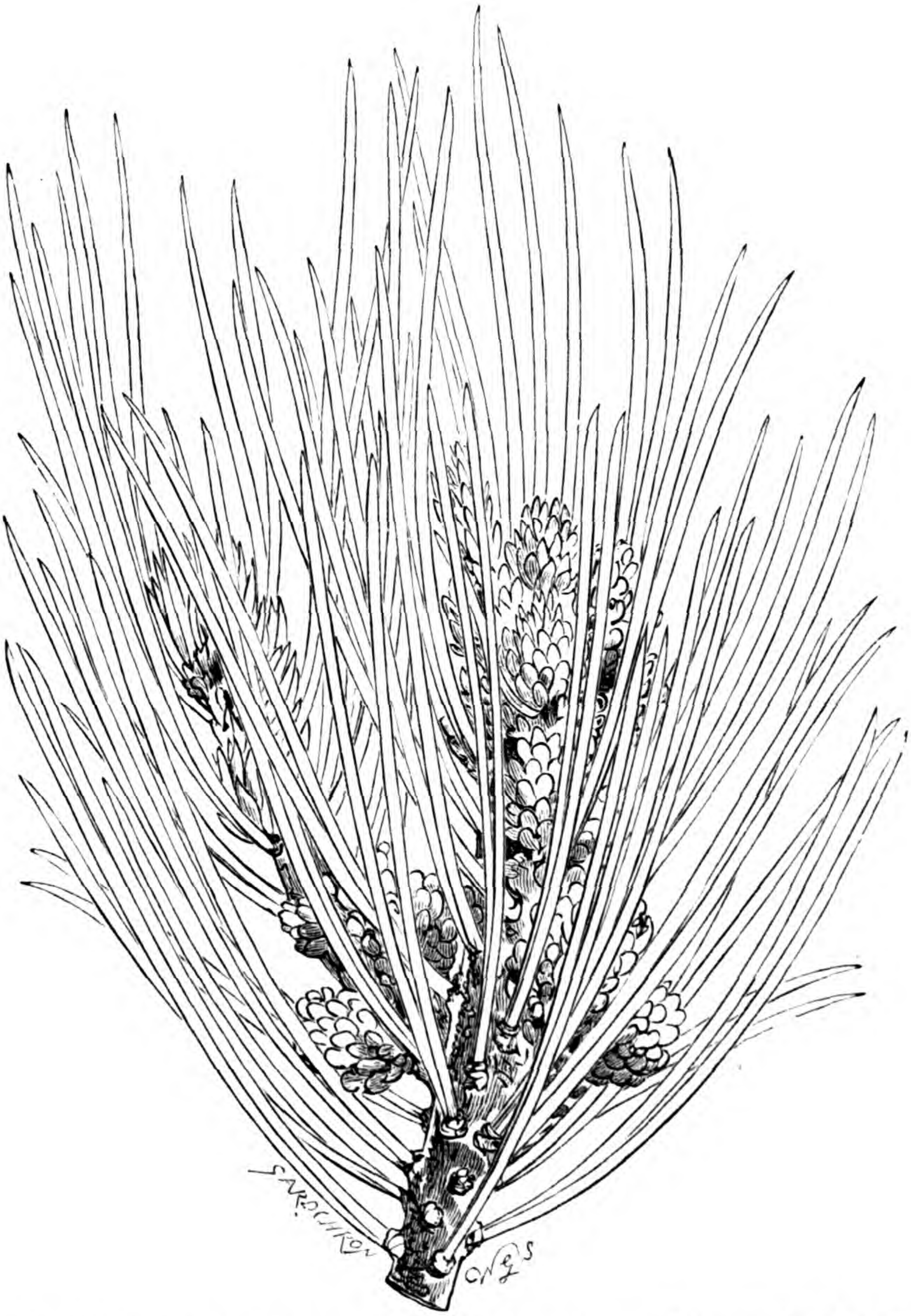
The section of the leaf is boat-shaped, the dorsum convex with numerous rows of stomata. There is one layer of hypoderm and the marginal resin-canals are also surrounded by similar cells. The endoderm-cells are about 30–36 in number; the meristele oblong, and the fibro-vascular bundle divides into two divergent branches, protected at the base by a band of stereome-cells (see also Trimble, fig. 28).

The cones are 4–5 cent. long, ovoid-conic, the apophyses transversely oblong-convex, destitute of mucro. Cotyledons 6–7.

60. P. SILVESTRIS, *Linnæus* (SYLVESTRIS); *Mouillefert, Traité des Arbres et Arbustes* (1892), t. ii. p. 1296.

The well-known Scotch Pine, still existing in a wild state in Scotland (see Gard. Chron. July 16, 1881), but formerly much more widely distributed in these islands (see Reid, Proc. Linn. Soc. March 15, 1894). Bubani, Flora Pyren. p. 33 (1897), refers to it as mentioned by Theophrastus as well as by the botanists of the sixteenth and seventeenth centuries. A specimen is preserved in the herbarium of Linnæus. It is distributed throughout the whole of Europe from the Arctic regions to the Apennines, as well as in North-West Asia, Siberia, the Caucasus,

Fig. 3.



Arrested growth of buds of *Pinus silvestris* resembling male flowers. (See Gard. Chron. June 24, 1899.)

and Asia Minor, and occurring from the sea-level to a height of 6000–7000 ft. in the mountains of Southern Europe. The species is very variable, so that many synonyms are cited in the text-books; to them may be added *P. armena*, Karl Koch (*Sintenis*, 3587). Differences in the quality of the timber coincide with variations in habit, size, and form of cone and cone-scale; hence the foresters recognize as distinct varieties, forms which

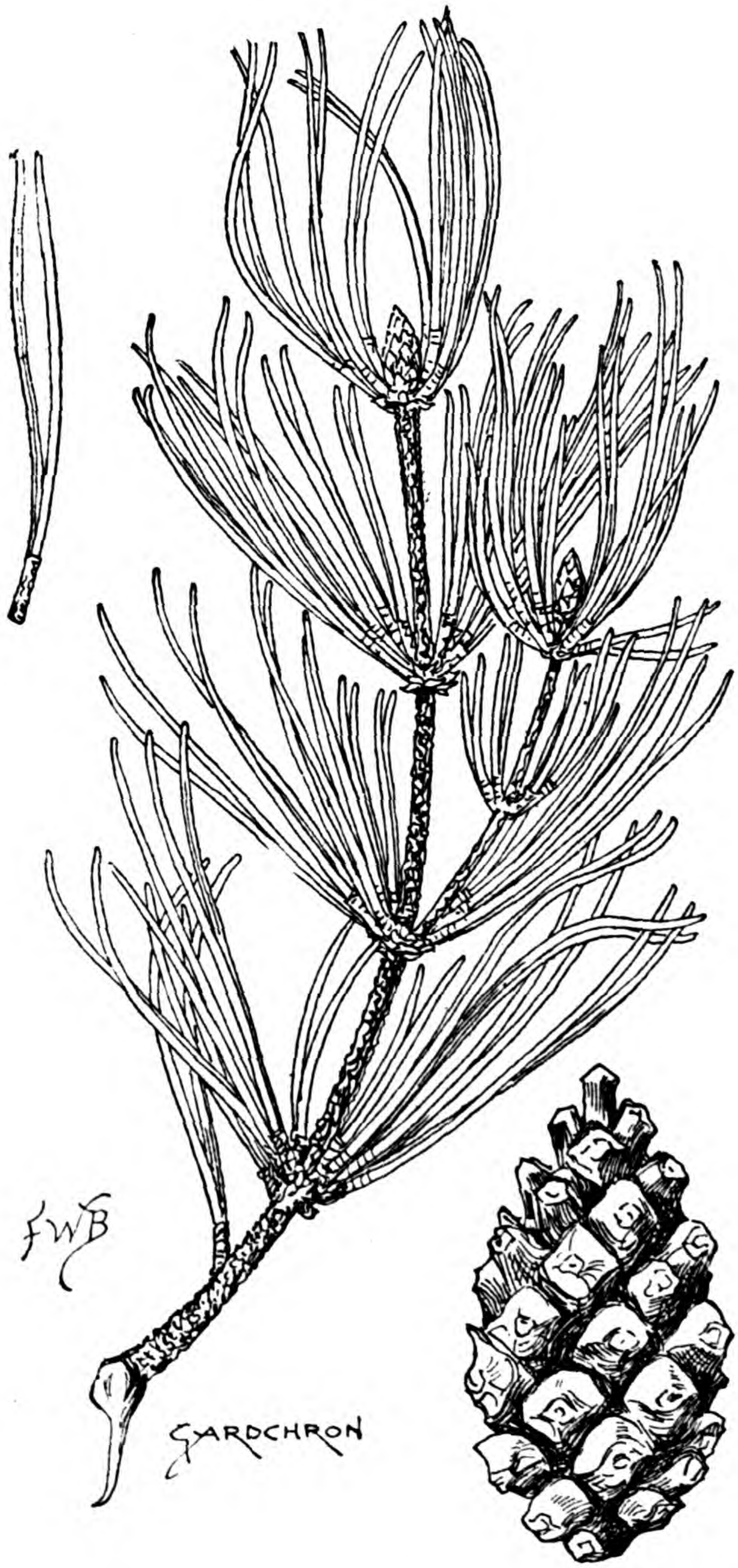
Fig. 4.

Pinus silvestris, showing terminal buds at the apex of the "spurs" with two leaves at the base.

the botanist would pass over or think not sufficiently distinct to warrant the application of a separate name.

The characteristics of this Pine are well known and detailed in all the text-books, so that only certain points need here be alluded to. Schlechtendal's paper, "De Pinastris Germaniæ et

Fig. 5.



Pinus silvestris, showing verticillate arrangement of tufts of leaves.

Helvetiæ Observationes," in Linnæa, vol. xxx. (1857), may be usefully consulted for notes on *P. silvestris*, *P. montana*, *P. Laricio*, etc.

The cotyledons, 3–8 in number, are triangular in section with subepidermal resin-canals and a central cylindric stele surrounded by endoderm, and having an unbranched fibro-vascular bundle.

The primordial leaves are elliptic in section, with convex sides, subepidermal resin-canals, and a branched fibro-vascular bundle.

The section of the adult leaf is boat-shaped, flattish on the ventral surface, with marginal canals, an elliptic meristele, as seen in section, and branched fibro-vascular bundle with a mass of stereome-cells between its two divisions. The endoderm-cells are about 60. The anther-crest is short, rounded or retuse.

The cones are usually stipitate and deflexed in the young state, spreading more or less horizontally in the adult condition. It is, however, not uncommon to find the adult cones erect. I have seen wild trees showing this character near Zermatt, in Switzerland, and in a cultivated state at Bournemouth and other British localities.

The apophysis is sometimes raised and pyramidal, with 4–5 sides, but in others it is flattish and lancet-shaped on the upper border. In another form the apophysis is decidedly hooked, as in *P. montana* var. *uncinata*.

To Mr. Burbidge I am indebted for specimens showing the fascicles of leaves arranged in whorls separated by long internodes (see fig. 5, p. 617). The disposition of otherwise isolated leaves in whorls is not uncommon, and is normal in *Sciadopitys*; but an arrangement of several tufts of leaves in verticils has not, so far as I know, been previously noted. In fig. 3, p. 615, is shown another abnormal condition of the buds placed in the position of the male flowers, but consisting of perular scales only; and in fig. 4, p. 616, are shown similar buds between the leaves at the apex of the contracted shoots.

61. Pinus Henryi, *Masters, in Journ. Linn. Soc., Botany*, vol. xxvi. (1902) p. 550.

This belongs to the *silvestris* group, but differs in the shape of the cone and of the apophysis. In appearance it is also like *P. densiflora*, but the cushion-shaped apophysis is prolonged into a central lobe and the umbo is deeply depressed.

The semiterete leaves have a double layer of hypoderm, marginal resin-canals surrounded by stereome-cells, an oblong meristele (in section), and a divided fibro-vascular bundle.

62. PINUS DENSIFLORA, *Siebold & Zuccarini*, *Mayr*, *Monog. Abietin. des Japan. Reiches* (1890), p. 72, tab. 5. f. 17, t. vii. f. 5; *Gard. Chron.* March 22, 1894.

P. tabuliformis, Fortune in herb.

A well-known Japanese species of which many forms are cultivated by the natives. The leaves are channelled on the upper surface and have subepidermal resin-canals. On one occasion I have seen a resin-canal in the centre of the vascular bundle. The two divisions of the bundle are separated by a thick layer of stereome-cells. The endoderm-cells are about 36. The anther-crest is membranous, truncated, and obscurely denticulate at the margin.

The apophysis is flattish, and the upper border is often prolonged into a lancet-shaped point.

In this species, as in *P. rigida*, *P. halepensis* (see p. 608), *P. Thunbergii*, *P. cubensis* (see p. 603), and *P. palustris*, the male catkins are occasionally androgynous. Mr. Kenjiro Fujii, in the 'Tokyo Botanical Magazine,' vol. ix. (1895), shows how the tranformation of a male into a female flower may be brought about by a local increase of nutriment.

This increase may be effected by pollarding the shoots, and thus "inducing all the nourishment in store to be used in the development of the remaining portions of the shoot, especially the flowers and the '*Kurztriebe*' (spurs) nearest to the wound." Mr. Kenjiro Fujii says that the formation of such flowers is mostly limited to the extension shoots ("*Langtriebe*) developed from the spurs or *Kurztriebe* of the last season, and that such transformation of spurs into extension-shoots takes place when the extension-shoots are in any way injured, and that the *Kurztriebe* which are transformed into *Langtriebe* are those which stand nearest to the point of injury of the *Langtriebe*.

The Japanese botanist just named, by making a series of experiments in the Tokyo Botanic Garden, was enabled to say that the sex of the flowers is not determined by their position, and that it is undetermined till a certain stage of their development, and lastly that "a flower which would otherwise develop into a male, has a tendency to become a female when local increase of nourishment takes place at a certain stage or during certain stages of its development."

63. Pinus divaricata, *Dumont de Courset, Bot. Cult.* iii. p. 760 (1802); *Sudworth, ex Sargent, Silva*, xi. (1897) p. 147, tab. 588; *Britton & Brown*, i. (1896) p. 52, fig. 114.

P. Banksiana (1803).

A species common in the Atlantic States of N. America, from Nova Scotia to Minnesota. It is more generally known under the name *Banksiana* (1803); but I follow Sargent, *l. c.*, in adopting the original name, as Aiton in 1789 alluded to it as var. *divaricata* of *P. silvestris*. It has also received the names of *P. Hudsonia* (Poiret, 1804) and *P. hudsonica* (Parlatore, 1868). The species is well known and has been often described, so that it is only necessary to add a few particulars mostly derived from the tree as met with in cultivation. The herbaceous shoots are cylindric and clothed to the base with leaves. In the cortex is a single row of resin-canals. The leaves are rarely more than 5 cent. long, slightly curved, and emerging from a very short sheath 5–6 mill. long. The thin wall-layer is conspicuous beneath the epidermis. The endoderm-cells number about 60. The resin-canals are in the substance of the mesophyll and surrounded by stereome. The meristele is elliptic, and the fibro-vascular bundle branched. The leaf-buds are slender, cylindric-obtuse or slightly pointed, the bud-scales lanceolate, membranous, but not lacerate at the edges. The clusters of male flowers are 15 mill. long, racemose. Anthers orange; anther-crest suborbicular, nearly entire. The female cones are produced laterally on the shoots of the year and are shortly stipitate, but ultimately become subsessile, upturned, and appressed to the branch, to which they remain attached for a long period. In shape they are oblong-conic, curved. Cotyledons 4–5.

64. P. muricata, *D. Don*; *Sargent, Silva*, xi. (1897) p. 139, tab. 585; *Masters, in Gard. Chron.* Jan. 12, 1884, figs. 8 & 9.

A native of the Californian coast-district, remarkable for the length of time that the cones remain attached to the branch. The elongated clusters of male flowers with the intervening bracts are also remarkable. The leaves are in pairs, rarely in threes. The section is boat-shaped, showing a thin layer of water-cells beneath the epidermis, between it and the thick hypoderm. The walls of the cells of the mesophyll are infolded. The endoderm-cells about 50 in number, much thickened on the outer surface. The resin-canals are median, not surrounded by stereome-cells. The meristele is elliptic with a branched fibro-vascular bundle, the branches separate at the base by fine cellular tissue. The cones are clustered, deflexed, obliquely ovoid-conic, 7–8 cent. long, with the apophysis thickened equally on each side of the terminal, upturned, awl-shaped mucro. The scales are not so broad as those in *P. attenuata* (*tuberculata*) (p. 594).

65. Pinus clausa, *Chapman*; *Sargent*, *Silva*, xi. (1897) p. 127, tab. 582; *Beissner*, *Carl Mohr*, *in Garden and Forest*, Aug. 20, 1890, also *Sudworth* in the same journal, April 6, 1892, p. 162.

P. inops var. *clausa*, Engelmann.

A species native to the coast and sand districts of Florida.

The section of the leaves is semiterete, convex beneath, flat above, with a double layer of hypoderm. The cells of the mesophyll have infolded walls. Resin-canals median, surrounded by stereome-sheath, meristele transversely elliptic; fibro-vascular bundle branched, its branches separated by the cells of the pericycle. Endoderm-cells about 49, thickened at the points of contact.

Buds slender, cylindric; male flowers congested; cones shortly stalked, spreading or deflexed, 6–8 cent. long, oblong-conic, persistent, and often more or less embedded by the over-growing wood of the branch; apophysis convex, transversely keeled, entire, with a central subulate mucro. The scales remain closed for several years, the vitality of the seed being thus preserved from five to nine years. The object of this serotinous habit is not clearly ascertained. It is discussed by Sudworth in the paper above referred to. (See also p. 595.)

66. P. maritima, *Linn.*; *Miller*, *Dict.* ed. viii. (1768) n. 7; *Poiret*, 1804; not of *Lambert* nor of *Aiton*.

P. silvestris, Miller, *l. c.* n. 1, not of Linnæus.

P. Pinaster, Solander, in Aiton, Hort. Kew. ed. i. vol. iii. p. 367; Parlatore; Sargent, Silva, xi. (1897), adnot. p. 7; Beissner, et auct. plurim.

P. Laricio, Santi (1795), not of Poiret.

P. syrtica, Thore, Promenade en Gascogne.

This well-known Mediterranean species is generally known in cultivation under the name *Pinaster*. In Linnæus's herbarium it is called *Pinus maritima*. Going back to pre-Linneau times, we note that it was the *maritima major* of Bauhin, and the *P. silvestris maritima conis firmiter ramis adhærentibus* of Plukenet's Almagest. (1696) p. 296. It is figured in Tabernæmontanus, 'Icones' (1588), ic. 937.

Bubani, Flora Pyren. p. 36, cites our plant under the name *P. maritima* of Theophrastus, and further refers to the 'Idylls' of Theocritus and the 'Bucolics' of Virgil! whose authority in such matters, however, the majority of modern botanists are not likely to recognize.

The tree is so well known that little need be added to its description. The long leaves are in pairs or in threes. When in pairs the leaf-section is boat-shaped, dorsally convex, flattish on the upper surface. When in threes the leaf-section is convex dorsally, with two slightly concave lateral surfaces. In all cases the resin-canals are median.

In most cases the cones are deflexed or pendulous, but in the variety *Lemonianus* the cones are terminal and erect (see Sir C. Lemon in Trans. Hort. Soc. Lond. ser. 2, vol. i. pl. 20, 1833). Sir Charles mentions having seen some hundreds of examples, which presented an unbroken constancy of character. Specimens of this variety may be seen in the Paris herbarium. I have seen similar change of position in *P. silvestris*, but never to the same extent. The trees, as described by Sir Charles Lemon, never produced leading shoots, as the terminal bud was represented by a female cone, beneath which the lateral shoots were produced. The ordinary *Pinaster* is readily recognized by its conical cones, prominent pyramidal apophyses, and stout subulate umbos. The male flowers are in racemose clusters.

In section the leaves are boat-shaped, with a prominent midrib projecting like a keel between the two somewhat concave sides. There is a thick layer of hypoderm beneath the epidermis, in contact with the cortical cells which have infolded walls. The resin-canals are in the substance of the mesophyll and surrounded by stereome-cells. The endoderm consists of 50 or more cells. The meristele is elliptic in section, with a branched fibro-vascular bundle, the branches convergent towards the upper surface. The structure of the primordial leaf is similar, but the endoderm is not so well differentiated and the resin-canals are not provided with a sheath of stereome. The cotyledons are 5–8 in number.

Parlatore recognizes a var. β. *Hamiltoni* with cylindric cones; var. α. *minor* with smaller cones; var. δ. *prolifera*, a malformation with cones in dense clusters; and var. γ. *Lemoniana* abovementioned.

67. PINUS PUNGENS, *Lambert, in Konig & Sims, Annals of Botany*, ii. (1806) p. 199; *Michaux*; *Sargent, Silva*, xi. (1897) p. 135; *Britton & Brown, Illustrated Flora*, i. p. 50, fig. 117; *Beissner, Handbuch*, p. 214, fig.

A species native of the Appalachian mountains, extending also to Virginia southwards and to Pennsylvania and New Jersey northwards.

The glabrous shoots are clothed to the base with tufts of foliage. The leaves are 3–5 cent. long, boat-shaped in section, flattish above, with a thick hypoderm projecting into the mesophyll in wedge-shaped masses, and cortex-cells with infolded walls. The resin-canals are median and surrounded by stereome-cells. The endoderm consists of 70 to 80 oblong, thick-walled cells. The meristele is elliptical, depressed on the upper surface. The fibro-vascular bundle is branched, the two branches widely divergent at the base (see also Coulter & Rose, p. 308). The cones are sessile, spreading, 7–8 cent. long, oblong-conic. Cotyledons 7–8. The apophyses are somewhat four-sided, dilated upwards, but taper gradually into a stout subulate, often reflexed, point.

68. P. VIRGINIANA, *herb. Linn.*; *Miller, Dict.* (1768); *Sargent, Silva*, xi. (1897) p. 123, tab. 581; *Britton & Brown, Illust. Flora*, i. (1896) p. 452, fig. 115.

P. inops, Aiton, Hort. Kew. iii. p. 367 (1789).

P. Royleana, Jameson.

A well-known American species, extending near the coast from New York to Georgia.

The leaves vary from 2–8 cent. in length. In section they are boat-shaped, with a double layer of hypoderm; the mesophyll-cells have infolded walls; the resin-canals are median and surrounded by a sheath of stereome. The endoderm-cells are about 60 in number, thickened on the outer wall. The meristele is elliptic in section, with a branched fibro-vascular bundle, the divergent branches being separated by cellular tissue. The buds are ovoid-oblong, acute; the male flowers in dense spikes, the cones shortly stalked, at first erect, but afterwards deflexed, 5–7 cent. long, oblong-conic; apophysis grey, lobed; the umbo very convex, with a short, subulate, reflexed mucro. Cotyledons 4–6.

69. PINUS GLABRA, *Walter* (1788); *Sargent, Silva*, xi. (1897) p. 131, tab. 583.

A North American species, extending from South Carolina to Florida.

The leaves are in pairs, each leaf about 5–8 cent. long, slender. In section the leaf is semiterete, flat on the upper surface, with epiderm, two layers of hypoderm, cortical cells with infolded walls; resin-canals median, in one instance internal, surrounded by stereome-cells. Sargent also figures one canal as internal. The meristele is oblong in section, separated from the cortical tissue by the endoderm-layer consisting of 30–40 oblong cells (see also Trimble, fig. 30; Coulter & Rose, p. 308). The male flowers are in rounded clusters; the cones sessile, ovoid, 4–5 cent. long. The apophyses are slightly convex, 4-sided, with a minute mucro terminating the umbo. Cotyledons 5–6.

An interesting account of this Pine is given by Carl Mohr in 'Garden & Forest,' June 18, 1890, p. 295, reproduced in the 'Garden' for July 5, 1890.

70. P. ECHINATA, *Miller* (1768); *Sargent, Silva*, xi. (1897) tab. 587; *Britton & Brown*, i. p. 53, fig. 116.

P. mitis, Michaux (1803) et auctt.

P. variabilis, Lambert (1803).

? *P. virginiana, β. echinata*, Du Roi in herb. Linn.!

A widely distributed species, occurring from New York to Florida, in Texas, Louisiana, and other Middle and Eastern American States.

The leaves are 8–12 cent. long, slender, boat-shaped in section, with one layer of hypoderm; cortical cells with infolded walls; resin-canals median, surrounded by a stereome-sheath; meristele elliptic; endoderm-cells about 40, thickened on the outer side; fibro-vascular bundle branched, with stereome-cells between the divergent branches. The buds are cylindric, acute; the male flowers in globose clusters. Cones shortly stalked or subsessile, spreading, 5–8 cent. long, oblong-conic. Apophysis slightly convex, keeled, 4-sided, upper border oblong, umbo with a minute reflexed mucro. Cotyledons 4–7.

71. P. LARICIO, *Poiret* (1804); *Sargent, Silva*, xi. (1897) p. 6, adnot.; *Masters, in Gard. Chron.* Jan. 18, 1884, p. 18,

Dec. 15, 1888, p. 692, fig. 97; *Maurice de Vilmorin*, *Revue Horticole*, ex *Garden and Forest*, Oct. 20, 1897, p. 41; *Mouillefert*, *Traité des Arbres et Arbustes*, t. ii. (1892) p. 301.

The nomenclature and synonymy of this species and its many varieties are involved beyond hope of extrication. The name *Laricio* of Poiret is here adopted as the one most generally employed, but it is by no means certain that its claims to priority are valid. Linnæus does not mention the species, nor is there a specimen in his herbarium. Plukenet, in his Almagestum (1696) p. 296, mentions a *P. hispanica Laricio*, which may refer to our present species. Reverting to post-Linnean times, Dr. Günther Ritter Beck von Mannagetta says that *P. nigra* of Arnold, Reise nach Mariazell (1785) p. 8, has precedence over *P. Laricio*. Arnold's plant is the same as that now generally known as *P. Laricio*, var. *austriaca*. Santi's *P. Laricio*, dating from 1795, is the same as Miller's *P. maritima* (1768), which is the *P. Pinaster* of Solander and later writers. Our present plant is the *P. maritima* of Solander in Aiton, Hort. Kew. (1789), but this name, as we have just seen, had been previously employed by Miller (1768) for the Pinaster.

The species figured by Miller as the Aleppo Pine in his "Figures of Plants," described in the 'Gardeners' Dictionary,' vol. ii. (1760) tab. 208, seems referable rather to a form of *P. Laricio* than to *P. halepensis*. It is not possible to ascertain the position of the resin-canals in Miller's figure; were it otherwise, it would be easy to distinguish any form of *P. Laricio* with median canals from *P. halepensis*, in which they are always subepidermal.

Parlatore considers the typical form to be equivalent to the var. *α. Poiretiana* of Antoine. The habitats for the typical form are the mountains of S.E. Spain, Southern France, Calabria, Corsica, Greece, and Western Asia Minor.

The Italian botanist groups the numerous varieties under three subspecies:—*β. tenuifolia*, *γ. nigricans*, and *δ. Pallasiana*.

In the *β. tenuifolia* varieties the leaves are relatively slender and soft, not rigid. Here are referred the varieties *pyrenaica* (not *P. pyrenaica* of Lapeyrouse), *cebennensis*, *monspeliensis*, *Salzmanni*, *angustisquama*, and *leptophylla*. This group is equivalent to the subsp. 2. *monspeliensis* of Koehne. Lapeyrouse's *P. pyrenaica*, for reasons given under the head of *P. bruttia*, may well be suppressed. Henry de Vilmorin, who studied the forms carefully in the Pyrenees, came to the conclusion that

Pinus Laricio var. *pyrenaica* is the one found in various parts of the Pyrenees, and that *P. monspeliensis* and *P. Salzmanni* were inseparable from it. See H. de Vilmorin, Bull. Soc. Bot. France, Montpellier Congress, xl. (1893) pp. lxxvii–lxxxi.

The tenuifoliate forms of *P. Laricio* occur in the mountains of S.E. Spain, in the Central Pyrenees, and the Cevennes.

The forms referred by Parlatore to his var. *γ. nigricans* are the following:—

P. nigricans, Host (1826), also of Link, Tenore, Bertoloni, and others.

P. austriaca of Höss (1826). The two last names were, according to Dr. Günther Ritter Beck von Mannagetta, published many years subsequently to the *P. nigra* of Arnold, which applies to the same form, and, except for the sake of convenience, should have precedence.

P. sylvestris, Baumgartner.

P. Pinaster, Besser, Tenore, not of Solander.

P. Laricio, Koch.

P. Laricio austriaca, Endlicher.

P. Laricio nigricans, Christ.

P. Fenzlii, Kotschy.

P. Heldreichii, Christ; see Gard. Chron. May 10, 1902, fig. 97. Of the last named I have seen a small cone forwarded by Dr. Christ, who speaks of it (*in litt.*) as "une variété très remarquable montagneuse et subalpine de *P. Laricio*, Poiret, très reduite et affectant presque le *P. pumila*. Elle est des hautes montagnes de la Grèce, Olympe et Thessale." By some this variety is included under *P. leucodermis* of Antoine, but the figures of the cones of the two are widely different.

P. leucodermis, Antoine, Oesterr. Bot. Zeitschr. xiv. (1864) p. 366, is said by its author to be distinguished from *P. Laricio*, var. *austriaca*, by the peculiar formation and colour of the bark, by the short, thick, densely crowded leaves, and by the somewhat smaller, far more resinous and black-green cones (see Dr. Günther Ritter Beck von Mannagetta, in the 'Wiener Garten Zeitung' (1889), and in his "Flora d. Sud-Bosnia," Ann. des k.-k. Hofmuseum, Wien, ii. p. 37, 1887).

Heldreich also, as quoted by Boissier, 'Flora Orientalis,' v. p. 697, says it differs widely from *Laricio* in its lower stature, thicker leaves, and much shorter cones (6–7 cent.), and in the form of the apophysis. Dr. Christ thinks it near to *P. montana*.

The figure of the cone certainly looks different from that of most forms of *Laricio.*

A young living plant, given me by Mr. W. Paul, greatly resembles a young plant of the Austrian pine, but the leaves are of a deeper green colour and the bud-scales more silvery. Moreover, the hypoderm projects in wedge-shaped masses into the substance of the leaf, which is not the case generally in the other forms of *Laricio.*

P. majellensis, Gussone, is sometimes included here, but the marginal position of the resin-canals shows this to be referable rather to *P. montana.*

P. taurica, hort.

P. dalmatica, Visiani.

Here also may probably be placed *P. Laricio*, var. *cilica*, Kotschy, n. 418, which has orange-coloured shoots as in *P. Laricio pyrenaica.*

P. Laricio orientalis is a short-leaved variety from Cyprus, *Kotschy*, 759!

The forms in this group occur in the mountains of Austria, Dalmatia, Venezia, Hercegovina, Montenegro, Calabria, Sicily, Greece, Crete, and the Taurus Mountains.

Under var. δ. *Pallasiana* are included forms with relatively thick, rigid leaves, but with larger cones than in those previously mentioned, and with the apophysis marked by radiating cracks. Here are referred:—

P. maritima of Pallas.

P. Pinea, Hablitz.

P. halepensis, Marschall v. Bieberstein.

P. Pallasiana, Lambert. *P. Laricio Pallasiana*, Endlicher and others.

In this series may also be placed *P. Laricio pindica*, the *P. pindica* of Formanek, from the mountains of Thessaly, *Sintenis*! (see Masters, in Gard. Chron. May 10, 1902, figs. 95, 96).

The *P. Laricio calabrica* of Delamarre is, in gardens, a tree with bushy pyramidal habit and upturned branches with dark green leaves. The names *italica* and *Romana* are supposed to apply to this form. A specimen from Calabria, given me by Dr. Christ, is in foliage and cone evidently a form of *Laricio*, var. *nigricans*, but whether it is the same as Delamarre's tree, I am not able to say.

A very distinct form is that gathered by the late General

Munro in the Crimea. This has relatively small cones resembling that sent by Dr. Christ as *Pinus Heldreichii*. The cones are ovoid, cinnamon-coloured, the scales have a concave apophysis and a minute rhomboid umbo.

P. Paroliniana of Visiani has been referred to this species, but, as pointed out by Karl Koch, is better placed under *P. halepensis*. This view is borne out by the marginal position of the resin-canals.

The late Henry de Vilmorin, who had specially studied this species and varieties, proposed the following arrangement (*in litt.*):—

P. Laricio.

Subsp. 1. *genuina* = *Poiretiana*.
,, 2. *calabrica*.
,, 3. *pyrenaica*.
,, 4. *taurica*.
,, 5. *karamana*.
,, 6. *austriaca*.
,, 7. *rubra*.
,, 8. *Massoniana* (= *Thunbergii*).

All the forms of *P. Laricio* have semiterete leaves with thick hypoderm, median, or very rarely subepidermal, resin-canals encircled by stereome-cells, an endoderm-sheath of 40–50 ovoid cells, an elliptical meristele, and a branching fibro-vascular bundle. Longo, in the 'Annali di Botanica,' Roma (1903), t. i. fasc. 2, tav. 3, says that in *P. Laricio* proper there are only one or two layers of hypoderm, whilst in *P. nigricans* there may be as many as four.

The leaf-buds in all the varieties are ovoid or ovoid-conic, generally with a prolonged point.

The male flowers are in subglobose tufts, each one cylindric, often somewhat twisted.

In the young seedling the radicle descends vertically to a great distance, and has horizontal branches at rather remote intervals.

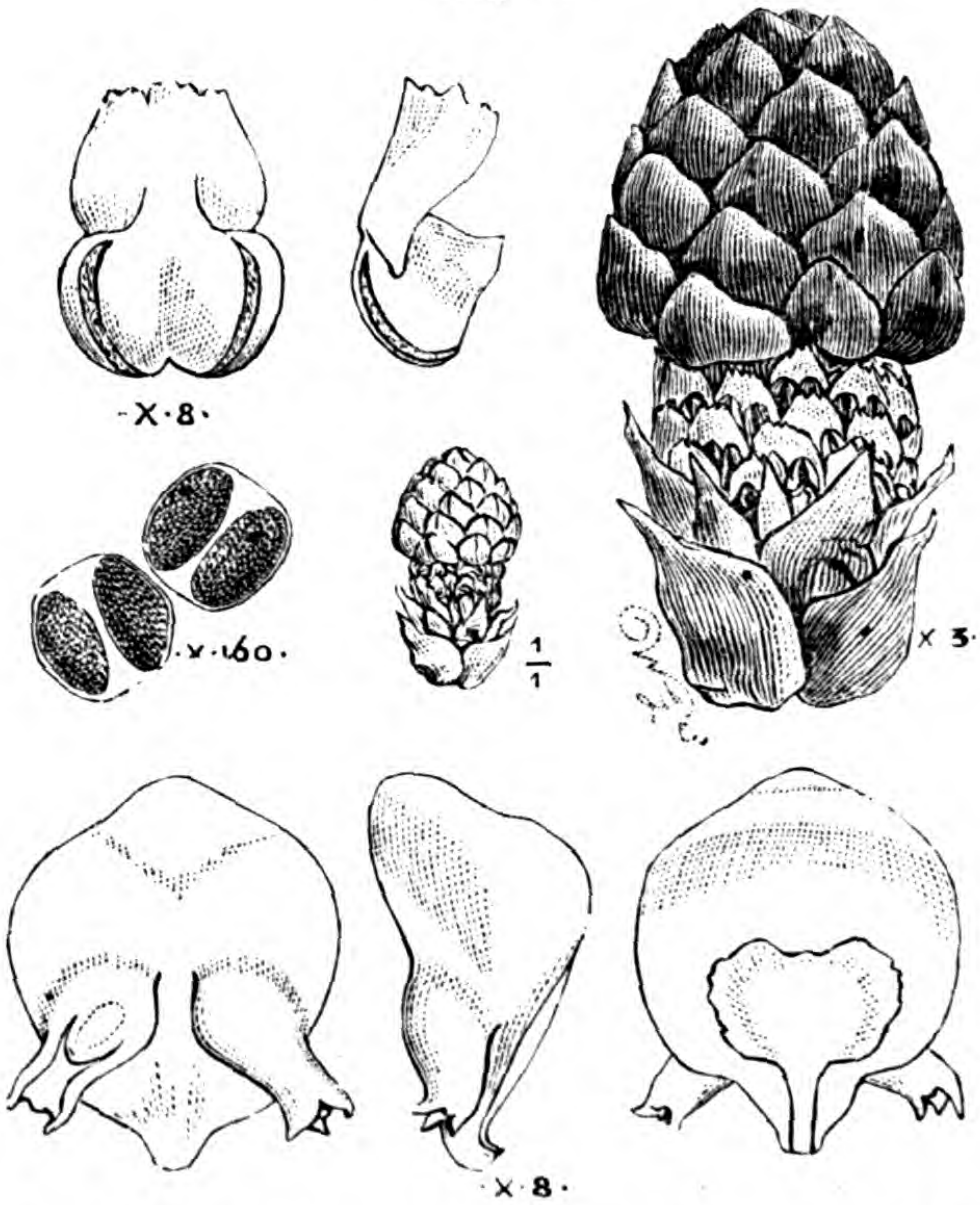
The caulicle attains a height of 5–7 cent., and becomes ultimately somewhat woody with a greyish-brown rind. The cotyledons vary from 4 to 8 in different specimens. The young stem-system is pyramidal, branching from the base.

The colour of the herbaceous shoots varies in the different varieties, but the tint of the bark on the older portions of the stem (in cultivated specimens) is less variable, being usually dull reddish brown, peeling off irregularly in long, narrow, thin flakes.

72. Pinus Thunbergii, *Parlatore* (1868); *Mayr, Monogr. der Abietin. des Japanischen Reiches* (1890), p. 69, t. 5. fig. 16; *Sargent, Forest Flora of Japan*, p. 79; *Masters, in Gard. Chron.* N. S. xxiii. (1885) p. 344, fig. 63.

A Japanese species formerly confounded with *P. Massoniana* (p. 611) and *P. densiflora*, but distinct from both in foliage, leaf-bud, and cones. The leaves are boat-shaped in section with a thick hypoderm. The cells of the mesophyll have infolded walls. The resin-canals encircled by a sheath of stereome traverse the centre of the mesophyll. The endoderm consists of about 30 or more

Fig. 6.



Pinus Thunbergii, showing androgynous spike with bracts and stamens beneath, bracts, fruit-scales, and ovules above: real size and magn. 3 diam.; details, fruit-scales, &c., magn. 8 diam.; pollen-grains 160 diam.

cells. The meristele is elliptic in section, and the two branches of the fibro-vascular bundle are separated by stereome-cells. Androgynous cones occasionally occur. See Gard. Chron. June 30, 1883, p. 825; also Tokyo Botanical Magazine, June 10, 1892, p. 239 cum ic. (see *ante*, pp. 603, 619).

The Abbé David, in a note attached to a specimen of this species, n. 2890, in the Paris herbarium, speaks of this as a large tree with verticillate ascending branches, occurring on the lofty mountains of Western Ourato.

The apophysis is lancet-shaped on the free border, rather flat, greyish, with a brownish umbo.

73. Pinus contorta, *Loudon* (1838); *Sargent, Silva*, xi. (1897) p. 89, tab. 567; *Masters in Gard. Chron.* 1883, p. 45, fig. 5.

A species growing near the coasts of Northern California, Vancouver, and Alaska. Inland it grows on the mountains of the "Sequoia" region at an altitude of 8500 feet, and there alters its character, constituting the variety *Murrayana*, as illustrated by specimens in the British Museum, collected near the Colombia River by Macoun. Another variety, with more slender foliage and catkins, has received the name *Bolanderi.*

In the typical *P. contorta* the cones are ovoid-conic, and the small four-sided umbos are provided with a small aculeate curved mucro.

The leaf-section is boat-shaped, flat on the upper surface, with a layer of hypoderm beneath the epidermis. The mesophyll-cells have infolded walls. The resin-canals are in the substance of the leaf and surrounded by stereome-cells. The section of the meristele is elliptic and surrounded by an endoderm-layer of about 50 cells, both in the type and in the variety *Murrayana.* The two divisions of the fibro-vascular bundle are widely separate by intervening cellular tissue.

Species of which no Specimens have been seen by the Writer.

Pinus recurvata, *Rowlee*, in 'Bulletin' of Torrey Botanical Club, xxx. (1903) p. 107.—Rowlee describes from the Isle of Pines a species which he says resembles *P. palustris*; but the cones are only half as large, and the depressed umbo and straight prickles are not like those of the species named. The cones are even more unlike those of *heterophylla* (*cubensis*). [Shaw refers this to *P. bahamensis*, Griseb.—Note added March 12, 1904.]

P. yunnanensis, *Franchet, in Journ. de Bot.* 1899, p. 253.

A tree described by Franchet as having the habit of *P. longifolia*, with three leaves to the tuft, each leaf 18–20 cent. long. The cones are smaller than those of *P. longiflora*, being about 9–10 cent. long, 6–7 broad, ovoid; apophysis rhomboid, prominent. The species was collected in Yunnan by Father Delavay, and seems to resemble *P. Massoniana.*

P. vermicularis, *Janka*, ex *Boissier, Flora Orient.* v. p. 698. ? *P. Peuke.*

Pinus leucosperma, *Maximowicz, in Bull. Acad. St. Pétersb.* t. xxvii. p. 425 (1881).—A native of Kansu, Terra tangutorum, collected by Przewalski in 1872. Of this two pairs of leaves have been kindly furnished by M. Fischer de Waldheim. The leaves are in twos, surrounded at the base by a short sheath, semicylindric, channelled above, faintly denticulate, stomatiferous on all sides. The length is 8 cent. in the one case, 11 cent. in the other. Beneath the epiderm are two layers of hypoderm with additional stereome-cells in the corners. The cells of the mesophyll are plicated, and the numerous resin-canals, each surrounded by stereome, are subepidermal. The meristele is elliptic in section, with an endoderm of 40–50 cells. The two branches of the fibro-vascular bundle are widely divergent. In structure it appears like *P. silvestris*.

P. eldarica, *Medwejew, in Act. Hort. Tiflis* (1902), vi. II. p. 2.—Allied to *P. bruttia* and *P. halepensis*, but said to differ from both. A native of Transcaucasia. The figure shows sessile, ascending ovoid-conic cones. I am indebted to Mr. Hemsley for calling my attention to the figure and description of the tree.

P. funebris, *Komarow, in Act. Hort. Petrop.* xx. (1901), cited in Beissner, Mittheil. d. Deutschen botanischen Gesellschaft, as probably a form of *P. silvestris*.

P. apulcensis, *Lindl.* ex *Endl. Synops.* p. 153.

INDEX TO SPECIFIC NAMES AND SYNONYMS.

[Postscript, March 12, 1904.

As this sheet is passing through the press, a communication relating to the Pines of Cuba has been received from Mr. G. R. Shaw, of the Arnold Arboretum, for publication in the 'Gardeners' Chronicle,' March 19, 1904, pp. 179–180, fig. 74. In this note Mr. Shaw arranges the Cuban species thus:—

1. **P. cubensis**, Griseb.=*P. Wrightii*, Engelm.
2. **P. terthrocarpa**, Shaw.
3. **P, bahamensis**, Griseb., with numerous synonyms.]

A Chronological List of Specific Names, based on the Enumeration given in the 'Index Kewensis'; with Additions.

[Synonyms in italic; adopted names of true Pines in black type.]

1753. Linnæus, Species Plantarum.

	Pinus sylvestris.
sylvestris β.	— **Pinaster.**
	— **Taeda.**
	— **Cembra.**
	— **Strobus.**
Cedrus.	*Cedrus Libani.*
Larix.	*Larix decidua.*
picea.	*Abies pectinata.*
balsamea.	*Abies balsamea.*
Abies.	*Picea excelsa.*
	Pinus Pinea.

1755. Duhamel, Traité des Arbres etc. ii. p. 126.

hierosolimitana.	— **halepensis,** Miller (1768).

1762. Linnæus, Sp. Plant. ed. 2.

canadensis.	*Tsuga canadensis.*
orientalis.	*Picea orientalis.*

1765. Gouan, Flora Monspel. p. 418.

sylvestris.	**Pinus maritima.**

1768. Miller, Gard. Dict. ed. 8.

sylvestris.	— **maritima.**
	— **Pinea.**
rubra.	— **sylvestris,** var.
tatarica.	— **montana.**
Cembro.	— **Cembra.**
	— **maritima.**
	— **halepensis.**
	— **virginiana.**
	— **rigida.**
	— **Taeda.**
	— **echinata.**
	— **Strobus.**
	— **palustris.**

1771. Du Roi, Obs. Bot. p. 44.	
Abies.	*Abies pectinata.*
americana.	*Tsuga canadensis.*
canadensis.	*Picea alba.*
laricina.	*Larix americana.*
mariana.	*Picea nigra.*
Picea.	*Picea excelsa.*
virginiana β. echinata.	**Pinus echinata.**
1772. Scopoli, Fl. Carniol. ed. 2, ii. p. 247.	
Mughus.	— **montana.**
1777. Alstrœmer, Vet.-Akad. Handl. xxxviii.	
viminalis.	*Picea excelsa*, var.
1778. Lamarck, Flore Franç. iii. p. 651.	
excelsa.	*Picea excelsa.*
montana (not Miller).	**Pinus Cembra.**
maritima.	— **maritima**, Miller.
sativa.	— **Pinea**, or *Picea excelsa?*
pectinata.	*Abies pectinata.*
1780. Turra, Floræ Ital. Prod.	
Mugo.	**Pinus sylvestris.**
1781. Jacquin, Ic. Plant. Rar.	
Mugho.	— **sylvestris.**
1782. Molina, Sagg. Chile, ed. 1, p. 182.	
araucana.	*Araucaria imbricata.*
1784. Pallas, Flora Rossica, i. t. 7.	
Picea.	*Abies sibirica.*
Abies.	*Picea obovata.*
Cembra β. pumila.	**Pinus Cembra.**
Thunberg, Flora Japonica.	
Abies.	*Picea polita.*
Cembra.	**Pinus parviflora.**
japonica.	*Larix japonica.*
Larix.	*Larix leptolepis.*
sylvestris.	**Pinus Thunbergii.**
Strobus.	— **koraiensis.**
1785. Moench, Verzeichn.	
glauca.	*Picea alba.*
Arnold, Reise nach Mariazell, p. 8.	
nigra.	**Pinus Laricio**, Poiret.
1788. Walter, Flora Carolin. p. 237.	
	— **glabra.**
lutea.	— **palustris.**
squarrosa.	— **echinata.**

1788. Ehrhart, Beitr. iii.

laxa.	*Picea alba*

Gaertner, Fruct. ii. p. 60, t. 91.

americana.	*Picea nigra.*

1789. Aiton, Hort. Kew. ed. 1, p. 366 (Solander).

alba.	*Picea alba.*
inops.	**Pinus virginiana.**
nigra.	*Picea nigra.*
pendula.	*Larix americana.*
Pinaster.	**Pinus maritima,** Miller.
resinosa.	— **resinosa.**
sylvestris, var. *divaricata.*	— **divaricata.**
sylvestris, var. *maritima.*	— **Laricio.**
sylvestris, var. *montana.*	— **montana.**
Taeda, var. *alopecuroides.*	— **serotina.**
Taeda rigida.	— **Taeda.**
Taeda, var. *variabilis.*	— **echinata.**

1790. Castiglione, Viagg.

silvestris, var. *novocæsariensis.*	——?
Taeda, var. *echinata.*	**Pinus echinata.**
Taeda, var. *palustris.*	— **palustris.**

Loureiro, Flora Cochinchin.

Abies.	*Cunninghamia sinensis.*
sylvestris.	**Pinus Merkusii.**
sylvestris.	— **Massoniana.**

1791. Haenke, in Jirasek, Beobacht. p. 68.

Pumilio.	— **montana.**

Hoffmann, Deutschl. Flora.

montana.	— **sylvestris.**

1792. Gilibert, Exercit. Phyt. ii. p. 414.

P. binato folio.	— **sylvestris.**

1794. Moench, Method. Plant.

tetragona.	*Picea alba.*

1795. Santi, Viagg. p. 59.

Laricio.	**Pinus maritima** (Miller).

1796. Salisbury, Prod.	
borealis.	**Pinus sylvestris.**
effusa.	*Cedrus Libani.*
fastuosa.	**Pinus Pinea.**
glomerata.	— **maritima,** Miller.
læta.	*Larix decidua.*
longifolia.	**Pinus palustris.**
lucida.	*Abies pectinata.*
pendula.	*Larix americana.*
pyramidalis.	*Picea excelsa.*
taxifolia.	*Abies balsamea.*
tenuifolia.	**Pinus Strobus.**
1797. Swartz, Prod. Fl. Ind. Occ. p. 103.	
	— **occidentalis.**
1798. Savi, Flora Pisana, ii. p. 354.	
Laricio.	— **maritima,** Miller.
resinosa.	— **sylvestris.**
1800. Du Roi, Baumz. ed. Pott, vol. ii.	
intermedia.	*Larix americana.*
1801. Duhamel, Traité Arb. i.	
resinosa.	**Pinus Laricio,** var. **pyrenaica**?
1802. Dumont de Courset, Bot. i.	
	— **divaricata.**
1803. Michaux, Flora Bor.-Am. ii. p. 204.	
mitis.	— **echinata.**
rubra.	— **resinosa.**
rupestris.	— **divaricata.**
Lambert, Pinus, ed. 1.	
Banksiana.	— **divaricata.**
Dammara.	*Agathis loranthifolia.*
lanceolata.	*Cunninghamia sinensis.*
longifolia (not of Salisbury).	*Roxburghii,* Sargent?
taxifolia.	*Pseudotsuga Douglasii.*
variabilis.	**Pinus echinata.**
Poiret, in Lam. Encycl. Méth. v.	
alepensis.	— **halepensis.**
Mugho.	— **montana.**
Hudsoni.	— **divaricata.**
	— **Laricio.**
	— **maritima.**
	— **Taeda.**
	— **virginiana.**

1805. Ramond, in DC. Flore Franç.

uncinata.	**Pinus montana.**

1808. Marschall v. Bieberstein, Fl. Taur.-Cauc. ii.

halepensis.	— **Laricio.**
Pinea.	— **Laricio.**

1809. Besser, Flora Galic. ii. p. 294.

Pinaster.	— **Laricio.**

Roemer, Collect. p. 158.

baldensis.	*Abies pectinata.*

1810. Thore, Promenade en Gascogne.

? *ericetorum.*	
syrtica.	**Pinus maritima,** Miller.

Aiton, Hort. Kew. ed. 2 (Dryander).

maritima.	— **Laricio,** var.

Michaux fil., Hist. Arb. Am. i.

australis.	— **palustris.**
	— **pungens.**
rubra.	— **resinosa.**
rupestris.	— **divaricata.**

1811. Dumont de Courset, Bot. Cult. ed. 2, vi.

australis.	—— ?

1812. Loiseleur, in Nouv. Duhamel, ii.

californiana.	**Pinus radiata.**

1813. Lapeyrouse, Hist. Pl. Pyren.

penicillus.	— **Laricio,** var. **pyrenaica.**
sanguinea.	— **montana,** var.

R. Brown, in Aiton, Hort. Kew. ed. 2, vol. v.

Taeda β. alopecuroidea.	— **serotina.**
maritima.	— **Laricio.**

1814. Roxburgh, Hort. Bengal.

longifolia.	— **longifolia**
Deodora.	*Cedrus Libani.*

Pursh, Flora Am. Sept.

variabilis.	**Pinus mitis.**
Fraseri.	*Abies Fraseri.*

1815. Bosc, ex Desfontaines, Tableau, ed. 2.

adunca.	? **Pinus radiata.**

1816. Baumgarten, Enum. Pl. Transilv.

silvestris.	— **Laricio.**

Poiret, Encycl. Méth. Suppl.

adunca.	— **radiata.**

1817. Kunth, in Humboldt et Bonpland, Nov. Gen.
occidentalis. **Pinus Montezumæ.**
hirtella. *Abies religiosa.*
religiosa. *Abies religiosa.*

Cels, Cat. Arbres.
romeniaca. **Pinus Laricio.**

1818. Lapeyrouse, Hist. abrég. Pl. Pyrén.
pyrenaica. — **Laricio,** var. **pyrenaica.**

1819. Hamilton (*formerly* Buchanan), Account of Nepal.
— **excelsa.**

1820. Torrey, in Ann. Lyc. N. York.
resinosa. — **ponderosa.**

1821. Steudel, Nomenclator, i. p. 621.
americana. *Larix americana.*

1822. Bosc, in Nouv. Cours d'Agric, xi.
squamosa. **Pinus montana,** var. **uncinata.**

1823. James, in Long's Exped.
— **flexilis.**

1824. Elliott, Sketch.
Taeda heterophylla. — **cubensis** (*heterophylla*).

Lambert, Pinus, ed. 2.
excelsa. *Picea excelsa.*
Menziesii. *Picea Sitchensis.*
microcarpa. *Larix americana.*
Pallasiana. **Pinus Laricio,** var.
rubra. *Picea nigra.*
spectabilis. *Abies Webbiana.*
variabilis. **Pinus inops.**
— **Massoniana.**

1825. Don, Prod. Fl. Nepal.
dumosa. *Tsuga Brunoniana.*
tinctoria. *Abies Webbiana.*

Buch, Phys. Beschr. Canar. Ins.
Pinus canariensis.

Mirbel, Mém. Mus. Par. xiii.
sumatrana. — **Merkusii.**

1826. Sieber *ex* Sprengel, Syst. iii. p. 886.
arabica. — **halepensis.**

Risso, Hist. Nat. Europ. Mérid.
escarena. — **maritima** (Miller).

1827. Douglas, in Trans. Linn. Soc. Lond. xv.
Pinus Lambertiana.

Vellozo, Flora Flum. x.
dioica. — *Araucaria brasiliensis.*

Link, Abhandl. Akad. Berlin.
humilis. — **Pinus sylvestris.**
— **Cembra.**
nigra. — **— Laricio**, var.
rotundata. — **— montana.**
— Pinea.

Moris, Stirp. Sard. Elench.
Pinaster. — **— Laricio.**

1828. Wallich, Cat.
Finlaysoniana. — **— Merkusii.**

Don, in Lambert, Pinus, ed. 2.
Banksiana. — **— divaricata.**
— Massoniana.
— excelsa.
— Gerardiana.
Douglasi. — *Pseudotsuga Douglasi.*
Webbiana. — *Abies Webbiana.*

Link, in Flora, xi. p. 32.
austriaca. — **Pinus Laricio**, var.

Torrey, in Ann. Lyc. N. York.
resinosa. — **— ponderosa.**

1830. Loudon, Hort. Brit.
cœrulea. — *Picea alba.*

Link, Abhandl. Akad. Berlin.
humilis. — **Pinus sylvestris.**
nigra. — **— Laricio.**
rotundata. — **— montana.**

Host, Anleit. p. 6.
austriaca. — **— Laricio**, var.

Chamisso et Schlechtendal, in Linnæa, v.
— Teocote.

Siebold, in Verhandl. Ned. Bat. Genootsch. xii.
rubra. — **— Thunbergii.**
verticillata. — *Sciadopitys verticillata.*

Reichenbach, Flora Excurs.
obliqua. — **Pinus montana.**

1831. Bongard, Mém. Phys.-Math. St. Pétersb.
inops. **Pinus contorta.**

Host, Flora Austriaca, ii.
nigricans. — **Laricio**, var.

Tenore, Syll. Flora Neap.
conglomerata. — **bruttia** ?

1832. Schlechtendal et Chamisso, in Linnæa, vi.
— **leiophylla.**

Loudon, Hort. Brit.
rigensis. — **sylvestris.**

Zuccarini, in Abhandl. Akad. München, i.
— **cembroides.**

Lambert, Pinus, ed. 3.
Kaempferi. *Pseudolarix Kaempferi.*

Wallich, Plant. Asiat. Rar. iii.
Brunoniana. *Tsuga Brunoniana.*

1833. Douglas, in Trans. Linn. Soc. xvi.
Pinus Sabiniana.

Hook. et Arnott, Bot. Beechey's Voy.
rigida. — **radiata.**

Bongard, in Mém. Acad. St. Pétersb.
canadensis. *Tsuga Mertensiana.*
Mertensiana. *Tsuga Mertensiana.*
sitchensis. *Picea sitchensis.*

1834. Uspensky, Bull. Soc. Nat. Mosc. vii.
Cedrus. **Pinus Cembra.**

1835. Bentham, in Trans. Hort. Soc. Lond. ser. 2, i. p. 512.
Lemoniana. — **maritima** (Miller), var.

Tenore, Flora Nap. v. p. 366.
nigrescens. — **Laricio.**

1836. Douglas, in Hook. Comp. Bot. Mag. ii.
amabilis. *Abies amabilis.*
grandis. *A. grandis.*
nobilis. *A. nobilis.*
Pinus ponderosa.
venusta. *Abies bracteata.*
Pinus Sabiniana.

1836. Loddiges, Cat.	
Chylla.	**Pinus excelsa.**
Fischeri.	— **montana.**
Fraseri.	— **rigida.**
intermedia.	*Larix leptolepis.*
Pichta.	*Abies sibirica.*
scariosa.	**Pinus sylvestris.**
taurica.	— **Laricio**, var.
D. Don, in Trans. Linn. Soc. Lond. xvii.	
insignis.	— **radiata.**
tuberculata.	— **radiata.**
	— **muricata.**
	— **monticola.**
	— **Coulteri.**
1837. Blume, Rumphia, iii.	
Finlaysoniana.	— **Merkusii** ?
Wallich, in Lambert, Pinus, ed. 2, vol. iii.	
	— **Gerardiana.**
Don, in Lambert, Pinus, ed. 2, vol. iii.	
	— **monticola.**
Smithiana.	*Picea Morinda.*
Koch, Synops. Floræ Germ.	
maritima.	**Pinus Laricio**, var. **austriaca.**
Bon Jardinier, p. 974.	
caramanensis.	— **Laricio**, var.
serotina.	— ? **palustris.**
Blanco, Flora Filip.	
Tæda.	— **insularis.**
1838. Loudon, Arboretum.	
australis.	— **palustris.**
Cembra pygmæa.	— **Cembra**, var.
corsicana.	— **Laricio.**
insignis.	— **radiata.**
Pinaster.	— **Thunbergii.**
rigida, var.	— **serotina.**
squamosa.	— **montana.**
timoriensis.	— **insularis.**
	— **contorta.**
	— **ponderosa.**
Schiede, in Linnæa, xii.	
	— **oocarpa.**
	— **patula.**
Llaveana.	— **cembroides.**

1838. Ehrenberg, in Linnæa, xii.
Pinus Ayacuite.

Steven, in Bull. Soc. Nat. Mosc. xi.
hamata. — **sylvestris**, var.
Nordmanniana. *Abies Nordmanniana.*
Pithyusa. **Pinus halepensis.**

Fischer, Bull. Soc. Nat. Mosc. xi.
dahurica. *Larix dahurica.*

Neumann *ex* Wimmer, Breslau. Uebers.
uliginosa. **Pinus montana.**

Turczaninow, Bull. Soc. Nat. Mosc. xi.
obovata. *Picea orientalis.*
sibirica. *Abies sibirica.*

Hooker, Flora Bor.-Amer. ii.
inops. **Pinus contorta.**
Lambertiana β. — **flexilis.**
lasiocarpa. *Abies lasiocarpa.*
resinosa, partly. **Pinus ponderosa.**

1839. Loudon, Hort. Brit. Suppl. ii.
minor. — **halepensis.**

Lindley, Bot. Reg. Misc. xxv.
Devoniana. — **Montezumæ.**
macrophylla. — **Montezumæ.**
— **Hartwegi.**
Russelliana. — **Montezumæ.**
— **apulcensis** ?
— **pseudostrobus.**

Forbes, Pinetum Woburnense.
Gerardi. — **Gerardiana.**
japonica. — **densiflora.**

Royle, Ill. Plant. Himal.
Khutrow. *Picea Morinda.*
Pindrow. *Abies Webbiana.*

Strangeways, in Loudon, Gard. Mag. xiv
persica. **Pinus halepensis.**

G. Don, in Sweet, Hort. Brit. ed. 3.
— **acapulcensis.**

1840. Antoine, Conif.

Apollinis.	*Abies cephalonica.*
bifida.	*Abies firma.*
homolepis.	*Abies homolepis.*
jezoensis.	*Picea sitchensis.*
marylandica.	*Picea nigra.*
Naphta.	*Abies Pindrow.*
obovata.	*Picea obovata.*
polita.	*Picea polita.*
pyramidalis.	**Pinus montana.**
Schrenkiana.	*Picea orientalis.*

Lindley, Bot. Reg. xxvi., Misc.

macrocarpa.	**Pinus Coulteri.**

Strangeways, *ex* Gordon, in Loudon, Gard. Mag. xvi.

Pithyusa.	— **halepensis.**
tortuosa.	— **sylvestris.**

1841. Steudel, Nomenclator, ed. 2.

australis hort.	— **halepensis.**
denticulata.	—— ?
pseudolarix.	*Larix leptolepis.*
scarina.	**Pinus maritima** (Miller).
tortuosa.	*Picea nigra.*
Tsuga.	*Tsuga Sieboldi.*
uncinata.	—— ?

Royle, in Loudon, Gard. Mag. xvi.

	Pinus Khasya.

Hook. et Arnott, Bot. Beechey's Voy.

rigida.	— **radiata.**
Sinclairii.	— **ponderosa** and *insignis* (*radiata*).

Parolini, Hort. Bot. Parol.

Pallasii.	— **Laricio,** var.

1842. Bentham, Pl. Hartweg.

	— **tenuifolia.**

Endlicher, Cat. Hort. Vindob. i.

cephalonica.	*Abies cephalonica.*

Visiani, Flora Dalmat.

dalmatica.	**Pinus Laricio.**

Loudon, Encycl. Trees, p. 1013.

oocarpoides (Bentham).	— **oocarpa.**
	— **contorta.**

1842. Bosc, *ex* Loudon, Encycl. Trees, p. 975.
turbinata. **Pinus inops** ?

Grisebach, Spicil. Floræ Rumel. ii.
— **Peuke.**

Spach, Hist. Vég. xi.
Laricio γ. — **resinosa.**

Siebold & Zuccarini, Flora Jap. ii.
— **parviflora.**
— **densiflora.**
Massoniana (not of Lambert). — **Thunbergii.**
— **koraiensis.**

D. Don, in Lambert, Pinus, ed. 2.
— **Massoniana.**

1843. Koch, Synops. Floræ Germ. ed. 2.
maritima. — **Laricio**, var.

1845. Blanco, Flora Filip. ed. 2.
Taeda. — **insularis.**

De Vriese, Plant. Nov. Ind. Bat. v.
— **Merkusii.**

Torrey, in Frémont, Report, p. 319.
— **monophylla.**

De Chambray, Traité Arb. Resin. p. 342.
nepalensis. — **excelsa.**

Tenore, Cat. Hort. Neap. p. 90.
Hamiltoni. — **maritima**, *Pinaster.*

Schouw, in Ann. Sc. Nat. 3e Sér. iii. p. 233.
majellensis. — **montana.**

1846. Hartweg, in Journ. Hort. Soc. i.
californica. — **tuberculata** (Don).
insignis, var. *macrocarpa.* — **radiata.**
tuberculata, Gordon. — **attenuata** (Lemmon).

Gordon, in Journ. Hort. Soc. i.
cembroides. — **edulis.**
Orizabæ. — **pseudostrobus.**

Torrey, Report Whipple, p. 141.
Engelmanni (not of Carrière). — **ponderosa.**

1847. Endlicher, Synopsis.

Araragi.	*Tsuga Sieboldi.*
atlantica.	*Cedrus Libani*, var.
Lambertiana, var. *brevifolia.*	**Pinus flexilis.**
Ehrenbergii.	— **Hartwegii.**
Fremontiana.	— **monophylla.**
kamtschatkica.	*Pseudolarix Kaempferi.*
Ledebourii.	*Larix leptolepis.*
Bungeana.	**Pinus Bungeana.**
uncinata, var. *rostrata.*	— **montana.**
	— **insularis.**
Pallasiana.	— **Laricio**, var.
pygmæa.	— **Cembra.**
scotica.	— **sylvestris.**
sinensis.	— **Khasya**, partly.

Gordon, in Journ. Hort. Soc. ii.

Grenvilleæ.	— **Montezumæ.**
Wincesteriana.	— **Montezumæ.**

Hartweg, in Journ. Hort. Soc. ii.

Benthamiana.	— **ponderosa.**
californica.	— **radiata.**
Gordoniana.	— **Montezumæ.**

Griffith, Travels, i.

pendula.	— **excelsa.**

Griffith, Notul.?

spinulosa.	— **excelsa** ?

Presl, Epimel. Bot.

heterophylla.	— **parviflora.**

1848. Engelmann, in Wislizenus, Tour Mexico.

	— **chihuahuana.**
brachyptera.	— **ponderosa.**
macrophylla.	— **Engelmanni.**
osteosperma.	— **cembroides.**
strobiformis.	— ? **Ayacuite** or **strobiformis.**

Hartweg, in Journ. Hort. Soc. iii. p. 217.

Edgariana.	— **muricata.**

1849. Nuttall, Sylva, iii.

Strobus β. monticola.	— **monticola.**

1849. Gordon, in Journ. Hort. Soc. iv.

Fremontiana.	**Pinus edulis.**
tuberculata.	— **attenuata**, Lemmon.

Koch, in Linnæa, xxii.

armena.	— **sylvestris.**
heterophylla.	
pontica.	— **sylvestris.**

Klotzsch, in Linnæa, xxii.

Kochiana.	— **sylvestris**, var. **hamata.**

Mason, in Journ. Asiat. Soc. Bengal, i. p. 74.

Latteri.	— **Merkusii.**

Kalenisch, in Bull. Soc. Nat. Mosc. i.

cretacea?

squarrosa?

1850. Royle, *ex* Lindl. & Gordon, Journ. Hort. Soc. v.

nepalensis.	— **maritima** (Miller).

Lindley & Gordon, *l. c.*

Banksiana (not of Lambert).	— **contorta.**
excorticata.	— **Bungeana.**

Loudon, *ex* Lindl. & Gordon, *l. c.*

Lindleyana.	— **Montezumæ.**

1851. Salzmann, *ex* Dunal, Mém. Acad. Montpell. ii. p. 82.

monspeliensis.	— **maritima** (Miller).
Salzmanni.	— **Laricio**, var.

1853. Torrey, in Sitgreave's Report, p. 173.

macrophylla (not of Engelmann).	— **ponderosa**, var. **scopulorum.**

Murray, A., Oregon Report.

flexilis (not of James).	— **albicaulis.**
Jeffreyi.	— **ponderosa**, var., or distinct species?
	— **Balfouriana.**
Murrayana.	— **contorta**, var.

Antoine & Kotschy, in Oesterr. Bot. Wochenbl.

cilicica.	*Abies cilicica.*

1854. Miquel, in Zollinger, Syst. Verz. Ind. Archipel. p. 82.

scopifera.	**Pinus densiflora.**

Tenore, Ind. Sem. Hort. Neap.

maderensis.	— **Pinea.**

Carrière, Rev. Hort. p. 225.

Boursieri.	— **contorta.**
	— **Engelmanni.**

1854. MacClelland, in Griff. Notul. iv. p. 17.	
Griffithii.	**Pinus excelsa.**
1855. P. Lawson, Cat.	
MacIntoshiana.	— **contorta.**
Carrière, Traité, ed. 1.	
abasica.	— **halepensis.**
abchasica.	— **halepensis.**
altissima, hort.	— **Laricio.**
altissima (Ledebour).	— **sylvestris.**
Boursieri.	— **contorta.**
cinerea, Roehl. Deutschl. Fl., *ex* Carr.	*Picea excelsa.*
decidua, Wall. *ex* Carrière.	*Tsuga Brunoniana.*
Dicksoni, hort.	**Pinus excelsa.**
echinata.	— **montana.**
genevensis, hort.	— **sylvestris.**
japonica, hort.	— **maritima.**
Loiseleuriana.	— **pyrenaica.**
monteragensis.	— **radiata.**
nivea, Booth.	— **Strobus.**
orientalis, Frivaldsky *ex* Carrière.	*Picea excelsa.*
Paroliniana.	**Pinus halepensis.**
pseudohalepensis.	— **pyrenaica.**
Sinclairiana.	— **ponderosa.**
tatarica, hort.	— **Laricio.**
Grenier & Godron, Flore Franç. iii. p. 153.	
	— **Laricio**, var. **cebennensis.**
Jamieson, *ex* Lindl. in Journ. Hort. Soc. ix.	
Royleana.	— **echinata.**
Murray, A., in Edinb. New Phil. Journ. i.	
Beardsleyi.	— **ponderosa.**
Craigana.	— **ponderosa.**
Wood, Bot. Class-Book.	
montana.	— **pungens.**
1856. Torrey, Pacific Rail. Report, iv.	
cembroides.	— **albicaulis.**
Engelmanni, not of Carrière.	— **ponderosa.**
Visiani, in Mem. Ist. Venet. vi.	
	— **Laricio.**

1857. Roezl, Cat. Sem. Conif. Mex. *fide* Index Kewensis.

amecaensis.	**Pinus Hartwegi.**
angulata.	**— Montezumæ.**
Antoineana.	**— pseudostrobus.**
aztecaensis.	**— Montezumæ.**
Besseriana.	**— Teocote.**
Boothiana.	**— Montezumæ.**
Boucheiana.	**— Montezumæ.**
bullata.	**— Montezumæ.**
Buonapartea.	**— Ayacuite.**
Carrierei.	**— Montezumæ.**
Cedrus.	**— leiophylla.**
chalmaensis.	**— Montezumæ.**
coarctata.	**— Montezumæ.**
Comonfortii.	**— leiophylla.**
Decaisneana.	**— Montezumæ.**
De Candolleana.	**— Montezumæ.**
depauperata, ex Gordon, Suppl.	**— Montezumæ.**
dependens.	**— leiophylla.**
Doelleriana.	**— Montezumæ.**
Don Pedri.	**— Ayacuite.**
durangensis.	**— Ayacuite.**
Ehrenbergii.	**— leiophylla.**
elegans.	**— Montezumæ.**
Endlicheriana.	**— Hartwegii.**
Escandoniana.	**— pseudostrobus.**
exserta.	**— pseudostrobus.**
gracilis.	**— leiophylla.**
grandis.	**— Montezumæ.**
Haageana.	**— Montezumæ.**
hamata.	**— Ayacuite.**
Hendersoni.	**— Montezumæ.**
heteromorpha.	**— pseudostrobus.**
horizontalis.	**— Montezumæ.**
Hoseriana.	**— pseudostrobus.**
husquilucaensis.	**— leiophylla.**
inflexa.	**— Montezumæ.**
interposita, ex Gord. Suppl.	**— Teocote.**
Istacihuatlii.	**— Hartwegi.**
Jostii.	**— filifolia.**
Kegelii.	**— Teocote.**
Keteleerii.	**— Montezumæ.**
Lerdoi.	**— leiophylla.**

1857. Roezl, Cat. (*con.*).

Leroyi.	**Pinus Montezumæ.**
longifolia, ex Hemsley.	**— Hartwegii.**
Lowii.	**— Hartwegii.**
magnifica.	**— Montezumæ.**
michocaensis.	**— Montezumæ.**
microcarpa.	**— Teocote.**
monstrosa.	**— Montezumæ.**
Monti-Allegri.	**— leiophylla.**
Mulleriana.	**— Teocote.**
Ne plus ultra.	**— Montezumæ.**
Nesselrodiana.	**— Montezumæ.**
nitida.	**— Montezumæ.**
Northumberlandiana.	**— Montezumæ.**
Ocampi.	**— Montezumæ.**
Ocote.	**— Montezumæ.**
Ocotechino, ex Parlat.	**— leiophylla.**
Ortgiesiana.	**— Montezumæ.**
Otteana, ex Vilmorin.	**— Teocote.**
Papeleui.	**— Hartwegii.**
Paulikowskyana.	**— Montezumæ.**
Paxtoni.	**— Montezumæ.**
Pescatorei, ex Vilmorin.	— —— ?
Planchoni.	**— Montezumæ.**
Popocatepetlii.	**— Ayacuite.**
prasina.	**— pseudostrobus.**
protuberans.	**— pseudostrobus.**
Regeliana.	**— pseudostrobus.**
resinosa.	**— Hartwegii.**
retracta.	**— Montezumæ.**
Richardiana.	**— Montezumæ.**
Rinzii.	**— Montezumæ.**
robusta.	**— Hartwegii.**
Rohanni.	— —— ?
rubescens.	**— Montezumæ.**
rudis.	**— pseudostrobus.**
rumeliana.	**— Montezumæ.**
sanrafaeliana.	**— Montezumæ.**
scoparia.	**— Hartwegii.**
Soulangeana.	**— Montezumæ.**
spinosa.	**— Montezumæ.**
Standishii.	**— Hartwegii.**
suffruticosa, ex Gordon.	**— Hartwegii.**
tenangaensis.	**— Montezumæ.**
Thelemanni.	**— Montezumæ.**

1857. Roezl, Cat. (*con.*).	
Thibautiana.	**Pinus Montezumæ.**
Troubetzkoiana.	— **Montezumæ.**
tumida, ex Gordon.	— **Teocote.**
tzompoliana.	— **pseudostrobus.**
valida.	— **Montezumæ.**
Van Geerti.	— **Montezumæ.**
Van Houttei.	— **Montezumæ.**
Veitchii.	— **Ayacuite.**
verrucosa.	— **leiophylla.**
Verschaffelti.	— **Montezumæ.**
Vilmoriniana.	— **Teocote.**
Wilsoni.	— **Montezumæ.**
Zacattanæ.	— **Montezumæ.**
zamoriensis.	— **filifolia.**
Zitacuarii.	— **Montezumæ.**
Newberry, Pacific Rail. Report.	
cembroides (not of Zuccarini).	— **albicaulis.**
Tenore, Ind. Sem. *ex* Parlatore.	
	— **pseudotaeda.**
Ruprecht, Bull. Acad. St. Pétersb. xv.	
mandshurica.	— **Cembra**, var.
Bentham, Pl. Hartweg. p. 337.	
inops, var. (not of Aiton).	— **contorta.**
1858. Gordon, Pinetum, i. p. 202.	
alopecuroides.	— **serotina.**
aracanensis, Knight.	— **Pinea.**
Aucklandi, Loddiges.	— **Gerardiana.**
cairica.	— **halepensis.**
calabrica, hort.	— **Laricio.**
chinensis, Knight.	— **maritima** (Miller).
caucasica, Fischer.	— **sylvestris.**
cebennensis.	— **Laricio.**
colchica, Booth.	— **halepensis.**
concolor.	*Abies concolor.*
cubensis.	**Pinus occidentalis.**
divaricata (Banksiana).	— **divaricata.**
durangensis, *Roezl.*	— **Ayacuite.**
erzerumica.	— **sylvestris.**
georgica, hort.	— **palustris.**
lutea.	— **echinata.**
Loudoniana.	— **Ayacuite.**

1858.	Gordon, Pinetum (*con.*).	
	Massoniana.	**Pinus maritima** (Miller).
	Montereyensis(*insignis*).	— **radiata.**
	Montezumæ.	— **Hartwegii.**
	Morinda.	*Picea Morinda.*
	neglecta, Low.	**Pinus maritima** (Miller).
	Pinea.	— **Thunbergii.**
	Novæ-Hollandiæ, Loddiges.	— **maritima** (Miller).
	nummularia.	*Larix leptolepis.*
	Padufia, Ledebour.	**Pinus sylvestris.**
	Parryana.	— **ponderosa.**
	Pinceana ?	
	Poiretiana.	— **Laricio.**
	pseudostrobus.	— **Montezumæ.**
	pyramidalis.	— **Laricio.**
	Roezl, in Gard. Chron. 1858, p. 358.	
	Bonapartea.	— **Ayacuite.**
	pinea ?	
	Regel, Cat. Sem. Hort. Petersb.	
	pumila.	— **Cembra,** var. **pumila.**
1859.	Wichura, in Flora, xlii.	
	Friesiana.	— **sylvestris.**
	Torrey, Mexican Boundary Report.	
	deflexa.	— **Jeffreyi** ?
	Llaveana (not of Schlecht.).	— **quadrifolia.**
	Torreyana, Parry.	— **Torreyana.**
1860.	Lindley, in Gard. Chron. 1860, p. 46.	
	lophosperma.	— **Torreyana.**
	A. Murray, in Edinb. Phil. Journ. xi.	
	Jeffreyi.	— **ponderosa,** var., or distinct species.
	Murrayana.	— **contorta,** var.
	Torrey, in Ives's Report.	
	edulis, var. *monophylla.*	— **monophylla.**
1861.	Miquel, in Journ. Bot. Néerl. i. p. 86.	
	canaliculata ?	—— ?
1862.	Engelmann, in Wheeler's Bot. Rep.	
		— **arizonica.**
		— **aristata.**
	Engelmann, in Amer. Journ. Science, xxxiv.	
	aristata, see *ante*.	
	Parryana (not of Gordon).	— **Parryana.**
	ponderosa.	— **ponderosa,** var. **scopulorum.**

1862. Gordon, Pinetum, Suppl. i.

atrovirens, Roezl.	**Pinus Hartwegii.**
Backhouseana, Roezl.	— **Montezumæ.**
Boothiana, Roezl.	— **Montezumæ.**
Calochote, Roezl.	— **Teocote.**
chalmaensis, Roezl.	— **Montezumæ.**
cornea, Roezl.	— **Montezumæ.**
corrugata, Roezl.	— **Montezumæ.**
depauperata.	— **Montezumæ.**
Galochote, Roezl (*supra*).	— **Teocote.**
Geitneri, Roezl.	— **Hartwegii.**
fertilis, Roezl.	— **cembroides.**
? *frondosa*, Roezl.	— **Hartwegii.**
Kegelii.	— **Teocote.**
Krelagei.	— **Hartwegii.**
Lawsoni.	— —— ?
nootkatensis.	— **ponderosa.**
Ocote, Roezl.	— **Montezumæ.**
Palmieri.	— **palustris.**
Patrinensis.	— **palustris.**
Paulikowskyana, Roezl.	— **Montezumæ.**
rubra.	— **densiflora.**
Skinneri.	— **filifolia.**
subpatula.	— **patula.**
suffrutiosa, Roezl.	— **Hartwegii.**
tlamacaensis.	— **Hartwegii.**
tomacaensis.	— **Montezumæ.**
tumida.	— **Teocote.**
zamoruensis.	— —— ?

Provancher, Flore Canadienne.

alba canadensis.	— **Strobus.**

1863. Christ, in Verh. Naturf. Ges. Basel, iii.

Heldreichii.	— **Laricio**, var.

Engelmann, Trans. Acad. St. Louis, ii.

aristata.	— **Balfouriana**, var., or distinct species.

Grisebach, Mem. Amer. Acad. viii.

— **cubensis** (Wrightii, *Engelm.*).

1864. Antoine et Kotschy, *ex* Rev. Hort.

Fenzlii.	— **Laricio**, var.

Antoine, in Oesterr. Bot. Zeit. xiv.

leucodermis.	— **Laricio**, var.

Grisebach, Flora Brit. W. Indies.

— **bahamensis.**

1865. Henkel & Hochstetter, Conif.

Tschugatskoi. — *Abies cilicica.*

1866. Bolander, in Proc. Calif. Acad. iii.

muricata. — **Pinus contorta.**

Grisebach, Cat. Plant. Cubens.

cubensis, var. terthrocarpa. — **P. terthrocarpa,** Shaw (1903).

A. Murray, in Lawson, Pinet. Brit.

porphyrocarpa. — **Pinus monticola.**

Neilreich, Nachträge Fl. von Nied. Oesterr.

virescens. — *Picea alba.*

Schur, Enum. Plant. Transsilv.

montana. — *Picea excelsa.*

subarctica. — **Pinus montana.**

1867. Carrière, Traité, ed. 2.

arctica, hort. p. 456.	— **Pinea.**
Cavendishiana.	— **Massoniana** (sinensis).
clamaensis.	— **Hartwegii.**
detritis, hort.	— **maritima** (Miller).
fragilis.	— **Pinea.**
Ghiesbreghtii, hort. p. 426.	—— ?
humistrata.	— **Cembra,** var.
japonica, hort. p. 457.	— **Pinea.**
Massoniana, hort. ex Gordon.	— **maritima** (Miller).
nivea, hort.	— **monticola.**
Novæ-Hollandiæ (*Lodd.*)	— **maritima** (Miller).
parviflora.	— **parviflora.**
pentaphylla.	— **parviflora.**
Roezlii.	— **Hartwegii.**
ruthenica.	— **inops.**
Sanctæ Helenicæ.	— **maritima** (Miller).
Shasta.	— **albicaulis.**
sibirica.	*Larix dahurica.*
sudetica.	**Pinus montana.**
tabuliformis.	— **Thunbergii.**

Parlatore, Flora Ital. iv.

Laricio β. nigricans. — **Laricio.**

1868. Parlatore, in DC. Prod. xvi. 2.

Alcoquiana.	*Picea Alcockiana.*
amabilis.	*Abies concolor.*
bicolor (Maximowicz).	*Picea Alcockiana.*
Bolanderi.	**Pinus contorta.**

1868. Parlatore, in DC. Prod. xvi. 2 (*con.*).

brachyphylla.	*Abies brachyphylla.*
Cavendishiana?	**Pinus Khasya.**
commutata.	*Picea Engelmanni.*
colorado.	**Pinus Ayacuite.**
falciformis.	*Podocarpus* sp.
Finnhonoskiana.	*Abies homolepis.*
Fortunei.	*Keteleeria Fortunei.*
Greggi (Engelmann, MS.).	—— ?
Griffithii.	*Larix Griffithii.*
hayuenoviensis.	**Pinus sylvestris.**
holophylla.	*Abies firma.*
hudsonica.	**Pinus divaricata.**
japonica.	— **maritima** (Miller).
Kasya.	— **Khasya.**
Lyalli.	*Larix Lyalli.*
Maximowiczii.	*Picea Maximowiczii.*
monophylla.	**Pinus sylvestris,** forma.
Nuttalli, Parl.	*Larix occidentalis.*
Ocotechino, Roezl.	**Pinus leiophylla.**
Pattoniana.	*Tsuga Pattoniana.*
quadrifolia.	**Pinus Parryana.**
saskatchewanensis.	— **contorta.**
selenolepis.	*Abies Veitchii.*
Tshonoskiana.	*Abies homolepis.*

1869. Carrière, in Rev. Hortic. p. 126, fig.

Grozelieri.	**Pinus monticola.**

A. Murray, in Gard. Chron.

Tamrac.	— **contorta.**

Wood, Class-Book, p. 663.

mitis, β. pauper.	— **glabra.**

1871. S. Watson, in King's Report, v. p. 331.

contorta latifolia.	— **contorta,** var. **Murrayana.**

1873. Karl Koch, Dendrol. ii. p. 270 *et seq.*

africana.	— **Pinea.**
armena.	— **sylvestris.**
hagenavensis.	— **sylvestris.**
helenica, hort.	— **maritima** (Miller).
pumila.	— **sylvestris.**
pygmæa.	— **sylvestris.**
Reginæ Ameliæ.	*Abies Apollinis.*
rostrata.	**Pinus montana.**
tabulæformis.	— **Strobus.**
tatarica.	— **halepensis.**
umbraculifera, hort.	— **Strobus.**

1875. Gordon, Pinetum, ed. 2.

Merkiana.	**Pinus Merkusii.**

Vasey, Report Agric. Dep. U.S. p. 178.

Benthamiana.	— **ponderosa,** var.
Bolanderi.	— **contorta.**
clausa.	— **clausa.**
Jeffreyi.	— **ponderosa.**

1876. Engelmann, Trans. Acad. St. Louis, iii.

subalpina.	*Abies lasiocarpa.*

McNab, in Proc. R. Irish Acad. ii.

baborensis.	*Abies numidica.*
Davidiana.	*Keteleeria Davidiana.*
firma.	*Abies brachyphylla.*
Harryana.	*Abies homolepis.*
Hookeriana.	*Tsuga Pattoniana.*
Lowiana.	*Abies concolor.*
magnifica.	*Abies magnifica.*
Pattoniana.	*Tsuga Mertensiana.*
Sieboldi.	*Tsuga Sieboldi.*
Veitchii.	*Abies Veitchii.*

Pančić, Oestl. Alp.

Omorika.	*Picea Omorika.*

Reichardt, in Verh. zool.-bot. Gesell. Wien.

	Pinus Neilreichiana.

1877. Engelmann, in Coult. Bot. Gazette, ii.

inops, var. clausa.	— **clausa.**

1878. Engelmann, in Wheeler's Exped. vi. p. 258.

Balfouriana, var. aristata.	— **aristata.**
flexilis, var. *reflexa.*	— **strobiformis.**
flexilis β. *macrocarpa.*	— **strobiformis.**
	— **arizonica.**

1880. Engelmann, in Trans. Acad. St. Louis, iv. p. 185.

Elliotti.	— **cubensis** or **bahamensis,** *teste* Shaw.
Wrightii.	— **cubensis.**
cubensis, *var.* terthrocarpa, *ex* Wright, in Griseb. Cat. Plant. Cubens. p. 217.	— **cubensis** = **terthrocarpa,** Shaw.

Engelmann, in Brewer & Watson, Bot. Calif. ii. p. 126.

	— **ponderosa,** var. **scopulorum.**
	— **contorta,** var. **Murrayana.**

1881. Masters, Journ. Linn. Soc., Bot. xviii.
Massoniana, hort. **Pinus densiflora.**

Maximowicz, in Bull. Acad. St. Pétersb. xxvii. p. 558.
— **leucosperma.**

1882. Engelmann, in Coult. Bot. Gazette, vii. p. 4.
reflexa. — **strobiformis.**

Engelmann, in Gard. Chron. 1882, Dec. 2, p. 712.
— latisquama (sp. dub.).

Rusby, in Bull. Torrey Bot. Club, ix. p. 80.
reflexa. — **flexilis.**

1883. Lemmon, in Erythea, i. p. 134.
Engelmanni, not of Torrey nor of Carrière. — **ponderosa,** var. **Mayriana.**

1884. Franchet, Plant. David. i. p. 285.
— **Armandi.**

Sargent, Forest Trees, p. 199.
— **clausa.**

1888. Lemmon, Report Calif. Board Forest, ii. p. 70.
insignis, var. radiata. — **radiata.**
lævigata. — **radiata.**
monticola, var. *minima.* — **monticola,** var.
Lambertiana, var. *minor.* — **Lambertiana,** var.
ponderosa, var. **Benthamiana.** — **ponderosa,** var.

Lemmon, West American Cone-bearers.
Var. **nigricans.** — **ponderosa.**

1889. Sargent, in Garden and Forest, ii. p. 496.
latifolia. — **ponderosa,** var. **Mayriana.**

1890. Mayr, Mon. Abiet. Japan.
Murrayana, var. *Sargenti.* — **contorta,** var. **Murrayana.**
— **pentaphylla.**
pumila, tab. vi. f. 21. — **Cembra** var.? or distinct species?

1891. M. E. Jones, in Zoe, p. 251.
monophylla, var. *edulis.* — **edulis.**

Beissner, Handbuch der Nadelholzkunde, contains a very carefully elaborated list of names and synonyms of cultivated species.

1892. Lemmon, Mining & Scientific Press, Jan. 16, *ex* Sargent.
Pinus attenuata.

Kellermann, in Coult. Bot. Gazette, xviii. p. 280.
rigida, *var.* lutea. — **rigida.**

1894. Lemmon, in Erythea, ii. p. 103.
Apacheca. — **ponderosa.**

1895. Lemmon, W. Amer. Cone-bearers, p. 22.
contorta. — **contorta,** var. **Hendersoni.**
Lambertiana. — **Lambertiana,** var. **purpurea.**
monticola. — **monticola,** var. **digitata.**
muricata. — **muricata,** var. **Anthonii.**

1896. Formanek, in Verhandl. d. Naturf. Verein in Brünn, xxxiv. p. 20.
pindica. — **Laricio,** var. **pindica.**

(Masters, in Gard. Chron. May 10, 1902, p. 302, fig.)

1897. Sargent, Silva, xli. p. 9.
aristata. — **Balhouriana,** var.
heterophylla. — **cubensis** or **bahamensis,** *teste* Shaw.
quadrifolia. — **Parryana.**
— **attenuata.**
Roxburghii. — **longifolia.**

Sudworth, Bull. 14, Forestry Dept.
Mayriana. — **ponderosa,** var. **maxima.**
var. *megalocarpa.* — **flexilis,** var.
quadrifolia. — **Parryana.**

Lemmon, in Garden and Forest, x. p. 183.
scopulorum. — **ponderosa,** var.

1898. Masters, in Bull. Herb. Boissier, vi.
— **scipioniformis.**

1899. Franchet, in Journal de Bot. p. 253, and Bois, in Journ. Soc. Nat. Hort. Paris, p. 230.
— **yunnanensis.**

1902. Masters, in Journ. Linn. Soc., Bot. xxvi. p. 550.
— **Henryi.**

1902. Medwejew, Tifliser botanischen Garten (1902), *ex* 'Le Jardin,' October 1903.

Pinus eldarica, sp. n.?

A species only known to me by the above reference. It is said to be like *P. bruttia* and *P. halepensis*, but differs from both.

1903. Rowlee, W. W., Bulletin Torrey Bot. Club, xxx. Feb. 1903, p. 107.

cubensis, var. *anomala*. **Pinus terthrocarpa** in part.
recurvata. — **bahamensis,** *teste* Shaw.

Shaw, in Sargent, Trees and Shrubs, i. p. 149.

— **terthrocarpa.**

EXPLANATION OF THE PLATES.

The photographic reproductions from the original slides were made by Mr. A. E. Smith, and show transverse sections of the leaves magnified 50 diameters.

Plate 20.

Fig. 1. *Pinus sylvestris*, section half-cylindric; resin-canals marginal, surrounded by stereome-cells; cells of the cortex plicated; endoderm of about 50 cells; meristele transversely oblong in section, somewhat depressed in the centre on the upper surface; fibro-vascular bundle branched, branches widely divergent.

Fig. 2. *Pinus Cembra*, section 3-sided; one resin-canal distinctly median, two others less so, but yet separated from the hypoderm by one layer of cortical cells, and therefore not truly marginal or subepidermal; canals surrounded by stereome; cells of cortex not plicated; endoderm of about 22 cells; meristele circular in section; fibro-vascular bundle simple.

Fig. 3. *Pinus cubensis*, showing 3-sided leaf, resin-canals internal; meristele somewhat triangular in section; fibro-vascular bundle simple or with two branches united.

Plate 21.

Fig. 4. *Pinus monophylla*, showing circular section, three layers of hypoderm; marginal resin-canals encircled by stereome; plicated mesophyll-cells; meristele circular, surrounded by an endoderm of about 60 cells; fibro-vascular bundle simple, with well-marked transverse bands of phloem and xylem and with scattered stereome-cells in the pericycle.

Fig. 5. *Pinus Donnell-Smithii*, leaf with one convex and two concave sides; hypoderm double; cortex-cells plicated; endoderm-cells about 36; meristele triangular; fibro-vascular bundle branched.

Fig. 6. *Pinus filifolia*, leaf 3-sided; hypoderm in two layers, with projecting processes; resin-canals median, surrounded by stereome; endoderm-cells about 30; meristele somewhat triangular; fibro-vascular bundle branched.

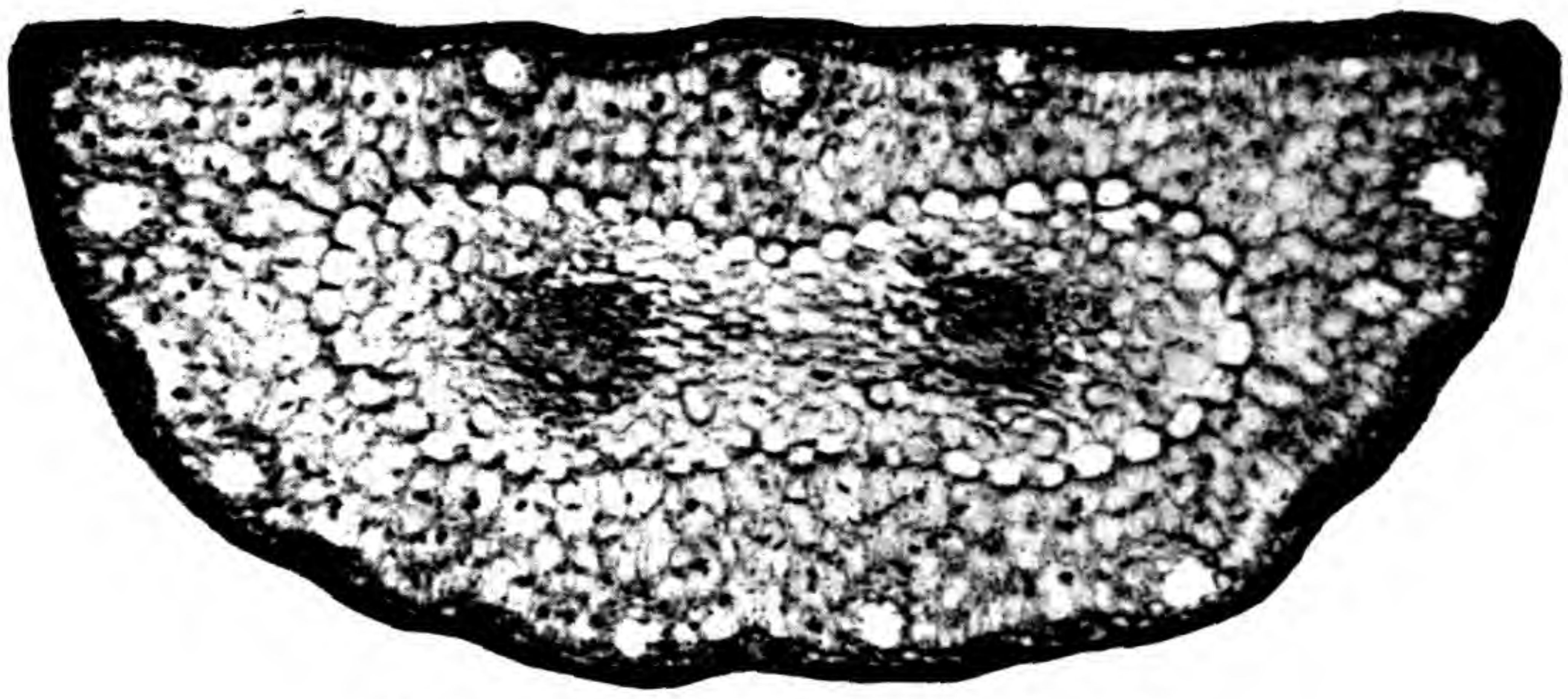


FIG. 1.—**Pinus sylvestris.**
Resin-canals, peripheral.

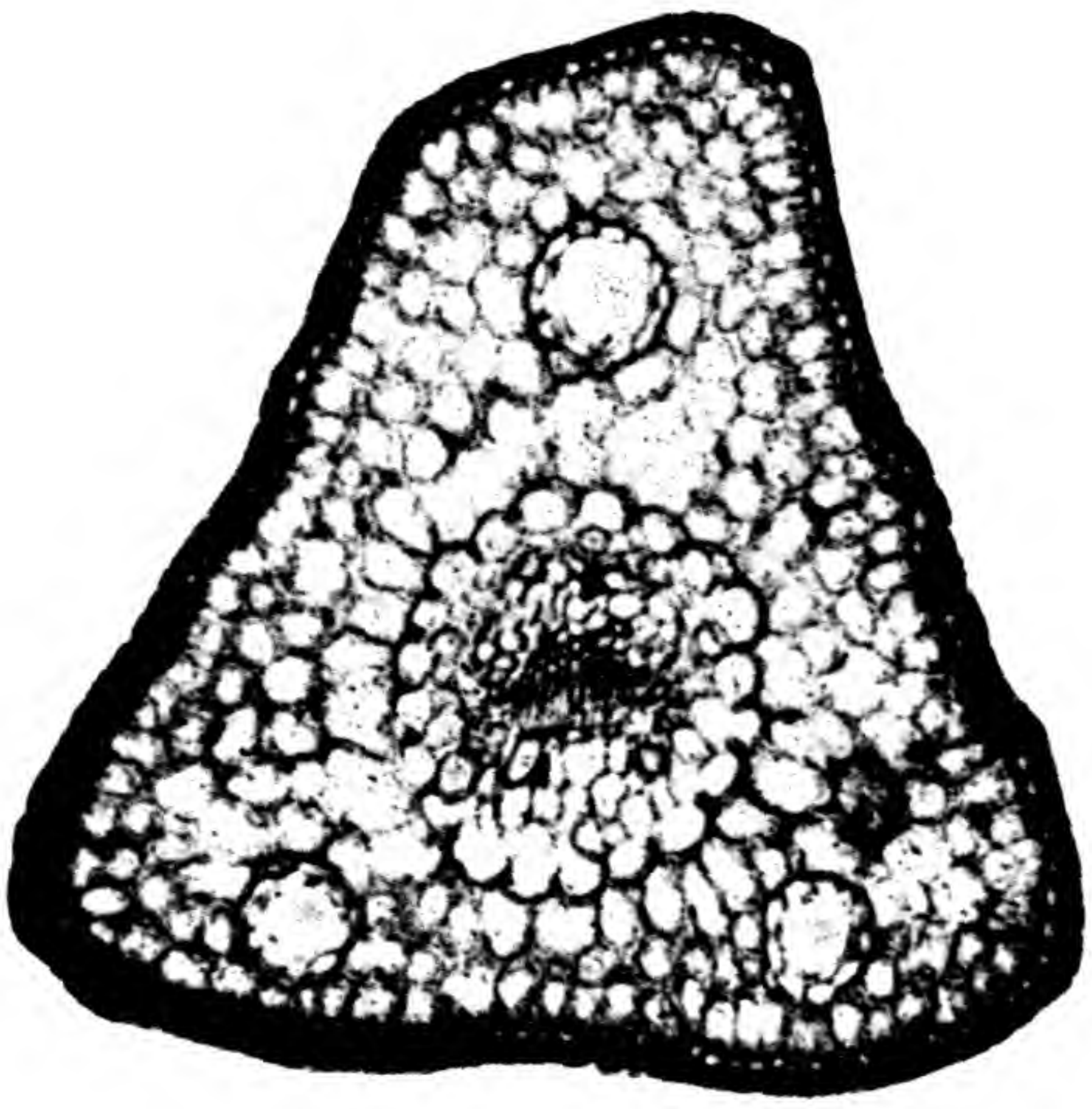


FIG. 2.—**Pinus Cembra.**

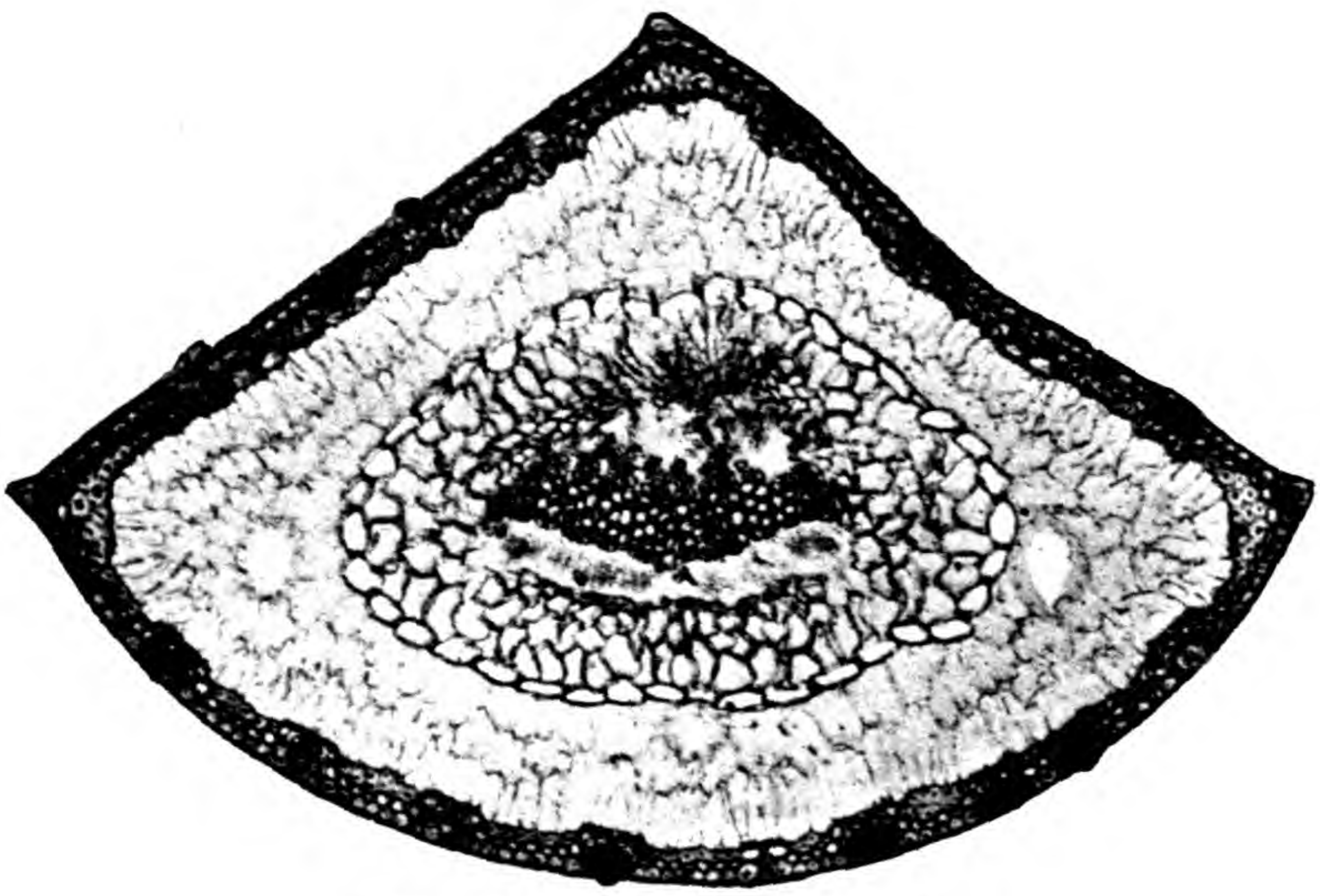


FIG. 3.—**Pinus cubensis.**

SECTIONS OF LEAVES OF PINUS.

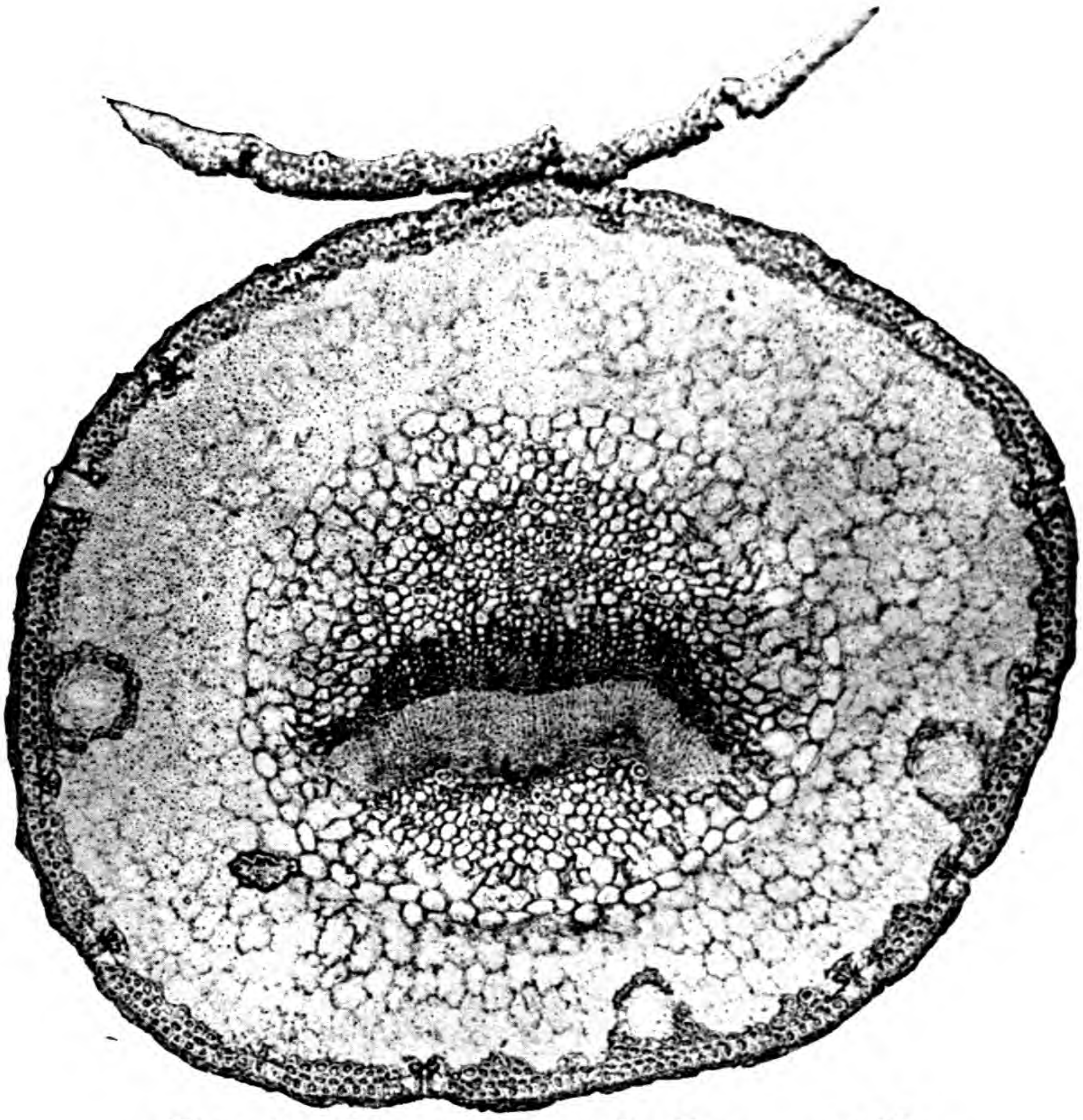


FIG. 4.—**Pinus monophylla.** × 50.

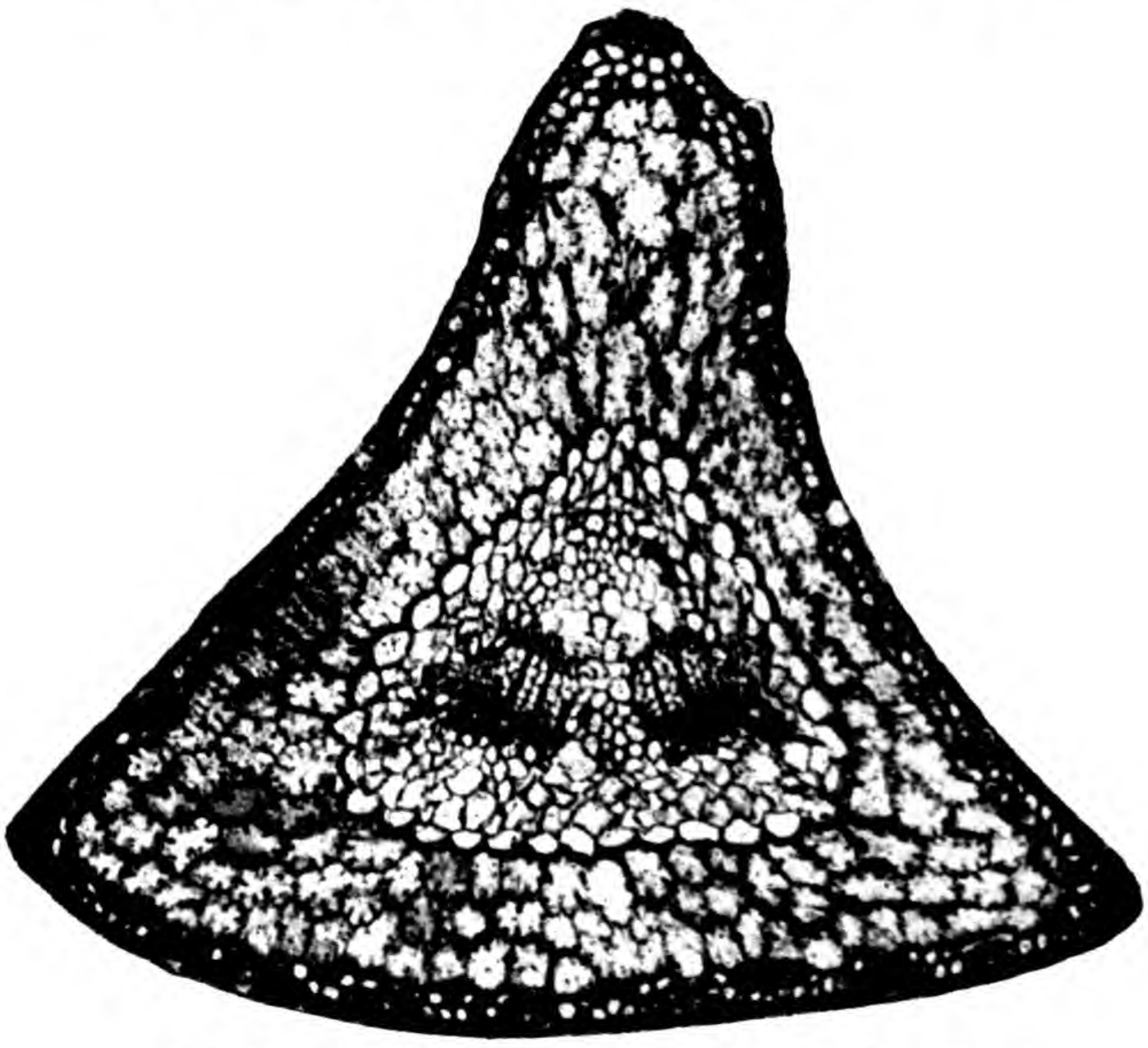


FIG. 5.—**Pinus Donnell-Smithii.**

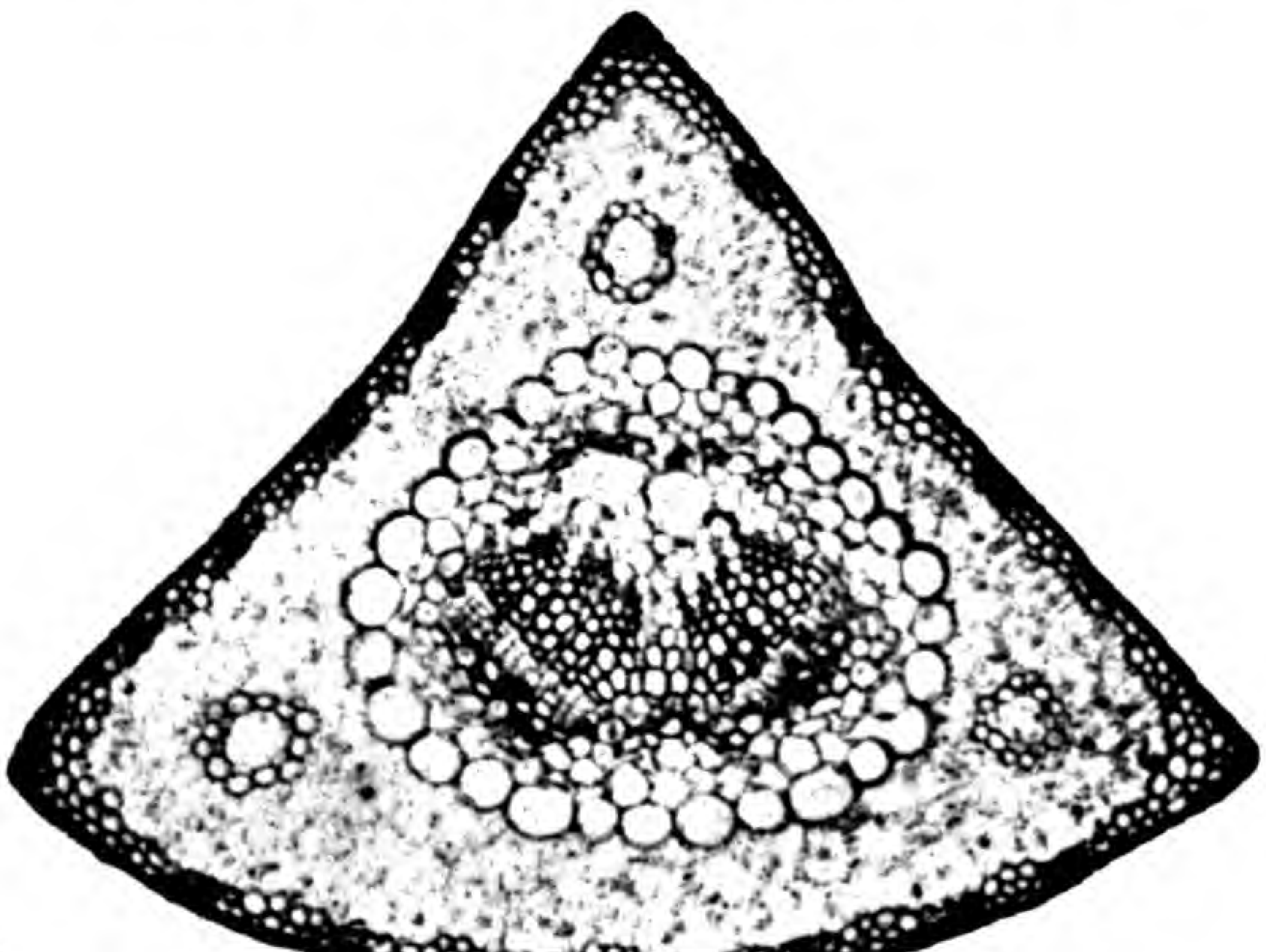


FIG. 6.—**Pinus filifolia.**

SECTIONS OF LEAVES OF PINUS.

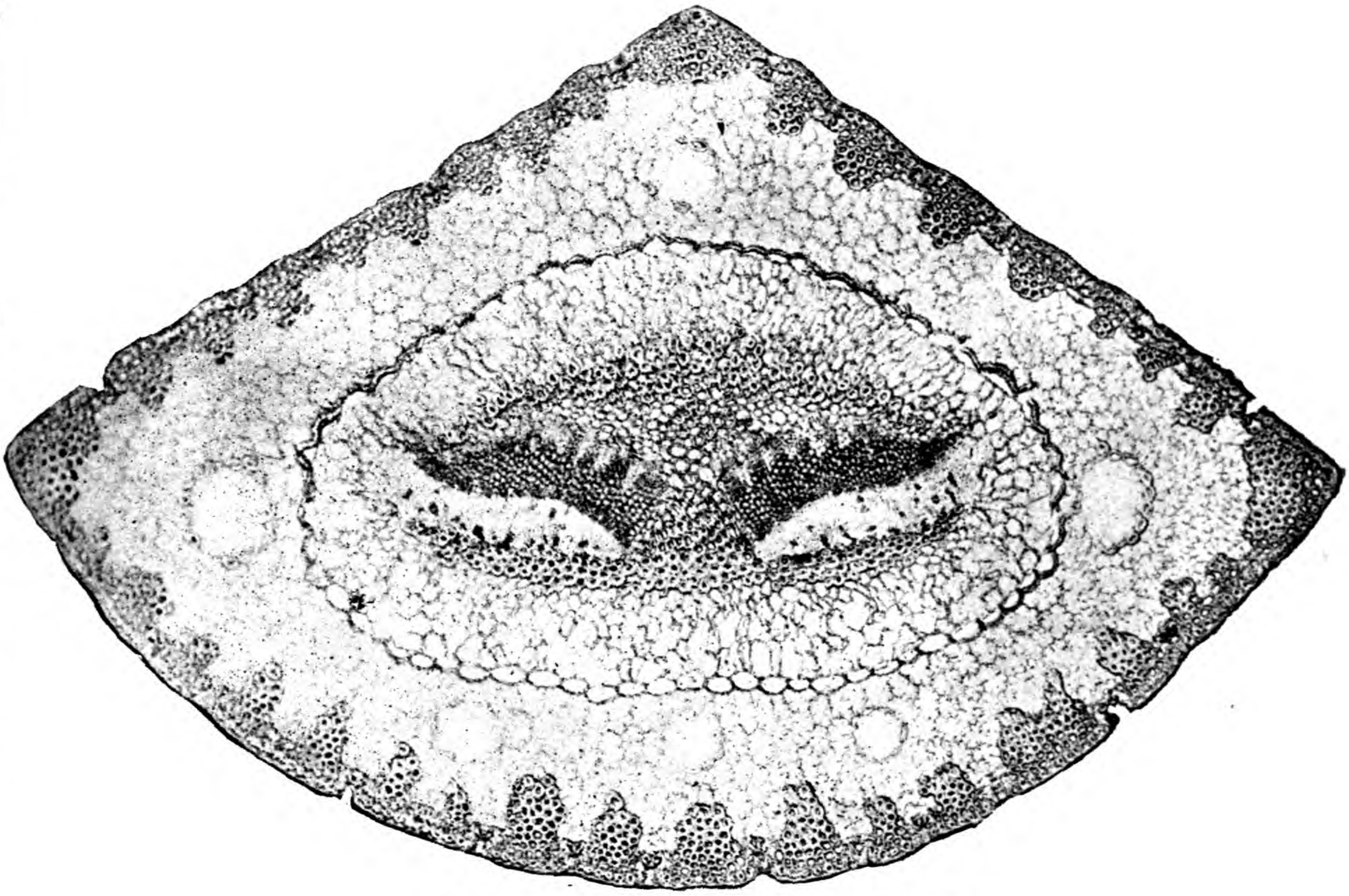


FIG. 7.—**Pinus Coulteri.** × 50.

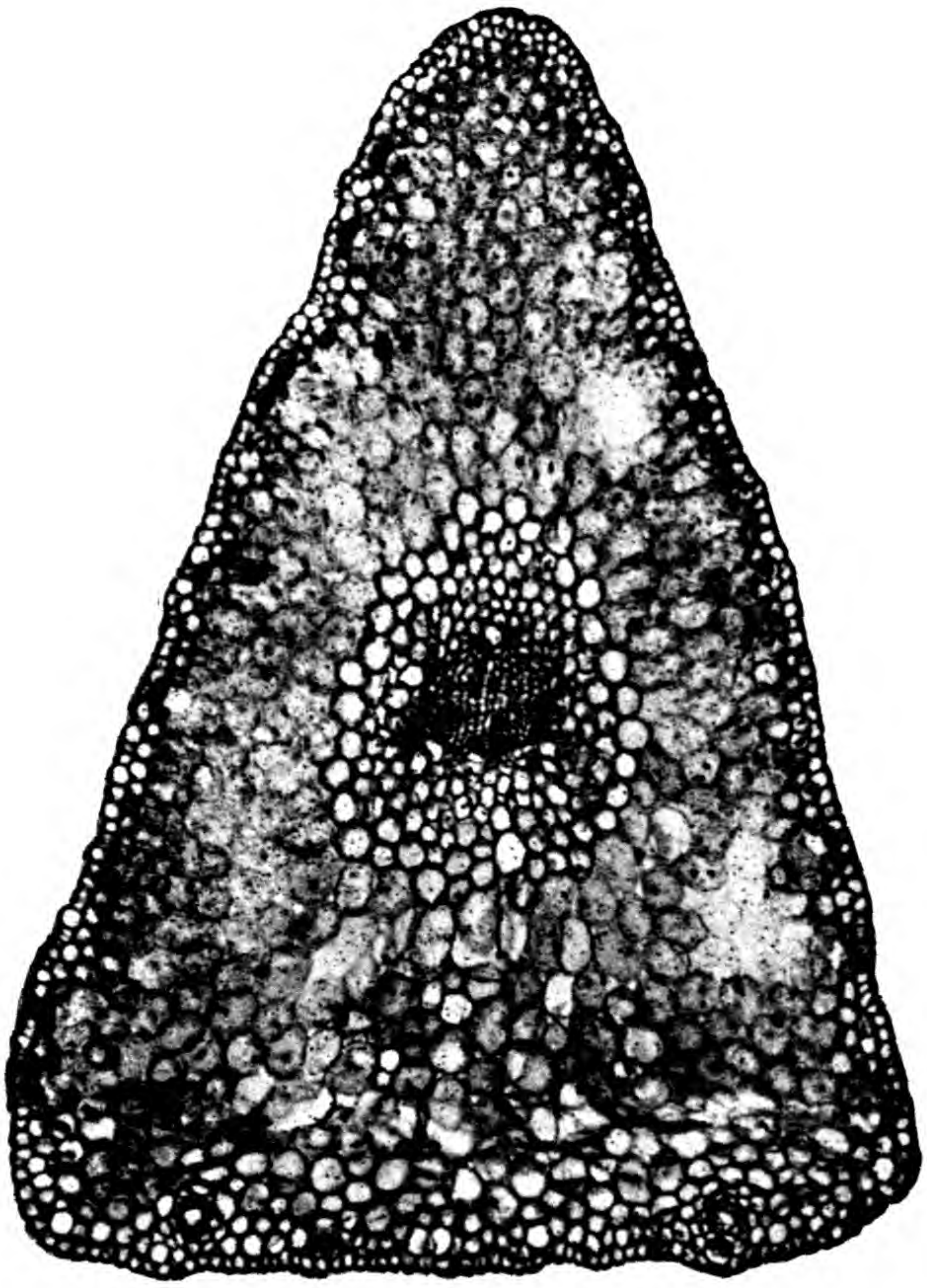


FIG. 8.—**Pinus Pinea.**—Cotyledon.

SECTIONS OF LEAVES OF PINUS.

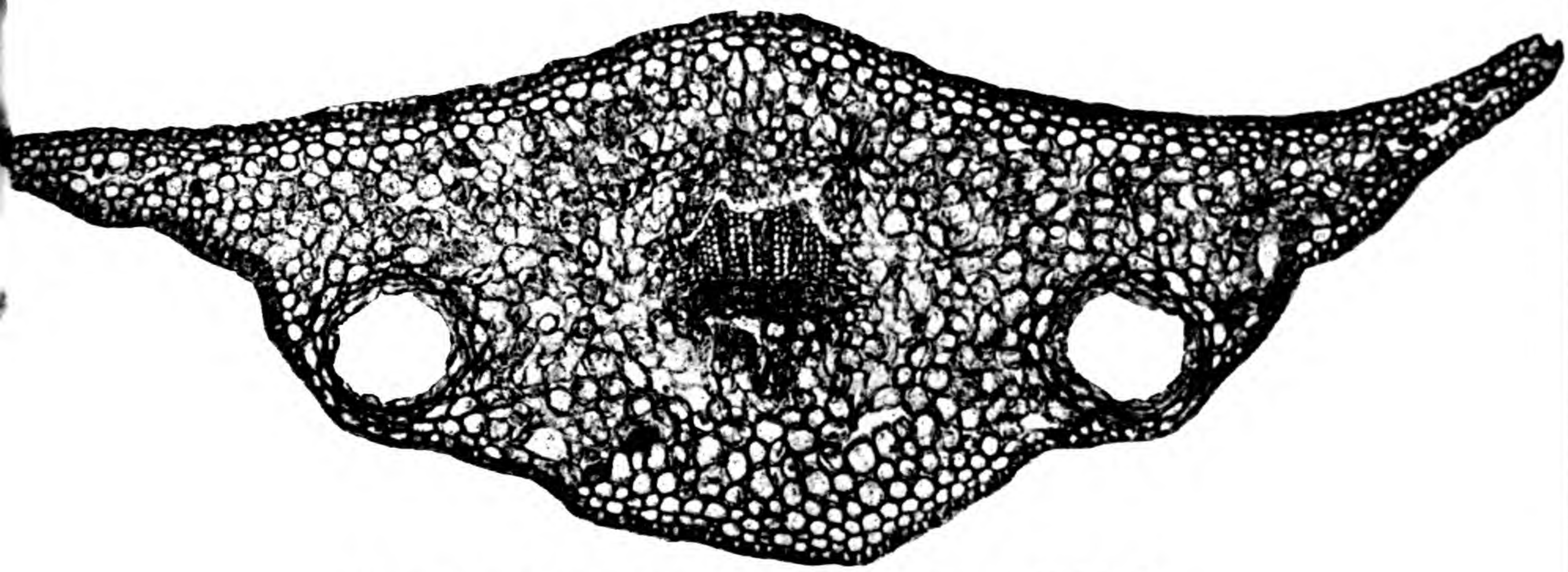


FIG. 9.—**Pinus Lambertiana.**—Primordial leaf.

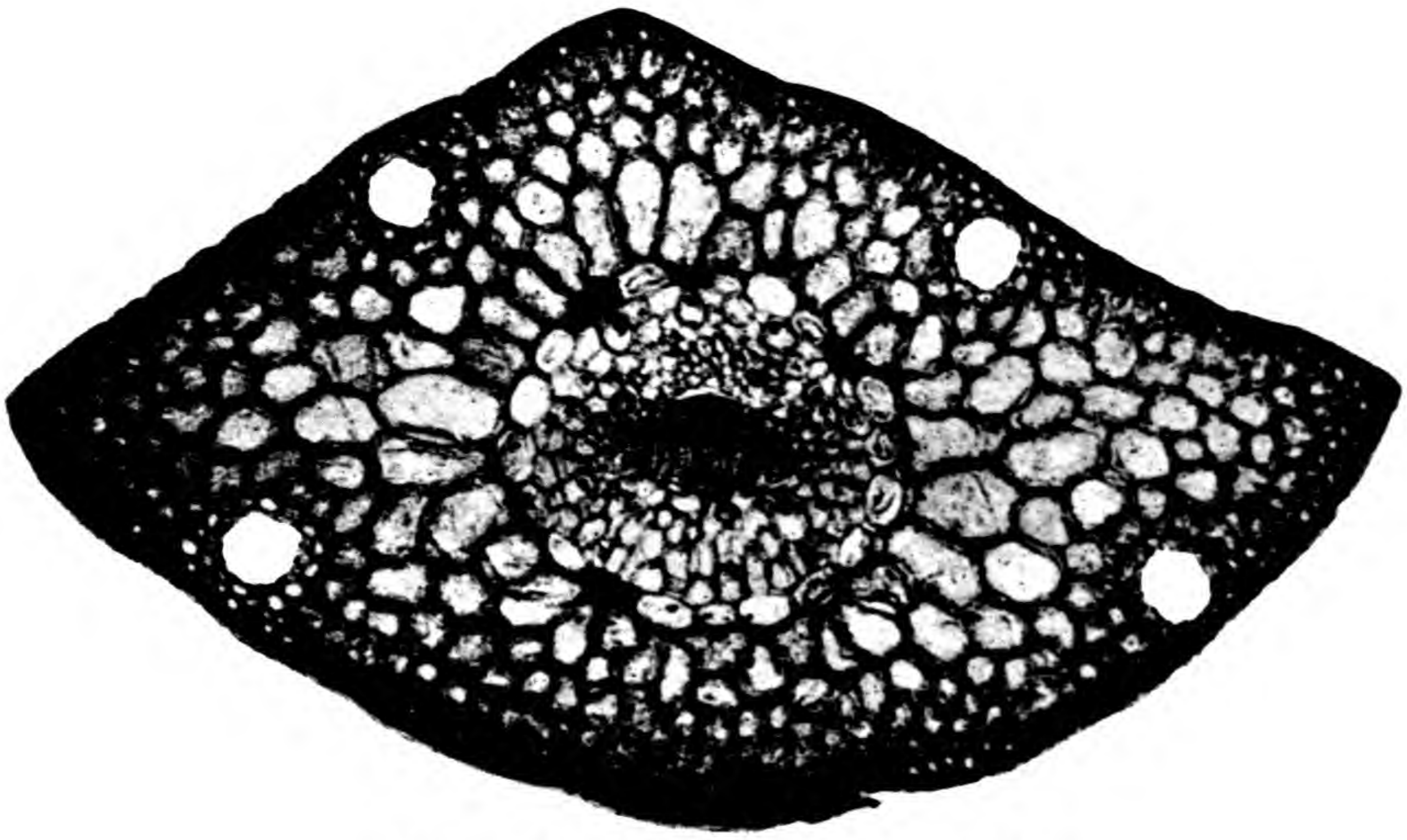


FIG. 10.—**Pinus Bungeana.**

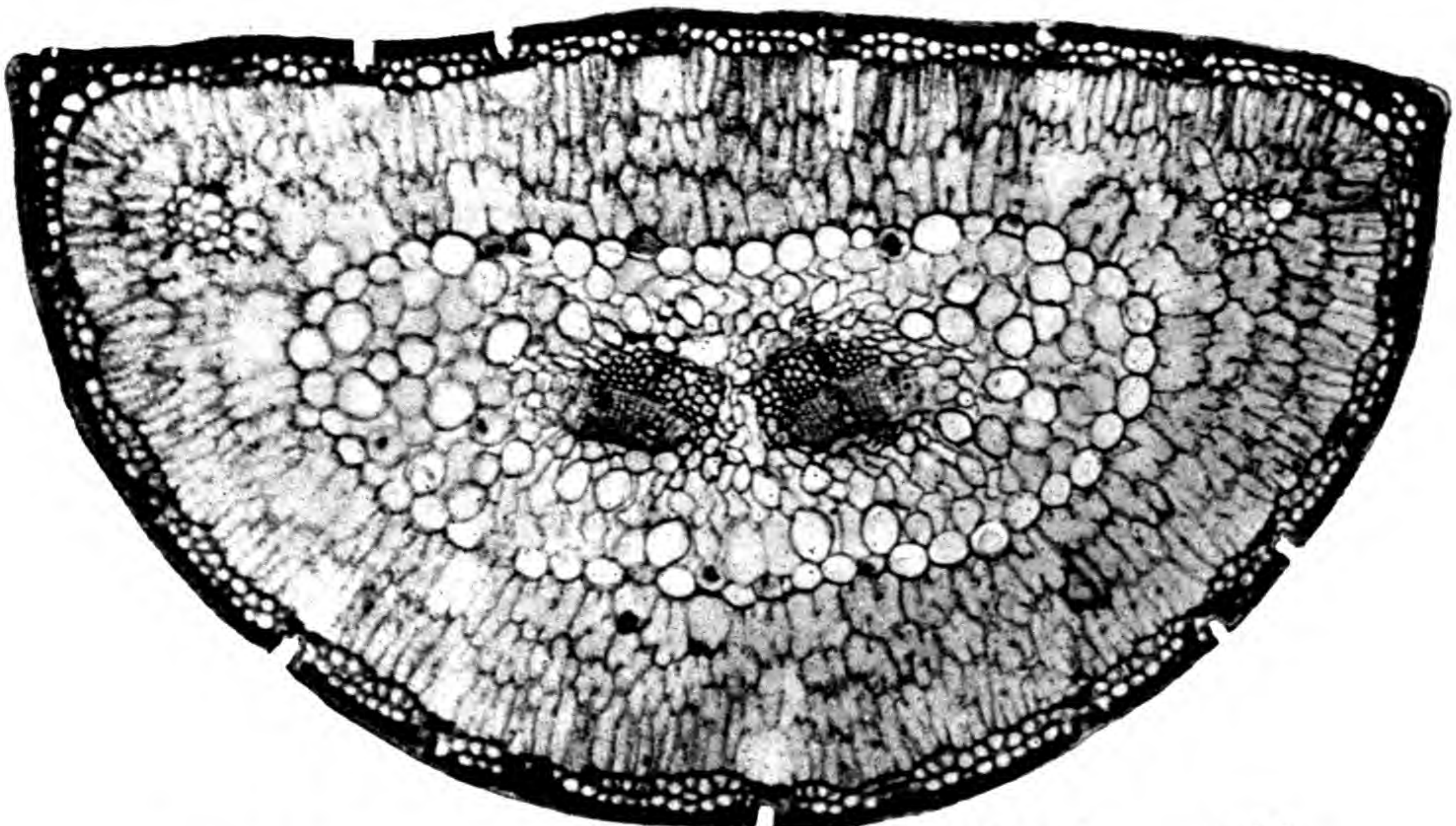


FIG. 11.—**Pinus maritima**, var. **Hamiltoni.** × 50.

SECTIONS OF LEAVES OF PINUS.

PLATE 22.

Fig. 7. *Pinus Coulteri*, showing 3-sided leaf, thick hypoderm projecting inwards in wedge-like masses; mesophyll-cells plicated; resin-canals median and internal, without stereome-sheath; endoderm of about 70 cells; meristele somewhat triangular in section; branches of the fibro-vascular bundle separate at the base by a mass of stereome-cells projecting from a horizontal band of similar cells, in contact with the lower surface of the phloem.

Fig. 8. *Pinus Pinea*, cotyledon 3-sided; epidermis and hypodermis feebly developed; cortex-cells not infolded; resin-canals subepidermal, with no stereome-sheath; meristele subtriangular; fibro-vascular bundle simple; endoderm-layer of about 35 cells, irregular. Compare the appearances with the adult structure described in the text.

PLATE 23.

Fig. 9. *Pinus Lambertiana*, primordial leaf with two very large subepidermal resin-canals and a single fibro-vascular bundle; epiderm, endoderm, and hypoderm imperfectly differentiated. Compare this with the fully-developed structure of the adult leaves (see text).

Fig. 10. *Pinus Bungeana*, leaf-section somewhat triangular; resin-canals subepidermal, surrounded by stereome-cells; cortical cells radiating from the central cylinder; endoderm-cells about 24; fibro-vascular bundle simple.

Fig. 11. *Pinus maritima*, var. *Hamiltoni*, section semi-cylindric or boat-shaped; epiderm broken by stomata on all sides; hypoderm double; cortical layer showing palisade-cells; endoderm-cells about 50; meristele oblong in section, slightly depressed on the upper surface; fibro-vascular bundle branched, with little or no stereome between the branches.

The Structure of the Leaves of the Bracken (*Pteris aquilina*, Linn.) in relation to Environment. By L. A. BOODLE, F.L.S. (With 5 text-figures.)

[Read 5th November, 1903.]

IT is a familiar fact that the bracken, though little variable in its choice of soil, grows in very diverse habitats, *e. g.*, on dry heaths and also in damp and deeply shaded copses. It has been observed that certain external characters are typical of the specimens which grow in exposed and in sheltered places respectively. Thus Druery (Gardeners' Chronicle, no. 822, 1902, p. 228) mentions that deep shade and shelter from wind bring about a more foliose and spreading habit, while exposure tends naturally to a harder and dwarfer habit. Luerssen also (in Rabenhorst's Kryptogamenflora, vol. iii. p. 108) states that sunny and dry localities favour the production of very hairy forms, while damp and especially shady places tend to show plants which are little or scarcely hairy.

Among other distinctive characters, one may mention that in exposed plants the leaves are darker green than those of shaded plants, the veins are more sunk and the sub-division of the secondary pinnæ is usually not carried so far; while in quite sheltered plants the proportionate number of sterile leaves is very much greater than in exposed plants, and the sori in the former are commonly small.

During the years 1902 and 1903 I made observations on the structure of the leaf of the bracken in different natural habitats, and I also carried out a cultural experiment, the results of which bear on the same subject.

In describing these observations, it will be most convenient to begin with a comparison of the structure in plants from two kinds of habitat *, which rank as opposite extremes.

If we compare two leaves †, one from a dry situation fully exposed to sun and wind, and the other from the deep shade and shelter of a dense copse, we find that the structure is rather strikingly different. In the *exposed* leaf, as compared with the sheltered one, the outer wall of the upper epidermis is considerably thicker, there is a well differentiated hypoderm (either continuous or nearly so), the thickness of the leaf is considerably greater, the palisade-tissue usually occupies a distinctly greater proportion of the mesophyll and its cells are more elongated, while the spongy tissue usually appears less lacunar. In the *sheltered* leaf there is practically no hypoderm, *e.g.* a few cells accompanying the midrib and none elsewhere, or sometimes two or three cells accompanying some of the veins in addition, while a certain number of epidermal cells may contain chlorophyll. There may sometimes also be no differentiated palisade. The difference between these two types of leaf may be illustrated by

* Observations were made on bracken-leaves in the following places:—Sheen Common, Richmond Park, and localities near Windsor, near Kemsing in Kent, and near Woodmancote, Telscombe, and Crowborough in Sussex.

† For the structural comparison of two leaves the parts usually chosen were the lowest segments on the lowest-but-one secondary pinna of the lowest primary pinna.

referring to figs. 1 and 2 (p. 663), though these diagrams represent a somewhat different case to be described below, and are not quite extremes as regards dimensions.

A few measurements may be given here. The thickness of the outer wall of the upper epidermis (taking the average for a few cases) is 5·7 μ for leaves from very exposed situations *, and 2·9 μ for leaves from a very sheltered and shaded locality. The entire thickness of the leaf, again taking two similarly opposite types of habitat, is 318 μ for the exposed one and 163 μ for the sheltered one. Thus the difference in both cases is roughly in the ratio of 2 to 1. The exposed leaf may be called markedly xerophytic, chiefly on account of its hypoderm, while the other type of leaf is a distinct shade-leaf.

In the exposed leaf the veins are accompanied by colourless cells, which have slightly or considerably thickened walls, and are in contact with the epidermis on the lower side and with the hypoderm on the upper side †. Owing to (1) the increased mechanical support of this arrangement, (2) the greater thickness of the leaf and of the walls of the upper epidermis, and (3) perhaps the somewhat denser mesophyll, the exposed leaf is very firm to the touch, while the sheltered leaf is quite soft. A considerable number of cases were tested with regard to this, and it was found possible to estimate the internal structure fairly well from the degree of hardness of the leaf.

In various localities rough observations were made by walking through patches of bracken and feeling the leaves, with the purpose of discovering a plant whose leaves were manifestly much softer or much harder than was typical for the habitat; but, in localities belonging to the two extreme types referred to above, no such case was found.

That the leaves of the same species should have a distinct hypoderm in some cases and practically none in others, is an example of a rather wide range of structure, and, as will be described more fully below, the same range may be attained by different leaves of the same plant, or even by different pinnæ of the same leaf. Instances of a similar kind are on record; thus

* This scarcely differs from the average thickness (5·5 μ) found by Parkin and Pearson ("The Botany of the Ceylon Patanas, II.," Journ. Linn. Soc., Bot. vol. xxxv. (1903) p. 440) in the case of the flora of the Ceylon Patanas.

† The midrib has a large amount of thick-walled tissue, which, in the sheltered leaf, is less in amount and less thickened.

Stahl * mentions that in *Ilex Aquifolium* the sun-leaves have a continuous hypoderm, while, in the shade-leaves, hypoderm is differentiated only in the neighbourhood of the midrib, the stronger veins and the margin of the leaf. The differences relating to the thickness of the leaf, the differentiation of the palisade, &c. in the bracken are less remarkable. Similar cases are described by Lamarlière and Stahl. Lamarlière † found that in the oak and the beech the shade-leaves had one layer of palisade and the sun-leaves two (both leaves being taken from the same tree), and that in *Salix rosmarinifolia* the palisade has a greater thickness in insolated leaves than in shaded leaves in the ratio of 30 to 12. Again, the thickness of the leaf was found by Stahl ‡, in the case of several flowering-plants, of which he gives measurements, to be greater in a specimen growing in a sunny locality than in one in the shade, the size (superficial area) of the leaf and the thickness of the leaf being to a certain extent inversely proportional to one another. He also adds that *Pteris aquilina* shows similar variations in the thickness of the leaf.

Before considering the question of the plasticity of the bracken we must take some further observations into account. In habitats having an intermediate character, the structure of the leaves is, speaking generally, of an intermediate type likewise. The outer wall of the upper epidermis is of medium thickness, hypoderm may be present over about half the total area of the leaf, or may be continuous but not very well differentiated (*e.g.*, most of its cells containing a very small amount of chlorophyll), and, with respect to the differentiation of palisade and the total thickness of the mesophyll, the leaf takes a position between the extreme types of structure.

In most intermediate localities, however (*e.g.*, between scattered trees or close to a wood or a hedge-bank, which form a wind-screen), it is impossible to gauge the real nature of the habitat, so there is no need to discuss these in detail. But in other cases, where there was evidence of special conditions affecting certain plants or part of a plant, one obtains useful data. I will therefore quote a few such cases.

* Stahl, "Einfluss d. Standortes auf d. Ausbildung d. Laubblätter," Jenaische Zeitschr. xvi. 1883, p. 176.

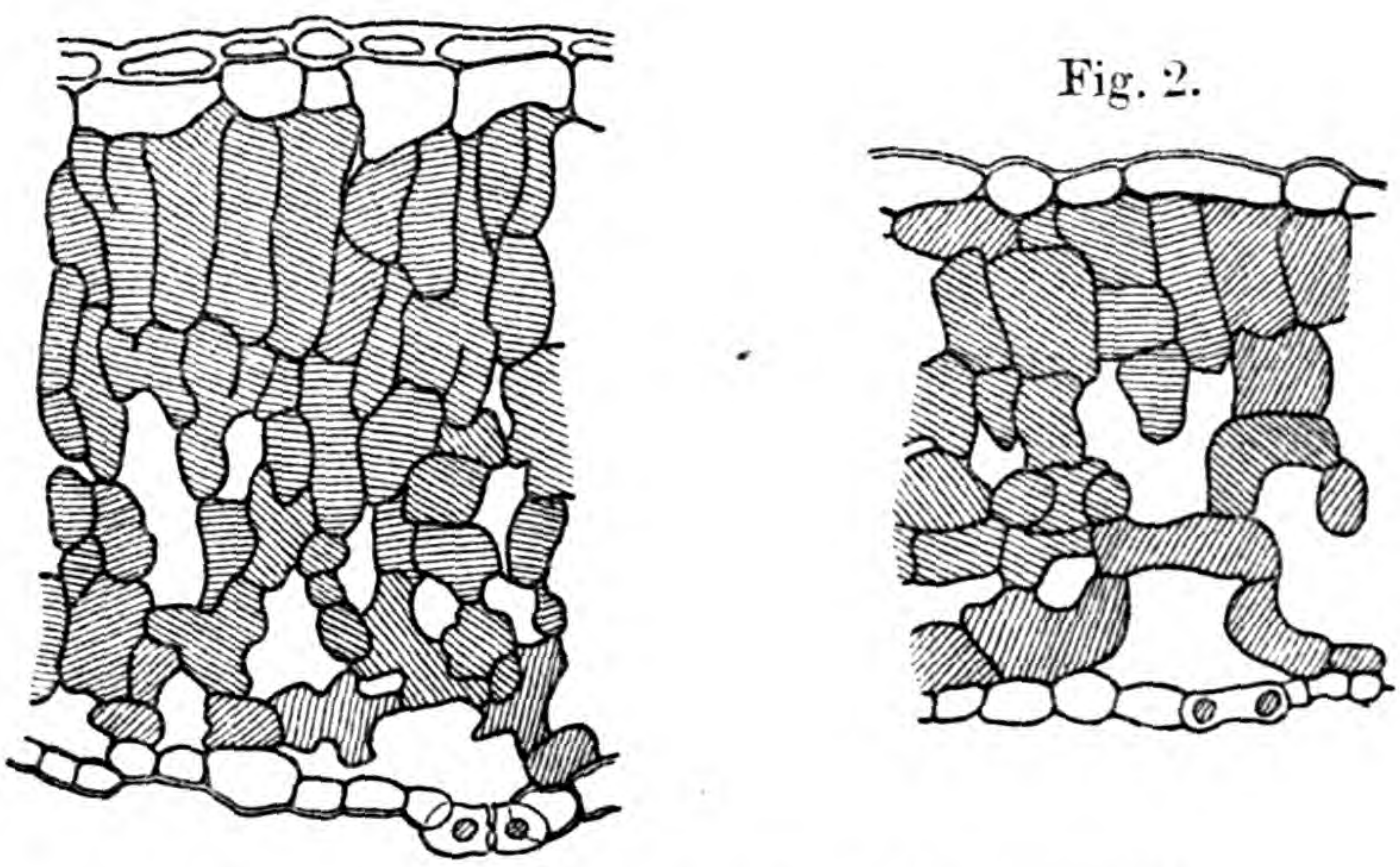
† Lamarlière, "Recherches physiologiques sur les feuilles etc.," Revue Générale de Bot. iv. 1892, p. 484.

‡ Stahl, *loc. cit.* p. 182.

In a patch of bracken apparently under uniform external conditions, one leaf was conspicuous in having more xerophytic characters than the adjacent leaves. It was found that the petiole had been partly severed on one side (evidently when young). The conduction of water from the soil was doubtless interfered with by this injury, and one is led to conclude that the different character of the leaf was due to reduction of its water-supply.

The following is a case often met with. Bracken was growing crowded and beneath oak-trees, where the shade was not very dense. The plants nearly out of shelter (just outside the trunks on the edge of the belt) had hard leaves, while leaves occurring

Fig. 1. Fig. 2.



Structure of different parts of the same leaf.
Fig. 1, exposed pinna; fig. 2, sheltered pinna. × about 195.

further in were, on the whole, fairly soft; but the more exposed parts of these leaves were decidedly more xerophytic and had long sori. Where the bracken was growing densely, it was found that those leaves, or lower parts of leaves, which were well covered by the top growth were soft and either sterile or with short sori.

A still better example of the same kind may be described in greater detail. A leaf about 6 feet high had grown up through a rather dense bush consisting of gorse, hawthorn, and bramble. The lower part of the leaf, immersed in the bush, was of the soft type; its structure is illustrated in fig. 2. The uppermost pinnæ of the leaf had overtopped the bush and were well exposed to both sun and wind. Fig. 1 shows that this portion of the leaf has xerophytic characters. In fact, the upper and lower parts have a structure identical with that of leaves from very exposed and very sheltered habitats respectively, though not quite extreme. It may be deduced from this that, not only does the structure depend on the environment, but the mature structure is only determined at a rather late stage in the growth of the leaf, viz. in this case when the leaf had grown taller than the bush, which it did not greatly exceed in height *.

It remains now to describe the cultural experiment. In the spring of 1902 a rhizome of the bracken (of intermediate type) was dug up and transferred to a greenhouse (heated) attached to the Jodrell Laboratory. The greenhouse faces nearly south; the air in it was kept very moist; the temperature varied a good deal, but was not often below 65° F., while, especially during bright sunlight in the summer, it often reached 80° and sometimes 90°. All the leaves produced in the greenhouse were soft and very delicate in appearance †, and in structure they closely resembled leaves from very dense shade and shelter, palisade not being differentiated or only slightly. This fact suggests that in the bracken, light (at any rate when not intense) is not the all-important factor ‡ determining the structure of sun-leaves and shade-leaves. Unfortunately no readings were taken with an actinometer; but the illumination was certainly strong, and must have been decidedly stronger than in certain habitats under the shade of oak-trees, where the bracken-leaves might be called half-tough and have a fair amount of palisade.

The nature of the experiment renders the results inconclusive, but the deduction suggested above gains in probability when taken in connection with Eberhardt's results §. In each of his experiments with flowering-plants three plants were used, all

* The reverse of this was found by Nordhausen ("Ueber Sonnen- und Schattenblätter," Ber. d. deutsch. bot. Gesellsch. 1903, p. 30) to apply to "sun-branches" and "shade-branches" of trees and shrubs (*e. g.* the beech), in which the character of the mature leaf is to a great extent determined in the leaf-rudiments within the winter-buds.

† There are one or two leaves, in several respects resembling these, in the Kew Herbarium. They are named *Pteris aquilina*, L., var., and they come from the Tropical Fern House, where they were produced in 1901 by a piece of rhizome accidentally introduced, as Mr. C. H. Wright informs me.

‡ As assumed by Stahl, Jenaische Zeitschr. xvi. (1883) p. 182.

§ Eberhardt, "Infl. de l'air sec et de l'air humide sur la forme et la struct. des végétaux," Ann. Sci. Nat. Bot. 8ᵉ sér. t. xviii. 1903, p. 61.

under glass bell-jars and under identical conditions of illumination; but one plant was supplied with normal air, the second with very dry air, and the third with very damp air. These experiments gave the very interesting result that in damp air and in dry air the leaves showed a marked structural divergence from those in normal air, and of the type characteristic of shade-leaves for those in damp air, and of sun-leaves for those in dry air. Unfortunately, the author makes no statements regarding the structure of the leaf grown under glass as compared with leaves of the same plant grown in the open.

Though it is just possible that, to a certain extent, sunlight (apart from its action in increasing chlorovaporisation) may act as a stimulus, which in some unknown way helps to determine the mature structure of the leaf, yet it seems probable that the chief determinant (which must act during the later stages of development of the leaf) is a factor which would be represented by the sum of the external factors inducing loss of water from the surface of the leaf, coordinated in some mathematical relation with the sum of the factors (external and internal) regulating the supply of water to the leaf *.

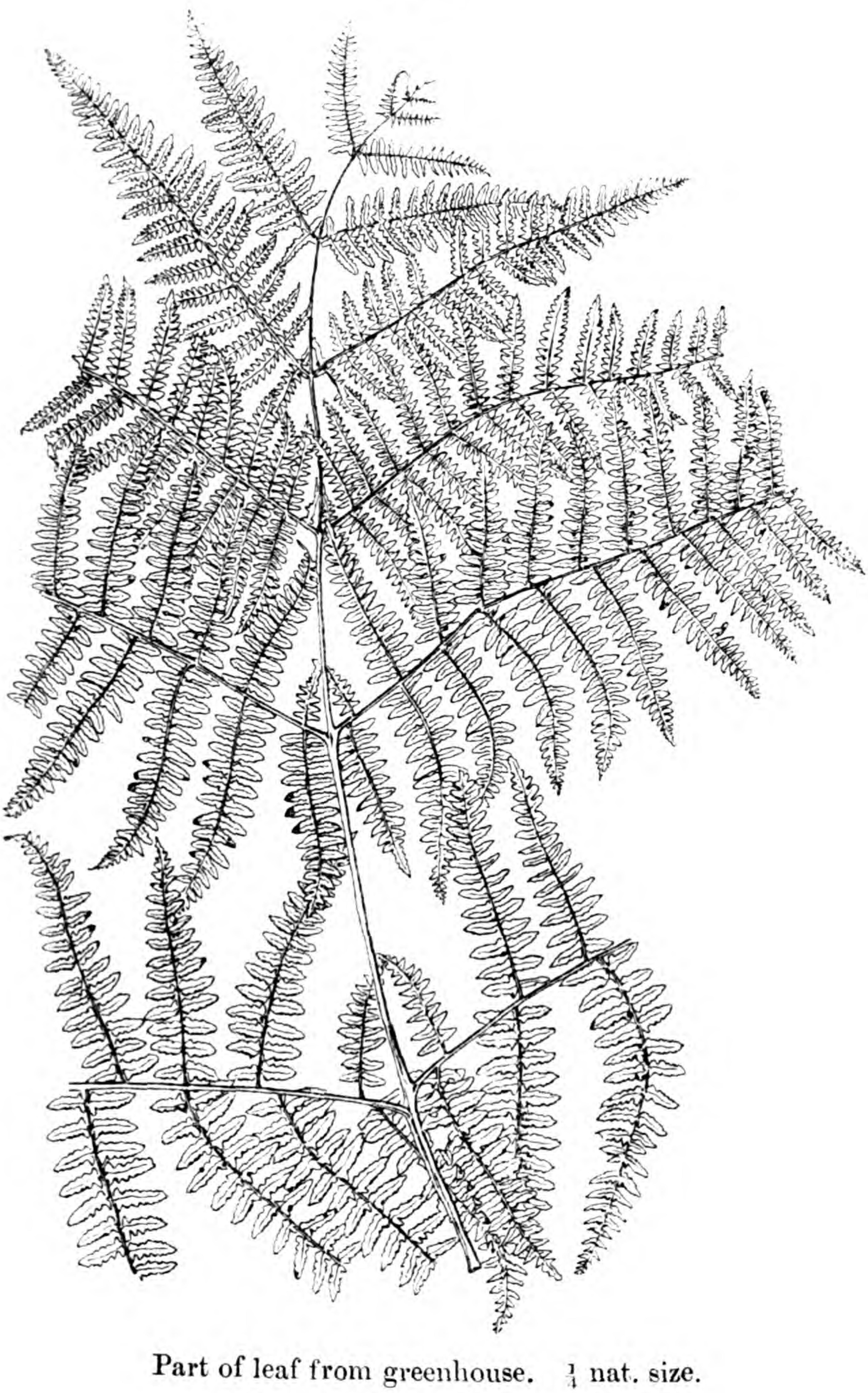
The different factors, with which one is concerned in the study of œcology †, need not be specially discussed here; but it may be pointed out that in natural habitats it is extremely difficult to determine the preponderance of any one factor. For in localities exposed to sunlight (which increases chlorovaporisation) there would usually be several other factors working in the same direction, either by increasing evaporation or by reducing water-supply, *e. g.*, one or more of the following:—dryness of air, exposure to wind, dryness or coldness of soil. In the greenhouse experiment, though the high temperature has to be taken into account, it would appear that dampness of the atmosphere and protection from wind may have been stronger factors in one direction than fairly strong illumination is in the other direction; or, more probably, it is simply that in this case the balance of factors was such that, the absorptive power of the roots being increased by the high temperature, and transpiration being kept fairly low by the dampness of the atmosphere, there was no

* *Cf.* Pfeffer, 'The Physiology of Plants,' Engl. ed. p. 239.

† Enumerated by Warming and others; Warming, 'Oekologische Pflanzengeographie' (tr. Knoblauch).

difficulty in supplying the amount of water required under the particular degree of illumination concerned, so that the precise ratio between supply and loss of water which induces xerophytic structure was not attained. It may possibly be some such factor

Fig. 3.

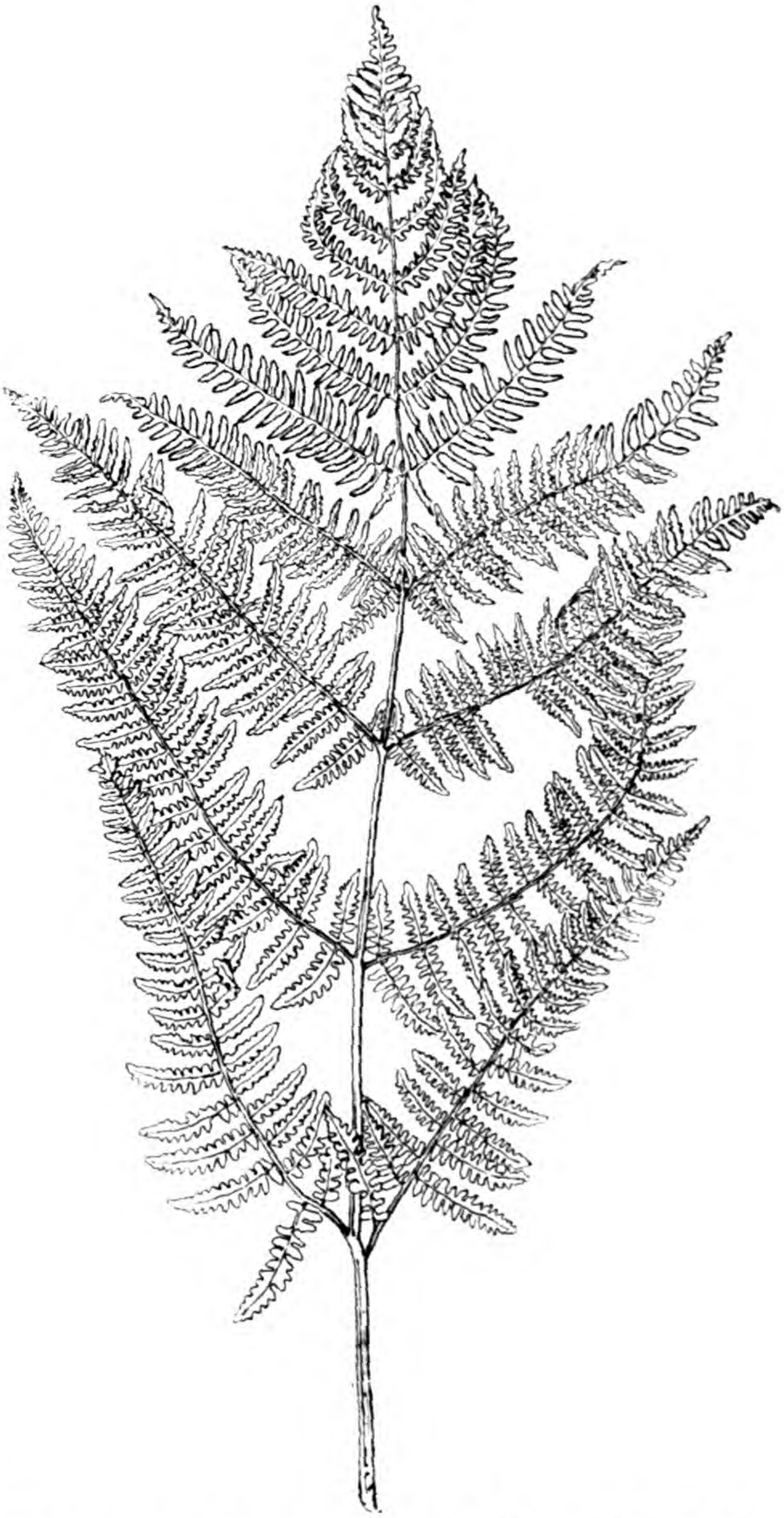


Part of leaf from greenhouse. $\frac{1}{4}$ nat. size.

as strong periodic fluctuations in the turgescence of the cells of the leaf (due to scarcity of water when transpiration is most active) which determines in the immature leaf of the bracken whether the leaf shall be xerophytic or not; and the same may apply to other plastic species.

Fig. 3 is from a photograph of a leaf which was produced by the plant in the greenhouse.

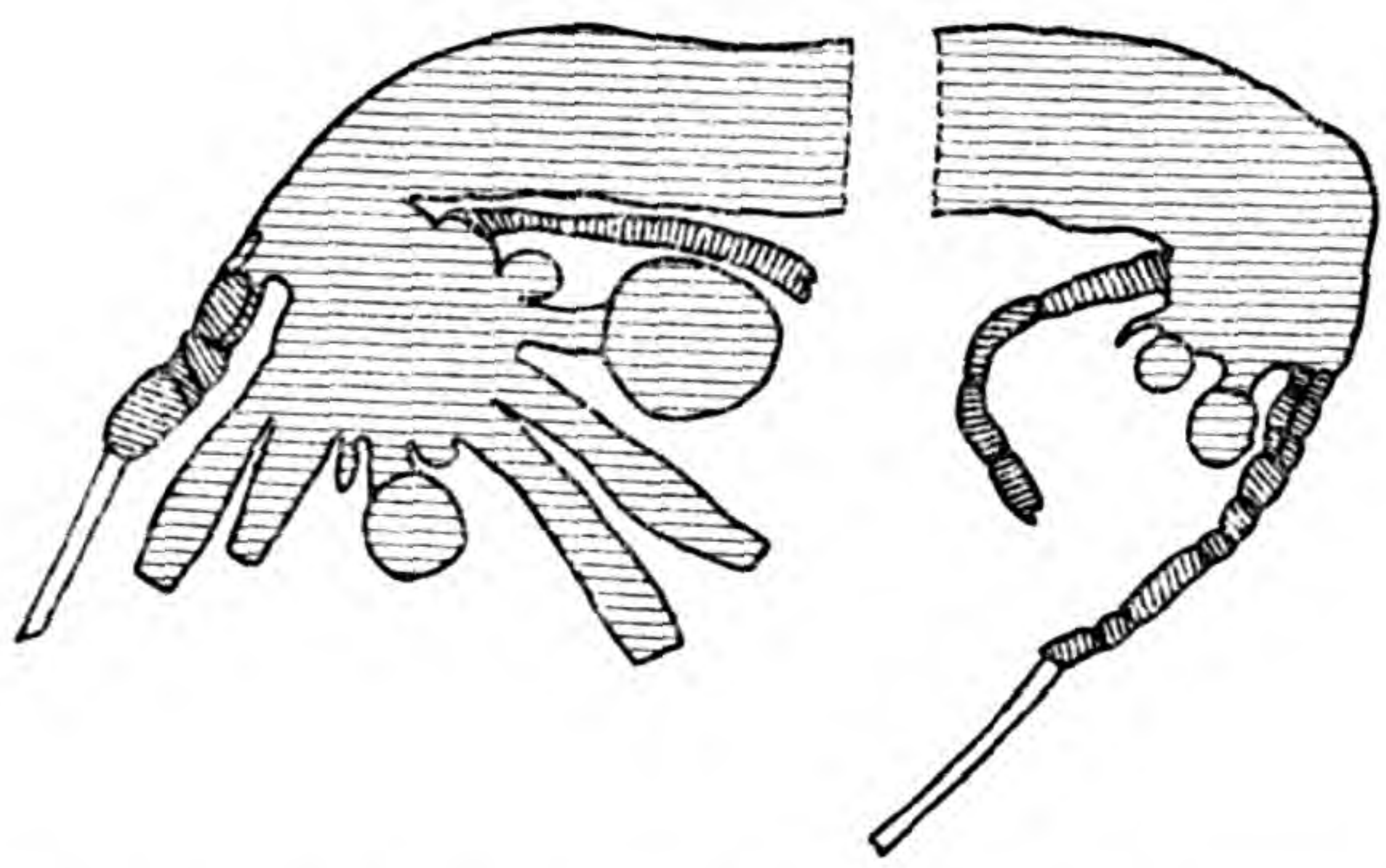
Fig. 4.



Leaf from same plant grown out of doors. $\frac{1}{4}$ nat. size.

Towards the end of 1902 the plant was put out of doors once more, and during 1903 it produced only leaves of a xerophytic or half-xerophytic type. Fig. 4 is one of the earlier of these leaves (about the fourth leaf put up). In habit it is one of the dwarf, upright, distinctly xerophytic leaves. It should be compared with fig. 3. The leaves produced later in the season may be called half-xerophytic, and, though small, they agree in habit with the leaves of the original neighbours of this plant. Hypoderm is present, but often does not extend for more than about half the length of the transverse section of a pinnule. These leaves, when fertile, mostly produced the long sori described as characteristic of the species; while in the greenhouse the sori were quite small and very few, and showed distinct reduction of the marginal indusium, as seen in fig. 5, where the left-hand diagram is from a greenhouse-leaf, that on the right from an outdoor-leaf. Both introrse and extrorse indusia are shaded. In the greenhouse-leaves, in parts of certain sori both indusia may

Fig. 5.



Margin of pinnule, showing indusia in greenhouse-leaf and outdoor-leaf respectively.

be practically absent. This reduction of the indusia is of some importance, as the characters of the indusia are used for classificatory purposes.

The production of thicker leaves, which are richer in palisade-tissue, on transferring the bracken-plant from the greenhouse to the garden, may be compared with Bonnier's experiments on the transplantation of different plants from a lowland to an alpine situation *.

The facts brought forward in the present paper establish a high degree of plasticity for *Pteris aquilina*. Though this applies to the particular plants dealt with, it cannot be definitely asserted that much less plastic forms, or even fixed forms (as regards structure), may not exist within the species, *e. g.* among the

* Bonnier, Comptes Rendus, cx. p. 363.

extreme types, though some of the observations make this appear unlikely. Details of the outline of the pinnæ, on which character several varieties have been founded, were not specially considered.

It may be added that the stomata are slightly raised, and, on an average, to about an equal extent in all the forms examined, including the greenhouse-leaves. The importance of this as a factor necessitating xerophytic leaf-structure cannot be estimated, because much exposed leaves are often more hairy on the lower side than less exposed ones.

Summary.

In dry, exposed situations the leaves of the bracken are xerophytic, and have a hypoderm, while in well-sheltered and shaded habitats the leaves are of the type of delicate "shade-leaves," having no hypoderm, and either weakly developed palisade or sometimes none.

The same range of structure may be shown by the different leaves of the same plant or by different parts of the same leaf, when opposite external conditions are sufficiently localized.

A plant, grown first in a damp greenhouse and then in the garden, produced shade-leaves in the former and sun-leaves in the latter. The greenhouse-leaves showed reduction of the indusia.

The mature type of structure is not determined at an early stage in the growth of the leaf.

The amount of illumination is probably not the only factor determining the structure of the leaf.

The examination of material, collected from different localities, was carried out at the Jodrell Laboratory, Royal Botanic Gardens, Kew. My thanks are due to Dr. D. H. Scott, F.R.S., to whom I am indebted for several valuable suggestions.

Notes on *Myriactis Areschougii* and *Coilodesme californica*.

By May Rathbone. (Communicated by V. H. Blackman, M.A., F.L.S.)

[Read 3rd December, 1903.]

(Plate 24.)

It is hoped that the following observations on *Myriactis Areschougii* and *Coilodesme californica*, fragmentary as they are, may be of some use in helping to bridge over one or two of the numerous gaps in our knowledge of the life-history and structure of the parasitic and symbiotic marine algæ.

Myriactis Areschougii, *Batt.*, is synonymous with *Elachistea Areschougii*, Crouan, as in 1892 Mr. Batters transferred to *Myriactis* the latter species, together with *E. stellulata*, on the ground of the absence of paraphyses and the entire or partial immersion of the basal portion of the parasite in the thallus of the host. If this view be accepted, one of the generic characters given by Kjellman, viz., the tapering at both ends of the assimilating filaments, will require modification, as in *M. Areschougii* the assimilating filaments are distinctly broadened and thickened at the upper ends. Kützing's original diagnosis of the genus, however, presents no such difficulty.

M. Areschougii was first discovered by the brothers Crouan in September 1860, growing on *Himanthalia lorea* at the entrance to the Port of Brest, and published by them, under the name of *Elachistea Areschougii*, in their 'Liste des Algues Marines,' and they figure and describe it in the 'Florule du Finistère.'

Of the two figures given, one shows the plants on *Himanthalia lorea* in their natural size; the other is a magnified section of part of a tuft, but unfortunately the drawing of this last is not very good, especially where it shows the immersed portion of the thallus.

In March and May 1877 M. Bornet found this alga again at Le Croisic, and it is to this he alludes when he states in the 'Études Phycologiques,' p. 21, that he has found *Elachistea clandestina* upon *Himanthalia lorea*. This confusion between the species, of which he, himself, informed M. Sauvageau, arose from the fact that the Crouan specimen named *E. Areschougii* in his herbarium really belonged to another species.

M. Sauvageau, in a very interesting paper in the 'Journal de

Botanique,' describes this alga, under the name *Elachistea Areschougii*, as forming very small tufts, with a cushion of large torulose colourless cells, deeply sunk in the host-thallus. The short filaments are incurved and narrow at the base, while the long ones are of the same thickness throughout their whole length; and the pyriform sporangia are of the same dimensions as those of *E. clandestina*, but sometimes attain a length of 120 μ. Both the sporangia and the filaments arise on a level with the surface of the host-plant. M. Sauvageau also states that in many cases the cells of the base, and almost invariably those forming the lateral walls of the cavity in *Himanthalia* occupied by the parasite, appear to be undisturbed by contact with it, though the 1–3 epidermal layers surrounding it frequently appear compressed, as if there had been a neck to the cavity, and this had been widened by the growth of *M. Areschougii*. Hence, though he has never observed the young stages, he supposes that *M. Areschougii* is developed in a cryptostoma or conceptacle of the host-plant. He noticed a few distorted filaments given off from the base of the cushion, with joints about 10–25 μ wide by 25 μ long passing between the host-cells. He followed one of these stolons, as he calls them, for more than 600 μ across the central tissue of the host, but was unable to determine its destination; however, M. Sauvageau suggests that these "stolons" may connect the tufts with each other, and so help to propagate the plant. He also suggests that in the first instance the host-plant may be infected by the germination of the zoospores of *M. Areschougii* in the conceptacles or cryptostomata. Some young individuals which he observed were evidently growing up from the interior of the thallus, but owing to the state of the preparation he was not able to recognize the entophytic filaments. No figures are given of this species.

It was suggested to me that it might be possible to clear up some of the points left doubtful by M. Sauvageau, and in September some material was sent to me from Cumbrae, where it was very plentiful, while later in the year more specimens were obtained from N. Berwick and Port Erin.

Hoping to be able to follow out the life-history of *M. Areschougii* during the winter, some *Himanthalia lorea* were obtained in December from Port Erin, and in January from Cumbrae, but in neither case could any trace of the parasite be found. In March some *H. lorea* from Cumbrae were again examined, and though this time numerous small algæ with penetrating rhizoids were found on the thallus, it was impossible to decide whether they were really *M. Areschougii* in its early stages or one of the numerous other parasites by which its host is infested. As, therefore, it seemed hopeless to try to determine the young stages of this species by any method but that of pure cultures, which under the circumstances would have been difficult, if not impossible, the work was necessarily confined to a study of the older stages.

Nothing is positively known about the first entrance of the parasite into the host, but presumably this takes place, as M. Sauvageau suggests, by means of zoospores. The theory that these enter by means of the cryptostomata or conceptacles seems hardly tenable, as in *Himanthalia* cryptostomata only occur on the very young receptacles, the hairs being shed at an early stage and replaced by the organs of fructification. The cushion of *M. Areschougii* is not sunk so deeply in the host-tissue as are the conceptacles, and the plants do not appear to be connected with these in any way; indeed, I have seen a tuft growing close to the edge of a conceptacle without entering it, and the rhizoids of the parasite often work their way among the cells surrounding a conceptacle without penetrating into the cavity.

The few rhizoids which start from the base of the cushion soon branch, and travel for long distances in the host-plant, some twisting and twining among the filaments of the loose central tissue of the *Himanthalia*, and others, working their way through the cell-walls of the denser elements bordering this, form here and there small knots which stain deeply with iodine or Hoffmann's blue (Pl. **24**. figs. 2 & 3). In fresh material these rhizoids are easily distinguished from the host-tissue by their pinkish-brown colour, and in sections treated with aqueous solutions of methyl-violet or methylene-blue, those rhizoids which are wandering about in the loose central tissue stain less deeply than the filaments of the host, and, in the case of the methyl-violet, assume a bluer tint. Under the action of these reagents the rhizoids take on a characteristic appearance, owing to the deeper staining of certain small granules in the protoplasm. With methyl-violet and methylene-blue, the *Himanthalia*-tissue itself is too deeply dyed to allow the passage of the parasitic filaments between the cell-walls to be traced; but with Hoffmann's blue the penetrating rhizoids stain so much more deeply than the host-cells that their course can be traced fairly well, especially after the sections have lain for some time in glycerine. When these rhizoids are once recognized, it is astonishing to find how numerous they are, and how little they seem to affect the host-cells among which they creep; and this seems to point to the conclusion that *M. Areschougii* is an endophyte rather than a true parasite, though it may possibly obtain some nutriment from the water and mucilage which fill up the spaces in the central tissue of its host. In consequence of the devious course of the rhizoids and the distance between the plants of *M. Areschougii*, it is almost impossible to trace any one individual rhizoid from one tuft to another; but along the whole distance between the tufts so many filaments are to be found passing through the host-tissue, that there seems little doubt that these rhizoids do act as stolons for propagating the plant. This supposition is also supported by the fact that in *M. stellulata*, where the tufts are closer together, the connecting filaments can be easily traced.

In the material from Scotland and Port Erin active cell-division was not unfrequently to be found going on in the host-cells at the base and sides of the *Myriactis*-plant, and in sections stained with Hoffmann's or aniline-blue the host-cells below the parasite often stain rather differently from the adjoining cells. This seems to indicate some alteration in the cell-contents. *M. Areschougii* secretes a large quantity of mucilage, which is found chiefly at the base of the hairs and round the assimilating filaments, though in some cases it penetrates far down into the cushion. This secretion stains pink with Hoffmann's blue, dull purple with both aniline and methylene-blue, and a pale brownish colour with picro-carmine. The mucilage found among the filaments of the central tissue in *Himanthalia* stains a bright pink with this last reagent, which points to a difference in the composition of the two substances.

Mucilage is also present, but less abundantly, in *M. stellulata*, where it sometimes takes the form of threads, which may be seen running like a cobweb from one filament to another. This appearance may, however, be caused by the reagents used.

As yet only unilocular sporangia have been found in *M. Areschougii*; but as plurilocular sporangia exist in both the closely-allied species *M. pulvinata* and *M. stellulata*, it seems likely that they occur in this species also. The plurilocular sporangia of

Myriactis stellulata are figured by Harvey in his 'Phycologia Britannica,' though, as Mr. Batters pointed out, they are there wrongly described as paranemata.

COILODESME CALIFORNICA, *Kjellm.* (Adenocystis californica, *Rupr.*). (Pl. **24**. figs. 5 & 6.)

This alga, which grows upon *Cystoseira* and *Halidrys*, resembles *Myriactis Areschougii* in sending penetrating rhizoids into its host.

In the young stages of the parasite the rhizoids are but few, and, apparently, *Coilodesme* does not send out the long wandering filaments of *M. Areschougii*, but, in the mature plant, from the base of the thallus a dense mass of fine rhizoids can be traced in the cell-layers immediately beneath the base of the parasite. These rhizoids run in the substance of the cell-walls, and completely surround the cells of the host. When seen in longitudinal section under a low power, this habit gives the infected portion of the host-thallus a curiously opaque and ribbed appearance. The penetrating filaments of this alga appear to have been overlooked by other writers. Ruprecht, the author of the species, states that *Coilodesme californica* never has root-fibres (Wurzelgeflecht); and Kjellman, who fully describes and figures the vegetative and reproductive portion of the thallus, merely alludes to an almost hemispherical adherent disc (häftdyna).

In conclusion, I wish to offer most hearty thanks to the staff of the Botanical Department of the Natural History Museum, not only for permission to work there, but also for much kindness and assistance. My thanks are also due to Miss Ethel Sargant for lending me slides and giving me material of *Myriactis stellulata*, and to Mr. Batters for information on the differences between the genera *Elachistea* and *Myriactis*; to Mrs. Antony Gepp also, under whose direction this work has been carried out, I am indebted for a large amount of kind help and advice.

LITERATURE.

Myriactis Areschougii.

BATTERS, E. A. L.—Marine Algæ of Berwick-on-Tweed. Reprinted from Berwickshire Naturalists' Club Trans. 1889 (Alnwick), p. 71.

—— Additional Notes on the Marine Algæ of the Clyde Sea Area. Journ. Bot. vol. xxx., June 1892, p. 173.

P. Highley del. et lith.   Highley imp.

MYRIACTIS AND COILODESME.

Crouan, P. L. et H. M., frères.—Suite des Algues marines et Liste des Diatomées marines recueilles dans le Finistère. Bull. Soc. Bot. France, tom. vii. p. 836.

—— Florule du Finistère, p. 160. Paris, Brest, 1867.

Kjellman, F. R.—Engler & Prantl's 'Pfanzenfamilien,' Algæ, I. 2, pp. 225–227.

Kützing, F. T.—Phycologia Generalis, p. 330.

Sauvageau, C.—Sur quelques Algues Phéosporées Parasites. Journ. de Bot. tom. vi. (1892) p. 11.

Thuret, G. A., & E. Bornet.—Études Phycologiques, p. 21. Paris, 1898.

Myriactis stellulata.

Harvey, W. H.—Phycologia Britannica, vol. iii. pl. 261.

Coilodesme californica.

Kjellman, F. R.—Alger Häforder till Slaglet *Adenocystis*, p. 7.

—— Engler & Prantl's 'Pflanzenfamilien,' Algæ, I. 2, pp. 199, 201, & 202.

Ruprecht, F. J.—Algæ Ochotenses, in A. T. Middendorff, Sibir. Reise, Bd. i. Th. 2, 1850, p. 291.

Stromfelt, H. F. G.—*Coilodesme.* Bot. Centralblatt, 1886, vol. xxvi. p. 173.

EXPLANATION OF PLATE 24.

Fig. 1. Section of a tuft of *Myriactis Areschougii*, Batters, growing in the receptacle of *Himanthalia lorea.*

2. Rhizoids of *Myriactis Areschougii* in the loose central tissue of the receptacle of *Himanthalia lorea.* × 330.

3. Rhizoids of *Myriactis Areschougii* in the neighbourhood of a tuft, working their way through the cell-walls of the denser elements bordering the central tissue of the receptacle of *Himanthalia lorea.* × 60.

4. *Myriactis stellulata*, Batters. Plurilocular sporangia. × 330.

5. *Coilodesme californica*, Kjellm. Young plant.

6. *Coilodesme californica.* Penetrating rhizoids. × 70.

INDEX.

[Synonyms and native names are printed in *italics*. A star is added to names which are ostensibly here published for the first time.]

END OF THE THIRTY-FIFTH VOLUME.

PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.