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TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

VOLUME IX.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY.
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CONTENTS OF VOL. IX.

PROCEEDINGS FOR NOVEMBER 1866.

Page

Obituary Notices ... 3

I. On the Selaginellas cultivated in the Royal Botanic Garden, Edinburgh. By W. R. M'Nab, M.D. (Plate I.) ... 3

II. List of Fungi collected in Otago, New Zealand. By W. Lauder Lindsay, M.D. ... 13

III. List of Mosses and Hepaticæ collected in Otago, New Zealand. By W. Lauder Lindsay, M.D. ... 22

IV. List of Ferns, Lycopodiaceæ, and Marsileaceæ collected in Otago, New Zealand. By W. Lauder Lindsay, M.D. ... 27

V. New Localities for Rare Plants round Edinburgh. By Mr John Sadler. 47

VI. On the Preparation of Skeleton Leaves. By Dr G. Dickson ... 48

VII. Miscellaneous Botanical Communications ... 48

PROCEEDINGS FOR DECEMBER 1866.

I. Notes of an Excursion with Pupils to Braemar, in August 1866. By Professor Balfour ... 51

II. On the Reproductive Organs of Mosses. By William Bell ... 52

III. On Seedlings of *Taxus baccata variegata*. By Alex. J. Adie, Esq ... 52

IV. Extracts from Botanical Correspondence. By Mr John Sadler ... 53

V. On Abnormal Flowers in *Tropæolum majus*. By Dr Alex. Dickson ... 54

VI. Botanical Intelligence ... 54

VII. Report on Botanical Garden of Calcutta. By Dr Thomas Anderson... 54

VIII. Dr Cleghorn on the Supply of Wood-fuel to Indian Railways ... 56

IX. Dr Balfour on the Fruit of Passifloras ... 60

X. Mr M'Nab on a new Dwarf Arbor Vitæ ... 61

PROCEEDINGS FOR JANUARY 1867.

I. On the Glumaceæ of Otago, New Zealand, including Restiaceæ and Junceæ. By W. Lauder Lindsay, M.D. ... 63

II. Notice of a Species of Trichoscypha, and of a Species of Sarcocephalus from Old Calabar. By Professor Balfour ... 78

III. Note on *Vellozia elegans* from the Cape of Good Hope. By H. Fox Talbot, Esq ... 79

IV. Remarks on a Substance called "Puttoo Manga," found in the White Ants' Nests in Travancore. By Dr J. Shortt ... 80

V. On the Varieties of Variegated Greens, &c., as Ornamental Plants. By Mr M'Nab ... 81

VI. Notice of the State of Open-Air Vegetation in the Royal Botanic Garden. By Mr M'Nab ... 82

VII. Effects of Blight on Orange Trees. By Mr M'Nab ... 83

VIII. Botanical News ... 84

PROCEEDINGS FOR FEBRUARY 1867.

I. Obituary Notices of James Smith, Esq. of Jordanhill; of Dr G. A. Martin, Isle of Wight; and of George Ure Skinner, Esq. of Guatemala. By Professor Balfour ... 85

II. Notice of some Diatomaceæ from Iceland. By Dr W. R. M'Nab ... 95

III. Some Account of Botanical Travels in Oregon. By Mr Robert Brown.. 95

IV. Notes regarding *Polypodium calcareum* as a Scottish Plant. By Mr J. Sadler ... 95

V. Report on the State of the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'Nab ... 96

VI. Remarks on Beet-root Sugar. By Michael Connal, Esq. ... 98

Digitized by Google

PROCEEDINGS FOR MARCH 1867.

Page

I. On the Hybridisation or Crossing of Plants. By ISAAC ANDERSON-HENRY, Esq. 101
II. Notes on Some of the Compositæ of the Andes, and more particularly on *Chuquiraga insignis*. By Professor JAMESON, of Quito 115
III. Obituary Notice of Professor Goodsir. By Professor BALFOUR 118
IV. Report on the State of the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'NAB 127

PROCEEDINGS FOR APRIL 1867.

Obituary Notices. By Professor BALFOUR 129
I. On Silicified Vegetable Structure from the Zambezi. By Dr JOHN LOWE. (Plate II.) 131
II. On the Progress of Cinchona Cultivation in India. Communicated by Professor BALFOUR 133
III. Notice of Cinchona Planting in the Kangra Valley. By WILLIAM COLDSTREAM, B.A 136
IV. On New Zealand Carageen. By W. LAUDER LINDSAY, M.D 137
V. On the Botany of the "Jardin" of Mont Blanc. By Dr BUCHANAN WHITE 140
VI. Notes on *Grimmia subsquarrosa* of Wilson's MS. By Dr BUCHANAN WHITE. (Plate III.) 142
VII. Note on the Occurrence of *Buxbaumia indusiata* in Aberdeenshire. By Professor DICKIE 142
VIII. Extracts from Botanical Correspondence. By Mr JOHN SADLER 143
IX. Report on the State of the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'NAB 144

PROCEEDINGS FOR MAY 1867.

Obituary Notice 145
I. On Submarine Forests, and other Remains of Indigenous Wood in Orkney. By Dr WM. TRAILL 146
II. On the Lichen-Flora of Druidical Stones in Scotland. By Dr W. LAUDER LINDSAY 154
III. On the Introduction of the Mahogany Tree into Bengal. By Dr THOMAS ANDERSON 162
IV. Notice of some Rare British Mosses recently collected near Edinburgh. By Mr JOHN SADLER 163
V. Notice of an Excursion to the Forest of Fontainbleau. By Mr G. W. R. HAY 163
VI. Notice of the Bunch-Grass of California. By Mr M'NAB 164

PROCEEDINGS FOR JUNE 1867.

I. On the Arctic Cladoniæ. By Dr W. LAUDER LINDSAY 166
II. Recent Regulations regarding the Forest Department of India. By Professor BALFOUR 187
III. Recent Botanical Intelligence. By Professor BALFOUR 189
IV. On a supposed New Species of Vellozia, or probably a New Genus of the Order Hæmodoraceæ. By Professor BALFOUR 189
V. On the Discovery of *Orthotrichum phyllanthum* near Edinburgh. By Mr JOHN SADLER 190

PROCEEDINGS FOR JULY 1867.

I. On the Discovery of *Buxbaumia indusiata* near Aboyne. By Professor DICKIE 192
II. Botanical Intelligence. By Professer BALFOUR 192
1. On *Talbotia elegans*. By Professor BALFOUR 192
2. On Gases found in Plants. By Messrs FAIVRE and DUPRÉ 192
3. On the Nature and Structure of the Pod of Cruciferæ. By Professor BALFOUR 194
III. On the Palm Trees of Old Calabar. By the late WM. GRANT MILNE 195
IV. Notice of Two Mosses new to Science. By Dr BUCHANAN WHITE. (Plate III.) 198
V. On a supposed Fungoid Disease affecting the Human Hair. By JOHN BISHOP, Esq. 199
VI. Addenda to the Cryptogamic Flora of New Zealand. By Dr W. LAUDER LINDSAY 201

Digitized by Google

Proceedings for November 1867.

Page
Opening Address by the President (Isaac Anderson-Henry, Esq.)............ 206
I. Abstract of Observations on New Zealand Plants. By W. Lauder Lindsay, M.D. 231
II. Letter from Dr Robert O. Cunningham, H.M.S. "Nassau," Rio de Janeiro, to Professor Balfour 234
III. Notice of Mussana Bark (*Albizzia anthelmintica*) from Abyssinia. By Henry Hunter Calvert, Esq., British Vice-Consul, Alexandria. Communicated by Professor Balfour.... 238
IV. Extracts from Botanical Correspondence. Communicated by Mr Sadler. 239
Miscellaneous Notices........ 241

Proceedings for December 1867.

I. On the Nature of the Discoloration of the Arctic Seas. By Robert Brown, F.R.G.S........ 244
II. Notes on the Flora of Rannoch. By Dr F. Buchanan White.............. 252
III. Notice of a New Carduus gathered during a botanical visit to Ross-shire. By Mr Charles Howie and Mr Charles Jenner........ ... 257
IV. On the Botany of Frodsham Marshes, Cheshire. By Mr James F. Robinson. Communicated by Mr Sadler........ 265
V. Botanical Rambles up the Weaver Valley. By Mr James F. Robinson.. 267

Proceedings for January 1868.

I. Obituary Notices of Professor Daubeny, Oxford; Rev. Dr Hamilton, London; and Dr Schultz, Deidesheim, late Fellows of the Society. By Professor Balfour........ 267
II. Notice of a New British Moss (*Amblystegium confervoides* of Bruch and Schimper) in Dovedale, Staffordshire. By Dr John Fraser. Communicated by Mr John Sadler. (Plate IV.)........ 272
III. Account of a Botanical Trip to the Vosges Mountains. By Mr R. M. Stark........ 274
IV. Letter from Mr Wm. Bell, dated Kaoligir, (Dera-Doon), 2d November 1867, to Professor Balfour........ 274
V. Notice of Plants collected near Kirkmichael, Strathspey. By Mr Allan Coldstream........ 292
VI. Observations on New Zealand Plants, No. 3. By Dr Lauder Lindsay.. 292
Miscellaneous Communications... 292

Proceedings for February 1868.

I. Notice of Botanical Excursions in the Highlands of Scotland during the Autumn of 1867. By Professor Balfour........ 293
II. On Plants and Animals used for Food in Old Calabar. Extracted from the MS. Journals of the late Mr W. G. Milne, by Mr John Sadler.............. 300
III. Remarks on species of Elymus, Triticum, and Phleum from Vancouver's Island. By Professor Balfour........ 301
IV. Report on the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'Nab........ 303
V. Miscellaneous Notices........ 303

Proceedings for March 1868.

I. Obituary Notice of John Baddeley, M.B., C.M., late Fellow of the Society. By Professor Balfour........ 304
II. Notes on some New and Rare Mosses gathered in Ross-shire and Inverness-shire in July, by Mr Charles Jenner and Mr Charles Howie. By Mr Charles Howie, with Drawings and Descriptions by Professor Schimper. Communicated by Mr Sadler. (Plate V.)........ 31
III. On a peculiarity in the Structure of the Stem of *Hedera Helix*. By W. R. M'Nab, M.D., Edinburgh........ 316
IV. Recent Botanical Intelligence. By Professor Balfour........ 319
V. Report on the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'Nab........ 321
VI. Proposal for an Alpine Botanical Club........ 323

Digitized by Google

PROCEEDINGS FOR APRIL 1868.

Page

I. On the *Genus Lophiostoma* of British Fungi. By Mr M. C. COOKE, (Plate VI.)........ 325
II. On the British Species of Delphinium. By W. R. M'NAB, M.D........ 332
III. Report on the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'NAB........ 336
IV. Miscellaneous Notices........ 337

PROCEEDINGS FOR MAY 1868.

I. On the Cultivation of Sumach (*Rhus Coriaria*), in the vicinity of Colli, near Palermo. By Professor INZENGA. Translated by Colonel H. YULE, C.B. Communicated by Dr CLEGHORN........ 341
II. Notes of Mosses and Hepaticæ, collected by ROBERT BROWN, Esq., on the North-West Coast of America. By GEORGE DICKIE, M.D., F.L.S., Professor of Botany, University of Aberdeen........ 355
III. A Monograph of the Coniferous Genus *Thuja*, Linn., and of the North American species of the Genus *Libocedrus*, Endl. By ROBERT BROWN, F.R.G.S........ 358
IV. On the Vegetable Products used by the North-West American Indians as Food and Medicine, in the Arts, and in Superstitious Rites. By ROBERT BROWN, F.R.G.S........ 378
V. Report on the Open-Air Vegetation at the Royal Botanic Garden. By Mr M'NAB........ 396
VI. Miscellaneous Communications........ 397

PROCEEDINGS FOR JUNE 1868.

I. On the Reproduction and Cross Fertilisation of Passifloras. By Mr ROBERTSON MUNRO. Communicated by Mr SADLER........ 399
II. On the Characters of the Akazga Plant, and the difference between the Structure of its Stem and that of *Strychnos Nux-vomica*. By THOMAS R. FRASER, M.D., F.R.S.E., M.R.C.P.E., Assistant to the Professor of Materia Medica in the University of Edinburgh. (Plate VII.)........ 403
III. Notice of Poisoning of Goats by Rhododendrons. By Mr P. S. ROBERTSON........ 409
IV. Miscellaneous Communications........ 412

PROCEEDINGS FOR JULY 1868.

I. Biographical Notice of the late Dr Walker-Arnott, Regius Professor of Botany in the University of Glasgow. By Dr HUGH CLEGHORN, F.L.S........ 414
II. Obituary Notice of N. B. Ward, Esq. By Professor BALFOUR........ 426
III. Florula Discoana: Contributions to the Phyto-Geography of Greenland, within the Parallels of 68° and 70° North Latitude. By ROBERT BROWN, F.R.G.S., &c........ 430
IV. Notes of Algæ collected on the Coast of North-West America, by Mr R. Brown. By Professor DICKIE, Aberdeen........ 465
V. On the Numerical Law of Flowers. By JOSEPH BULLAR, M.D........ 467
VI. Notes of a Visit to Strath Glass and its Tributary Glens. By Rev. JAMES FARQUHARSON, Selkirk........ 474
VII. Notes on Vegetable Morphology. By Colonel COLLINSON, R.E., Malta. Communicated by Dr CLEGHORN........ 480
VIII. Notice of Plants collected during recent Excursions with Pupils. By Professor BALFOUR........ 480
IX. Physiological Effect of the Juice of *Scopolia lurida*, Dun. (*Anisodus luridus*, Link). By Professor CHRISTISON........ 482
X. Miscellaneous Communications........ 482

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LIST OF PLATES.

		Page
PLATE I.	Figs. 1-5, Selaginella Veitchii, *W. R. M'Nab*, . Figs. 6–8, S. involvens, *Spr.*	3
II.	Silicified Vegetable Structures from the Zambesi, .	131
III.	Fig. 1, Grimmia subsquarrosa, *Wilson*, . . .	142
	,, 2, Hypnum rupestre, *White*.	198
	,, 3, Hypnum Breadalbanense, *White*. . . .	198
IV.	Amblystegium confervoides, *B. & S.* . . :	272
V.	Didymodon Jenneri, *Sch.*, ...	314
VI.	Genus Lophiostoma, ...	325
VII.	Figs. 1 & 2, Sections of Stem of Akazga Plant, . Figs. 3 & 4, Do. Strychnos Nux-vomica,	403

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TRANSACTIONS

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BOTANICAL SOCIETY.

VOL. IX.—PART I.

EDINBURGH:
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The Botanical Society of Edinburgh is prepared to make exchanges of plants with Foreign Botanists. Extra-European species, and more particularly Ferns, are desirable.

British or Foreign species will be given in exchange, in accordance with the wish of the Contributor.

Part 3 of Vol. I. of the Transactions has been reprinted, and complete copies of the Transactions, up to Vol. VIII. inclusive, can be had for L.3, 10s., from the Treasurer.

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TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

8th November 1866.—Professor BALFOUR in the Chair.

The following Donations to the Library were laid on the table:—

Journal of the Linnean Society, London, Vol. IX. Nos. 36, 37 (Botany).—From the Society.

Journal of the Royal Horticultural Society, London, Vol. I. Part 3.—From the Society.

Proceedings of the Royal Horticultural Society, London, Vol. I. No. 5. (New Series).—From the Society.

Memoirs of the Literary and Philosophical Society of Manchester, Vol. II.

Proceedings of the same, Vols. III. and IV.—From the Society.

Natural History Transactions of Northumberland and Durham, Vol. I. Part 2.—From the Tyneside Naturalists' Field Club.

Flora of Devon and Cornwall. By Isaiah W. N. Keys.—From the Author.

Folicolous Sphæriæ. By M. C. Cooke.—From the Author.

Paradisi in Sole Paridisus Terrestris. By John Parkinson, 1629; and,

Theatrum Botanicum, the Theater of Plants. By John Parkinson, 1640.—From Dr Dickson, Jersey.

Annals of the Lyceum of Natural History of New York. Vol. VIII. Nos. 4–10.—From the Society.

Annual Report of the Smithsonian Institution. Washington, 1865.—From the Institution.

Extent and Nature of the Materials available for the Preparation of a Medical and Surgical History of the American Rebellion, Circular No. 6.—From the American War Office.

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Proceedings of the Boston Society of Natural History, 1865.—From the Society.

Proceedings of the Agri-Horticultural Society of the Punjab, 1865–66.—From the Society.

Actes de la Société Helvétique des Sciences Naturelles réunie a Genève, 1865.—From the Society.

Mittheilungen der Naturforschenden Gesellschaft in Bern, Nr. 580–602.—From the Society.

Rondelet et ses Disciples, ou la Botanique a Montpellier au XVIme Siècle. Discours et Appendice. Par M. J. E. Planchon.—From the Author.

Analysen zu den Natürlichen Ordnungen der Gewächse und deren Sämmtlichen Familien in Europa, Nr 1. Von Dr Adalbert Schnizlein.—From the Author.

Nya Botaniska Notiser utgifne af K. F. Thedenius.—From Dr Lauder Lindsay.

The following additions to the University Herbarium were announced:—

Leighton's Lichenes Britannici Exsiccati. Fasc. XIII.

From Dr Lauder Lindsay—Parcel of New Zealand and Australian Lichens.

From Mr J. F. Robinson, Frodsham—Parcel of British Plants.

From Mr John Sim—Specimens of *Sanguisorba canadensis*, collected near Perth.

The following Donations to the Museum at the Royal Botanic Garden were noticed:—

From Mrs Millar—Cake of Maple Sugar.

From the Earl of Mansfield—Branch of *Picea nobilis*, with eleven cones, produced at Scone Palace.

From Humphrey Graham, Esq.—Cone of *Picea nobilis*, produced at Belstane.

From Dr Duckworth—Galls on Beach Leaves, from Lucerne.

From Dr Forbes Watson—Fruit of *Jonesia Asoca.*

From Dr Mueller—Pods of *Cathartocarpus Brewsteri*, from Melbourne.

From Sir William Jardine, Bart.—Specimens of different kinds of Peat, taken from the Lake of Haarlem.

From Mr F. Page—Native Australian Dagger.

From Dr G. Dickson—Skeleton Leaves, prepared by himself, by means of a solution of Caustic Potass.

A letter was read from Professor Pringsheim, of Jena, thanking the Society for the honour they had conferred on

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him in electing him a Foreign Member. He also transmitted his photograph for the Society's album.

The Chairman made some opening remarks, in which he referred to the death of Dr Greville, the late president; of Dr W. H. Harvey, Professor of Botany, Trinity College, Dublin, an Honorary Fellow of the Society, who died on 15th May 1866, at the age of fifty-five; of Jean François Camille Montagne, one of the Foreign Honorary Fellows of the Society, a distinguished cryptogamic botanist, who died on 9th January 1866, at the age of eighty-two; and of Diedrich Friedrich Ludovic Von Schlechtendal, Professor of Botany and Director of the Botanic Garden at Halle, another Foreign Honorary Fellow, who died on 12th October 1866. It was stated that the following were the number of members on the roll of the Society:—Royal personages, 2; Honorary Fellows (British), 5; Honorary Fellows (Foreign), 23; Resident Fellows, 94; Non-resident Fellows, 268; Foreign and Corresponding Members, 96; Associates, 25; Ladies, 11—total, 524. The Chairman congratulated the members on the continued prosperity of the Society, and alluded to the valuable papers which had been read during the last Session, and which are printed in the "Transactions."

The following Communications were then read:—

I. *On the Selaginellas cultivated in the Royal Botanic Garden, Edinburgh.* By W. R. M'Nab, M.D., Edinburgh. (Plate I.)

The nomenclature of the cultivated Selaginellas is at present in a state of great confusion. The names given by Spring* in his Monograph have not been adhered to, and in many cases, the plants, when introduced, have been named without any attempt being made to discover whether the species had been already described or not. Such being the case, considerable confusion must be expected. In 1860 Professor Alex. Braun † published a paper entitled "Revisio Selaginellarum Hortensium," in which he gives the syno-

* Spring, Mem. de l'Acad. Roy. de Belgique. 1850.
† Annales des Sciences Nat. (Bot.) vol. xiii. 1860. p. 54.

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nomy of the Selaginellas then cultivated on the Continent and in Britain. This paper has, however, been entirely overlooked in this country, and the names of the Selaginellas in our nurseries and gardens have remained as they were. There are also a few recently introduced species added to our lists since Professor Braun's "Revisio" was published, and the confusion is thus growing worse and worse every year.

There is a twofold object in laying this paper before the Botanical Society. In the first place, it will help to make Professor Braun's paper better known in this country than it is at present; and, secondly, to endeavour to put the nomenclature of all the species now cultivated in Britain in a better state than it is, and save many of the inconveniences which at present this confusion occasions.

To give an idea of the confusion of names, and the mistakes it leads to, the following may be stated:—In nurserymen's catalogues we see the same species under two names at different prices, and even marked at one place as a stove, and another as a greenhouse plant. Then, again, the varieties of that ever-varying *S. Martensii* do duty for a large number of species figuring in nursery catalogues under different names and at different prices. Then, lastly we find the same species doing duty under two names at exhibitions in collections of limited extent sent in to compete for prizes. But can all this be wondered at when you find every one giving names of his own to species already described?

In attempting to name the Selaginellas in the Botanic Garden I have had to examine a great many specimens from other collections. I am indebted to Mr J. Smith, curator of the Royal Gardens, Kew, for a set of the specimens cultivated in that establishment. The Hookerian Herbarium at Kew has also been consulted, and a set of dried garden Selaginellas from Professor Braun in the Kew Herbarium, has afforded the means of identifying the species mentioned in the "Revisio Selaginellarum Hortensium." Lastly, Messrs Veitch and Sons, Royal Exotic Nursery, Chelsea, and Messrs T. Jackson and Son, Kingston, S.W., have very kindly supplied me most liberally with any specimens I wanted from their establishments.

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The arrangement followed is that of Professor Braun. All the species mentioned by him are inserted, although some of them are not, as far as I know, in cultivation in this country.

I. Homotropæ, A. Br. (*Homophyllæ*, Spr.)

Leaves all of the same shape (homomorphous), spreading in all directions.

A. Polystichæ. Leaves in many rows.

(*a*) *Cylindrostachyæ.* Bracts in many rows.

1. *Selaginella spinulosa*, A. Br. (*Lycopodium selaginoides*, Linn.) It is a native of Europe and North America. Found wild in Britain, and often cultivated.

(*b*) *Tetragonostachyæ.* Bracts in four rows.

2. *Selaginella rupestris*, Spring. (*Lycopodium rupestris*, Willd.) Widely distributed over the globe, being found in North and South America, South Africa, and the East Indies, but not in cultivation in this country, so far as I know.

B. Tetrastichæ. Leaves (and bracts) in four rows.

3. *Selaginella uliginosa*, Labill.—From Australia and New Zealand. Not uncommon in gardens and nurseries under the name of *Lycopodium uliginosum.* A very easily distinguished species, of long slender form, with long stiff leaves arranged in four rows, the leaves being opposite, and decussate.
4. *Selaginella pumila*, Spring. (*Lycopodium pumilum*, Schlecht. *L. pygmæum*, Kaulf. *L. bryoides*, Kaulf.) A very small South African species, of which I have only seen dried specimens.

II. Dichotropæ, A. Br. (*Heterophyllæ*, Spr.)

Leaves dimorphous, in four rows; bifarious.

A. Tetragonostachyæ, Hook. and Grev. Bracts homomorphous; spikes tetragonal.

(*a*) *Continuæ*, Spr. Stem not jointed (continuous); rootlets posterior.

a Repentes. Surculi creeping; rooting everywhere; growing continuously and indefinitely in length; or with the growth interrupted, and producing buds (innovations) at the apex; leaves dimorphous, bifarious.

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* *Sparsely branched; spikes terminal.*

5. *Selaginella apus*, Spr. (*S. apodum*, *S. brasiliensis*, Hort.) A well-known garden species, occurring in small green tufts. A native of North America.
6. *Selaginella Ludoviciana*, A. Br. (*apus γ denticulata*, *apothesa*, *apotheca*, *Louisiana*, Hort.) A much larger species than *S. apus*; the leaves with a white margin. A native of the southern part of North America. (*S. apothecia*, Hort. Veitch.)

** *Widely branched; spikes branchlike.*

7. *Selaginella helvetica*, Link. A South European species, but not so common in gardens as it should be.
8. *Selaginella denticulata*, Link. (*obtusa*, *obtusata*, Hort.) Also from the south of Europe; like *S. helvetica*, and quite distinct from the *S. denticulata* of gardens.

*** *Pinnately branched; spikes at the ends of the branchlets.*

9. *Selaginella delicatissima*, A. Br. In gardens as *S. microphylla*. A little like *apus*, but with very minute leaves. Its native country is unknown.
10. *Selaginella serpens*, Spr. From Jamaica, Cuba, and Mexico. Very abundant, under the names *S. mutabilis*, *variabilis*, and *jamaicensis*, Hort. (*S. argentea*, Hort. Veitch). The colour of this species varies at different times of the day. The large leaves are ovate.
11. *Selaginella sarmentosa*, A. Br. (*Whartoni*, Hort., *patula*, Spr.?) A West Indian species not common in gardens; not unlike the preceding, the leaves, however, narrower.
12. *Selaginella uncinata*, Spr. (*cæsia*, Hort.) A well-known bluish-green coloured species from China.
13. *Selaginella Breynii*, Spr. (*Panamensis*, Hort., *Pœppigiana*, Hort. Van Houtte.) A very pretty South American species, but not in cultivation in this country.

β *Adscendentes.* Surculi ascending, often sending off aerial roots; branches pyramidal or fastigiate.

* *Persistentes, perennial, producing buds (innovations) from the unchanged apices of the surculi.*

14. *Selaginella Martensii*, Spr. A very variable species from Mexico and Brazil.

    (a) *S. Martensii normalis*, A. Br. (*S. Martensii*, *stolonifera*, *sulcata*, *decomposita*, and *pulla*, Hort.)

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(β) *S. Martensii*, var. *flaccida*, A. Br. (*S. alata*, Hort. *S. circinale*, Hort.)

(γ) *S. Martensii*, var. *compacta*, A. Br. (*S. Huegelii*, *Danielsiana*, *monstrosa*, *asplenifolia*, Hort.) *S. formosa*, *S. robusta*, Hort.

(δ) *S. Martensii*, var. *divaricata*, A. Br. (*dichotoma*, Hort., *flexuosa*, Hort.)

(ε) *S. Martensii*, var. *congesta*, A. Br. (*S. ramosum*, *compactum*, Hort. Rollison.)

The *S. Martensii* and *S. stolonifera*, Hort., are synonyms of the *S. Martensii normalis*, and is a well-known garden species. *S. circinale*, Hort. Veitch, is apparently var. *flaccida*. *S. Danielsiana*, Hort. Edin., *S. formosa*, Hort. Edin. and Hort. Kew, *S. robusta*, Hort. Kew, are all *S. Martensii* var. *compacta*. *S. flexuosa*, Hort. Veitch, and *S. dichotoma*, Hort. Kew, are *S. Martensii*, var. *divaricata*. I have not seen *S. Martensii*, var. *congesta*.

The supposed hybrid *Selaginella* raised by Mr Scott, and described in the Botanical Society's Transactions, is a cross between *S. Martensii normalis* and *S. Martensii compacta* (*Danielsiana*, Hort.)

There are also variegated specimens of the *S. Martensii* in cultivation.

15. *Selaginella atroviridis*, Spr. A very handsome dark-green species introduced from Borneo by Messrs Veitch & Sons.

** *Redivivæ, ends of the upper or lower branches flagelliform or bulbiferous.*

16. *Selaginella ciliata*, A. Br. (*Warczewiczii*, Hort. Berol.) A South American species, not in cultivation in this country.

17. *Selaginella increscentifolia*, Spr. Also from South America, but not in cultivation here.

γ *Proceræ.* Surculi ascending, erect, or climbing; of indefinite length; branches definite, frondiform at the base, or at opposite side soboliferous.

* *Erectæ.*

18. *Selaginella inæqualifolia*, Spr. An East Indian species, apparently rare in collections.

** *Scandentes.*

19. *Selaginella lævigata*, Spr. A very common species from the East Indies, known as *S. cæsia arborea*. It resembles *cæsia* in the colour of the frond, but in no other particular.

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δ *Caulescentes.* Surculi erect, rooting at the base, and sending off hypogeal or epigeal stolons; below, simple; above, branching and expanding in the form of a frond of definite shape. Leaves on the primary axis often homomorphous.

20. *Selaginella caulescens*, Spr. A handsome species from the West Indies. A small variety, *β minor*, in Hort. Kew.
21. *Selaginella japonica*, Moore, Hort. Chels. (*S. involvens*, Hort., not Spring.) This species was sent home from Japan by Mr Fortune, and is in cultivation under the name *S. involvens.* It belongs, apparently, to the *Caulescentes.* It is a small, fine-leaved species, with the spikes of fruit peculiarly curled. Mr Moore has it in the Botanic Garden, Chelsea, labelled *S. japonica.* It is an undescribed species, and I have accordingly allowed Mr Moore's name to stand. It is not to be confounded with *S. involvens*, Spring, a species newly introduced from Japan by the Messrs Veitch, and one of the *Rosulatæ.*
22. *Selaginella erythropus*, Spr. (*S. umbrosum*, Hort. *S. Warczewiczii*, Hort. Veitch.) A small-leaved, red-stalked species from South America; not uncommon in collections.
23. *Selaginella viticulosa*, Kl. (*S. reticulata*, Hort. Jackson. *S. erythropus*, Hort. Veitch.) A very pretty species not unlike *S. erythropus*, but the stalks are green, and the under-surface is a beautiful silvery white colour. It is a native of Columbia, in South America.
24. *Selaginella flabellata*, Spr. A native of the West Indies and South America. Apparently rare in collections.
25. *Selaginella conferta*, Moore. A very pretty species introduced from Borneo by the Messrs Veitch.
26. *Selaginella hæmatodes*, Spr. (*S. filicina*, *Karsteniana*, Hort. *Warczewiczii*, Hort. Edin.) A red-stalked species from Columbia, S. America; easily distinguished from *S. erythropus* by its large size, more robust habit, and much larger and more distant leaves.
27. *Selaginella Griffithii*, Spr., Borneo. Introduced by the Messrs Veitch, but still rare in collections.
28. *Selaginella Lyallii*, Hook. and Grev. A very distinct species, from Madagascar, and not easily confounded with any other at present in cultivation.
29. *Selaginella Wallichii*, Spr. A very elegant species, introduced from Penang, by the Messrs Veitch, and now

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extensively cultivated. It is closely allied to the next species.

30. *Selaginella Lobbii*, James Veitch. Very close to *S. Wallichii*, but the leaflets more distant, and the *folia minora* more lanceolate. It is also handsomer, and is probably the finest Selaginella in cultivation. It was sent home from Borneo by Mr Lobb, collector for Messrs Veitch and Sons.

31. *Selaginella Pervillei*, Spr. (*S. africana*, Hort.) This species is very common under the garden name *S. africana*. A native of the island of Nosi Beh, near Madagascar. It is apparently confounded with the next species, *S. Vogelii*, from Fernando Po. I have a specimen from Mr Smith, from the Royal Gardens, Kew, named "*S. africana*, Br., West Africa," which is certainly *S. Vogelii*.

32. *Selaginella Vogelii*, Spr. This species is cultivated in the Botanic Garden, Edinburgh, as "*Selaginella*, sp. Old Calabar, Dr Hewan." It closely resembles the preceding species. The *Selaginella triangulare*, Hort. Edin., is apparently this species. It is probable that this species was received at Kew from Mr Mann, when collecting at Fernando Po, and been cultivated as the *S. africana*. The country, "West Africa," marked on the label, gives this additional weight. *S. Vogelii* is a very pubescent species.

33. *Selaginella pubescens*, Spr. This is a well-known species, long cultivated in gardens as the *S. Willdenovii*. It is a native of the East Indies. I possess a specimen from Kew Gardens, marked *S. Pogellii*. This is probably a mistake for *S. Vogelii*, and might be due to an accidental change of the label of the plant growing in the garden.

ε *Rosulatæ*. Surculi arranged in a spiral manner around a central axis, generally rolling in when dry.

34. *Selaginella cuspidata*, Link, (*cordifolia*, *avilæ*, *palusiana*, Hort.) A very pretty species, from Mexico, Guatemala, and Columbia, common in gardens. There are two well-marked forms of it, the true *cuspidata*, and a large form, the var. *elongata*, Spr. This last var. is the *S. cordifolia* of the Hort. Edin.

35. *Selaginella convoluta* (Walker-Arnott), Spr. (*paradoxa*, Hort.) A small species, common in gardens. It is a native of Brazil, Guyana, and Columbia.

36. *Selaginella involvens*, Spr. This is for the first time recorded as cultivated in this country. It was introduced from

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Japan by J. Gould Veitch, Esq. It is the true *S. involvens* of Spring, and must not be confounded with the *S. involvens*, Hort., which, as we have seen, is the *S. japonica* of Moore, Hort. Chels. The fronds are 4 or 5 inches long, of a fine green colour, and with a dark-brown streak in the back of the branch. The posterior edges of the *folia majora* are also brown. It will, no doubt, be a great acquisition. Messrs Veitch of Chelsea possess the only plants yet introduced, and I am indebted to their kindness for a specimen of it.

37. *Selaginella Veitchii*, Mihi. Surculis numerosissimis rosulatim confertis, patentibus, siccitate involutis, inæqualiter dichotomis, fastigiatis: foliis distantibus, glabris, nitidis, lateribus recurvatis, ovatis, falcatis, cuspidatis, remote serrulatis, basi inæqualiter cordatis, marginibus internis scariis; intermediis vix minoribus lanceolato falcatis, cuspidatis, remote serrulatis, nervo lineari prominente: bracteis e basi ovata, longe acuminatis, serratis, albomarginatis.

This species was introduced from Japan by Mr J. Gould Veitch, to whom I have dedicated the species. It resembles *S. involvens*, but is easily distinguished by its much more lax habit and more distant leaves. The leaves of *S. involvens* are more acuminate, while those of *S. Veitchii* are more ovate-falcate, the leaves bulging out greatly to the outer side. The *folia minora* are also more lanceolate than those of *S. involvens*. The bracts are larger and more acuminate in *S. Veitchii* than in *S. involvens*. The macrospores are yellow, $\frac{15}{1000}$th of an inch in diameter; the microspores are of a bright vermilion red, and $\frac{24}{1000}$th of an inch in diameter.

38. *Selaginella pilifera*, A. Br. This is the *S. lepidophylla* of gardens. It is quite distinct from the *S. lepidophylla* of Spring, so well known for its curious hygroscopic properties. It is supposed to be a native of Texas.

(*b.*) *Articulatæ.* Stem below each bifurcation with a joint-like swelling; rootlets anterior.

a Repentes.

* *Widely branched.*

39. *Selaginella Kraussiana*, Kunze (*hortensis*, Mett., *denticulata*, Hort.) This species is the one so long known as *S. denticulata.* Professor Braun has shown that this

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species, when introduced, was thought to be the *L. denticulatum* of Linnæus, and was even so described by Spring. Mettenius in 1856 (Filices, Hort. Bot. Lips.), discovered that this species was not the *denticulata* of Linnæus, but one of the *Articulatæ* section, and described it as *S. hortensis.* Professor Braun has identified this plant with the South African *L. Kraussianum* of Kunze (Linnæa, xviii. 1844, p. 114). Spring had in his Monograph confused *S. Kraussiana* with *S. mnoides*, and it is only now, thanks to the researches of Professor Braun, that we really know what the plant is. *S. Kraussiana* is a South African species, and is apparently widely distributed.

** *Pinnately branched.*

To this division the true *S. stolonifera* belongs. It is a West Indian species, and is not yet in cultivation in Europe. The *S. stolonifera* of gardens is *S. Martensii.*

β Adscendentes.

40. *Selaginella Galeottii*, Spr. (*Schottii*, Hort). A well-known garden species, which has been long in cultivation. It is a native of Mexico and Panama.
41. *Selaginella sulcata*, Spr. A very common Brazilian species, but not in cultivation in this country. Professor Braun says it is cultivated in the St Petersburg Garden. It resembles *S. Martensii*, and might be easily confounded with it, if the articulated nature of *S. sulcata* were not kept in mind.
42. *Selaginella affinis*, A. Br., is also included in Braun's list as *S. Pœppigiana*, Hook. and Grev., but I have not met with it. It is a South American species.

B. Platystachyæ. Bracts dimorphous, bifariously expanded; spikes compressed.

b. Resupinatæ. Anterior bracts largest; spikes resupinate.

43. *Selaginella stenophylla*, A. Br. (*microphylla*, Hort.) This species is a well-marked one, the large anterior bracts of the spikes at once distinguishing it. I have only seen it in Messrs Jackson's Nursery. It is a native of Mexico.
44. *Selaginella rubricaulis* (Moore), A. Br. This is an African species belonging to the same section as *S. stenophylla*, from which it is easily distinguished by its red stem, more pointed leaves, and narrower *folia minora.*

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TABULAR VIEW of the Synonymy of the *Selaginellas* cultivated in the Royal Botanic Garden, Edinburgh; the Royal Gardens, Kew; Messrs Veitch and Son's Nursery, Chelsea; and Messrs Jackson and Son's Nursery, Kingston-on-Thames. Kew and Edinburgh shew the names in such establishments as name their own plants —while the last two columns may be taken to represent the names used in the trade, and therefore mostly garden names.

Name.	Hort. Edin.	Hort. Kew.	Veitch's Nursery.	Jackson's Nursery.
Selaginella apus, *Lin.*	S. apus	S. apus	S. apodum brasiliensis	S. apodum
atroviride, *Spr.*	atroviride	atroviride	atroviride	atroviride
caulescens, *Spr.*	caulescens	caulescens	caulescens	......
,, var. minor	......	,, var. minor	,, var. minor	......
conferta, *Moore*	......	conferta	conferta	......
convoluta, *Spr.*	paradoxa	paradoxa	paradoxa	paradoxa
cuspidata, *Link.*	cuspidata	cuspidata	cordifolia	circinale
,, β elongata	cordifolia	,, β elongata	......	......
delicatissima, *A. Br.*	......	microphylla	microphylla	......
denticulata, *Link.*	......	denticulata	......	obtusata
erythropus, *Spr.*	umbrosum	......	Warczewiczii	umbrosum
flabellata, *Spr.*	......	flabellata	......	......
Galeottii, *Spr.*	Galeottii Schottii	Galeottii	Galeottii Schottii	Galeottii
Griffithii, *Spr.*	......	Griffithii	Griffithii	......
hæmatodes, *Kze.*	Warczewiczii	filicina	Karsteniana	......
helvetica, *Link.*	......	helvetica	......	......
involvens, *Spr.*	......	......	sp. Japan	......
inæqualifolia, *Spr.*	......	inæqualifolia	inæqualifolia	......
japonica, *Moore*	......	involvens	involvens. olim japonica	involvens
Kraussiana, *Kze.*	denticulata	hortensis	denticulata	denticulata
lævigata, *Spr.*	lævigata	lævigata	lævigata cæsia-arborea	......
Lobbii, *Veitch*	......	......	Lobbii	......
Lyallii, *Hook. & Grev.*	Lyallii	Lyallii	Lyallii	Lyallii
Ludoviciana, *A. Br.*	......	Ludoviciana	apothecia	......
Martensii, *Spr.*	Martensii	Martensii stolonifera	Martensii	Martensii
,, β flaccida	......	......	circinale	......
,, γ compacta	formosa Danielsiana	formosa robusta	formosa	......
,, δ divaricata	......	dichotoma	flexuosa	......
Pervillei, *Spr.*	africana	......	africana	......
pilifera, *A. Br.*	lepidophylla	lepidophylla	lepidophylla	lepidophylla
pubescens, *Spr.*	Willdenovii	pubescens Pogellii	pubescens Willdenovii	pubescens
rubricaulis, *A. Br.*	rubricaulis	rubricaulis	rubricaulis	rubricaulis
sarmentosa, *A. Br.*	......	sarmentosa	......	......
serpens, *Spr.*	serpens	serpens	argentea serpens	variabilis
stenophylla, *A. Br.*	......	......	......	microphylla
uliginosa, *Labill.*	uliginosa	......	uliginosa	uliginosa
uncinata, *Spr.*	cæsia	uncinata	cæsia	cæsia
Veitchii, *M'Nab*	......	......	sp. Japan	......
viticulosa, *Kl.*	viticulosa	viticulosa	erythropus	reticulata
Vogelii, *Spr.*	triangulare sp. Old Calabar	africana (West Africa)	......	......
Wallichii, *Spr.*	Wallichii	Wallichii	Wallichii	Wallichii

The thirty-six species enumerated here are those I have actually examined, with the synonyms under which they appear, in the different gardens and nurseries. A blank

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signifies that I have not seen or examined the species from that collection in which column the blank occurs. Prof. Braun, in his "Revisio," enumerates thirty-five species. *Selaginella spinulosa* I have not included in the list of species examined, and I have not seen *S. rupestris*, *S. pumila*, *S. Breynii*, *S. ciliata*, *S. increscentifolia*, *S. sulcata*, and *S. affinis*, in cultivation in this country.

Species enumerated in my paper, ...	44
Species, living cultivated specimens of which have been examined, ...	36
British species, ...	1
Species enumerated by Braun, but which I have not seen in cultivation, ...	7
	44

DESCRIPTION OF PLATE I.

Figs. 1 *to* 5.—*S. Veitchii*, Mihi.

1. *Folium majus.* *a*, superior margin; *b*, inferior margin; *c*, scarious portion; *d*, dark pitchy brown band; the rest green.
2. *Folium minus.* *a*, superior margin; *b*, inferior margin. The margins are white as far as the dotted line.
3. Gabelblatt (leaf produced at the back of each bifurcation), both sides are externally scarious, then with a dark pitchy brown band; middle dark green.
4. Bract from the fruit, posterior view.
5. Anterior surface, with sporangium.

Figs. 6 *to* 8.—*S. involvens*, Spr.

6. *Folium majus.* *a*, superior margin; *b*, inferior margin; *c*, scarious portion; *d*, dark pitchy brown portion.
7. *Folium minus.* *a*, superior margin; *b*, inferior margin. Leaf entirely dark green.
8. Gabelblatt, both margins scarious; two pitchy brown bands; centre green.

(All magnified 20 diameters).

II.—*List of Fungi collected in Otago, New Zealand.* By W. Lauder Lindsay, M.D., F.R.S.E., F.L.S., &c.

The few Fungi hereinafter enumerated were collected in the end of 1861, casually, in the course of excursions undertaken with very different objects, within a very limited area in the Greenisland district of the province of Otago, New Zealand, about 5 to 10 miles southward of the capital of the said province, Dunedin.

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Corticolous species were collected chiefly in those remnant patches of the primitive forest known respectively as Saddle-hill, Greenisland, and East Taeri "Bush." They affected the bark of the branches and trunks of dead, more frequently than of living, trees; the tree exhibiting the greatest proportion of species being the "Goai" (*Sophora tetraptera*, Aiton), whose very rugose bark, in the old state at least (as well as old weathered fabricated timber made from which), appear to be a favourite habitat of both Lichens and Fungi.

Lignicolous forms occurred mostly on the fabricated, bleached, partly decayed, old timber of farm and stockyard fences about the farm of Fairfield, Saddlehill, and its paddocks and patches of "Bush" among the Chain Hills.

Epiphyllous species were observed mostly on *Phormium tenax*, Forst., "New Zealand Flax;" *Coriaria ruscifolia*, L., "Toot;" *Clematis hexasepala*, DC., the "Puawananga" or "Poananga" of the Maoris, one of the most beautiful bush-climbers; *Epilobium junceum*, Forst., one of the common indigenous Willow Herbs; and *Microseris Forsteri*, Hook. fil. In certain cases, the parasites occurred only on the *dead* leaf or other parts of the plant; in others, they affected the *living* plant, producing disease, with or without deformity, thereof.

Terricolous species were found chiefly on the pastures of the Chain Hills (mica slate and gneiss); Saddlehill and Stoneyhill (basalt—bursting through talcose slates, and tertiary crag, sandstones and conglomerates).

My list does not adequately exhibit the total collects, which were probably about twice as numerous. It contains only such species as were found on examination in the Herbarium in a condition suitable for exact or approximate determination. My arrangements and opportunities did not admit of my doing what every student of Fungi in a new country should do—*make drawings and notes from living plants in their native habitats.* The specimens I collected were prepared for the Herbarium in the accredited way, but were not examined therein for nearly a year after the date of their collection. The result was, that about one-half may be said to have been useless for the purposes of determination of species. In certain cases, this arose from the plants having lost all their essential characters in the pro-

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cess of drying, (*e.g.* species of the genera *Agaricus*, *Geaster*, and *Æcidium*). In others, again, the specimens were found to have been collected in a degenerate, abortive, imperfect, or fruitless condition, the characteristic spores being absent (*e.g.* species of *Sphæria*).

I mention these circumstances chiefly for the information of *Botanists resident in New Zealand*, for whose immediate use, indeed, I have been induced to publish this list and commentary in its present form; because, I believe, that it is only by the examination of the plants *on the spot on which they grow* that material contributions can be made to the Fungology of New Zealand. Not only species and genera, but whole groups or classes of Fungi, are incapable of proper preservation in the Herbarium; their distinctive characters are extremely fugacious, and disappear entirely in the process of desiccation. Some, indeed, cannot be dried at all; but on removal from their place of growth, are decomposed and disappear *in toto*. These remarks apply, for instance, not only to the fleshy or succulent and the gelatinous Fungi, but to the whole tribe of "Moulds," a class which has probably, of all classes of Fungi, the widest geographical range, and possesses the greatest number of individuals; and of which, nevertheless, in New Zealand, where they must occur in abundance, nothing is yet known.

I trust that the imperfections especially of this list, may induce *local botanists* to study, in particular, the lower or microscopic Fungi of New Zealand *in their living state*, making drawings of their reproductive organs and corpuscles, and generally of their minute anatomy. By this means only is it possible to determine with accuracy the genus and species of many perishable Fungi, which are useless in the dried state to the home systematist. An additional attraction or argument is to be found in the fact, that no department of New Zealand botany (save perhaps the parallel classes of the lower or microscopic Algæ, *e.g. Diatomaceæ* and *Desmidiaceæ*,* and Lichens, *e.g. Lecideæ*, *Verrucariæ*, and *Graphideæ*) presents a field so likely to be fertile in novel and interesting species. But not only in a scientific point of view does this subject possess a high interest;

* *Vide* Paper "On the *Protophyta* of New Zealand," Quart. Journal of Microscopical Science, April 1867.

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it does so equally in a utilitarian sense, for the Fungi-produced diseases of indigenous or cultivated plants used as food, and in the arts, are of paramount interest to the whole community of New Zealand. Yet nothing, comparatively at least, is known of the important Epiphytal parasites—the "Smuts," "Bunts," "Rusts," "Rots," "Blights," "Mildews," and "Moulds"—that either already, or that will sooner or later inevitably, affect the food-plants of the great orders Cerealia, Cruciferæ, Solanaceæ, Vitaceæ, &c., whereon the prosperity of a colony, which is largely agricultural, so greatly depends. The local botanist cannot too soon study the diseases—produced by the growth of Fungi—of the food-plants of the colony; for these diseases or parasites, like certain British phænogamous weeds, invariably accompany colonisation; and if they have not already been as extensively and fatally developed as in older countries, immunity cannot be long looked for.* The *Poisonous* Fungi of Otago also await examination. At least one *Mushroom* is poisonous—a fatal accident having occurred to a child (who eat it), in Monro's Gully, Tuapeka, in May 1864.

With all its meagreness and imperfections, however, my list presents also certain features of further encouragement to the local botanist. The fact that an imperfect collection, made by a passing traveller, from a most limited area, contains upwards of 40 per cent. of new forms, affords good ground for the hope or anticipation, that a deliberate or special collection from a large area, by resident botanists, will yield fruits at least proportionate. Moreover, about one half of the apparently new forms belong to, and represent a group of parasites, of which little or nothing of a precise or satisfactory kind is yet known.† I refer to *parasites on the thallus and apothecia of Lichens.*‡ Many years ago§ I directed attention to the novelty of this field of research—to the gradually enlarging list of the species of

* In 1861, however, I found the same "blights" affecting the cabbage, rose, and other cultivated food or ornamental plants in Otago as at home.

† Group of *Fungo-lichenes*, p. 21 of this Paper.

‡ In a communication on the subject from Mr Currey in 1861, he remarks "I do not know of any Fungi growing habitually upon Lichens."

§ Monograph of *Abrothallus;* Quart. Jour. of Microscopical Science, Jan. 1857, p. 5.

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this group; and I gave expression to the opinion, which I still and more strongly entertain, that the subject is one that can be duly elaborated only by the conjoined efforts of Fungologists and Lichenologists, for the difficulties of separating the lower Fungi from the lower Lichens are extreme. Hitherto, however, this little observed and obscure group has not been successful in attracting the attention it deserves from Fungologists.

I have had the great advantage of the assistance of Mr Currey* in the examination of most of my New Zealand Fungi; and I have myself repeatedly examined them during the four years that have elapsed since my return home. The names assigned in the list—whether in the case of old or new species—have therefore not been hastily, or without due deliberation, adopted. But I have felt, in certain cases, the difficulty or danger of determining or recording as new to science species in an imperfect state, not possessing the characteristic spores or other organs essential for accurate determination. This applies especially to certain species of the genera *Sphæria*, *Microthelia*, *Æcidium*, *Celidium*, and *Phymatopsis*. Judging from the data presently at my command, I believe all the species or forms here recorded as new to science† really to be so; but the list is subject to revision and correction by local botanists, who may have opportunities of examining complete suites of specimens in a fertile and typical condition. Their researches may prove (what I even now suspect) that, in one or two cases, more than one form is included in a species;‡ that certain others are forms or synonyms of better known and already recorded species; and in one case, at least—that of *Æcidium*—they may abolish both genus and species.§ Whatever, however, may be their fate,

* In certain cases he kindly furnished the botanical diagnosis, with drawings of the spores, and he has otherwise afforded me indispensable aid throughout my inquiry. His researches on the *Sphæriacei* give to his opinions on species of the genera of that large and important family the highest value.

† *New* species are fully described in "Observations on New Lichens and *Fungi* collected in Otago, N.Z.," Trans. Royal Society of Edin. vol. xxiv. p. 423, plate xxx.

‡ *E.g.* *Celidium dubium*; *Phymatopsis dubia*.

§ If Oersted and De Bary are correct in their observations, *Æcidium* would

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the genus *Æcidium* and its species *Otagense*, are of importance as types of Fungi, which produce deformities or monstrosities of some of the most familiar and beautiful phænogams of Otago.

I. SPORIFERI.

Fam. I. AGARICACEÆ.

Ord. I. AGARICINI.

* Gen. 1. AGARICUS, L.

Sp. 1. *A. hypnorum*, Fr., var. *sphagnicola*, Currey. On upland pastures, frequented by cattle; about the base of Saddlehill.

The only one of several Agarics collected, which was found to be in a fit state for identification. *A. campestris*, L., and *A. arvensis*, Schæff., appeared to be among those I collected; but, with others, had quite lost all useful or distinctive characters in the process of drying. *Agaricus* is one of many genera of fleshy or succulent Fungi, whose species can be properly examined or determined only *in the living state;* one, in studying which, *drawings and notes should be made on the spot.* The same remark applies to the *Tremellini* or gelatinous Fungi, as well as to many others: a circumstance which the local botanist should bear carefully in mind.†

Ord. II. POLYPOREI.

* Gen. 2. POLYPORUS, Fr.

Sp. 1. *P. adustus*, Fr. On the bark of dead trees, Greenisland Bush; "a peculiar effused form" (Currey); as well as other more ordinary forms.

Sp. 2. *P. igniarius*, Fr. On trunks of trees, living and dead, Greenisland Bush; on trunks of dead trees, East Taeri Bush.

Sp. 3. *P. borealis*, Fr. On bark intermixed with moss.‡

Sp. 4. *P. sanguineus*, Fr.‡

Ord. III. AURICULARINI.

* Gen. 3. STEREUM, Fr.

* Sp. 1. *S. hirsutum*, Fr. On trees, East Taeri Bush; ravines of the

seem not to be a true genus at all, but only a form of other *Uredineæ*." Currey, 1865.)

* The asterisk * prefixed indicates genera and species which are *British*.

† *Foreign* species of *Agaricus* have hitherto been little studied; which arises in great measure from this difficulty of preserving them, and the necessity of examining them on the spot.

‡ In this and some other cases, where the precise locality of growth is not given, the label, containing the habitat and locality, has been lost.

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Chain Hills (Dobbin's Creek Bush); two or three different and common forms.

Sp. 2. *S. lobatum*, Fr.† On dead wood; "a small inconspicuous form" (Currey).

* Gen. 4. CORTICIUM, Fr.

Sp. 1. *C. ochro-leucum*, Fr. On bark; "a resupinate form" (Currey).‡

Fam. II. LYCOPERDACEÆ.

Ord. IV. PHALLOIDEI.

Gen. 5. ILEODICTYON, Tul.§

Sp. 1. *I. gracile*, Berk. A native of Australia and Tasmania; not recorded hitherto as having been found in New Zealand.‡

Ord. V. TRICHOGASTRES.

* Gen. 6. GEASTER, Mich.

Sp. 1. *G. fimbriatus*, Fr. This was probably a "puff-ball" I found on pasture lands about the flanks and base of Saddlehill; but, when examined in London about a year after their collection, my specimens were found not in a condition for accurate determination of the species.

* Gen. 7. LYCOPERDON, Tournef.

* Sp. 1. *L. giganteum*, Batsch. Base of Stoneyhill; common; grass paddocks about Myres, Inch Clutha.‡

* Sp. 2. *L. cœlatum*, Bull. Base of Stoneyhill, and on roadsides between Stoneyhill and Greenisland.

Fam. III. UREDINACEÆ.

Ord. VI. ÆCIDIACEI.

* Gen. 8. ÆCIDIUM, Pers.||

Sp. 1. *Æ. Otagense*, Linds.¶ Var. *a.* on *Clematis*; var. *b.* on *Epilobium*; var. *c.* on *Microseris*.

1. On *Clematis hexasepala*, DC. East Taeri Bush; Novem.; plant being in abundant flower; producing monstrosities of the flowers and flower-petioles.

2. On *Epilobium junceum*, Forst. On plants growing from eight

† *Vide* footnote (‡) on previous page.

‡ My Otago station is the only locality in which it has yet been found in N.Z.

§ The only non-European genus in my Otago collection.

|| My specimens were examined also by my friend M. C. Cooke, the author of a recent "Synopsis of the British *Æcidiacei*" in Seemann's Journal of Botany, vol. ii. p. 83.

¶ New Lichens and Fungi of Otago. Trans. Royal Soc. Edin. vol. xxiv. p. 430, plate. xxx. figs, 61–74.

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to fifteen inches high, on the Chain Hills and flanks of Saddlehill; Decem.; plant being in flower; on under surface of leaf.

3. On *Microseris Forsteri*, Hook. fil. In marshy places, Abbott's Creek, Greenisland; Oct. to Decem.; plant being in flower; on the leaf.

II. SPORIDIIFERI.

Fam. IV. HELVELLACEÆ.

Ord. VII. HELVELLACEI.

* Gen. 9. Peziza, Link.

* Sp. 1. *P.* (*Helotium*) *æruginosa*, Fr. On the trunks of dead trees, Saddlehill Bush. When moistened especially, the colour, as in the British plant, is a very beautiful deep emerald green. Should this parasite affect to any extent the hardwoods of Otago, they may become, like the so-called "Green Oak" of Tunbridge, available in ornamental upholstery, and the fungus-pervaded timber may thus acquire a marketable value.

Sp. 2. *P. lignyota*, Fr.†

* Gen. 10. Patellaria, Fr.

Sp. 1. *P. atrata*, Fr.‡ On weathered fabricated timber; stockyard fence of old "Goai" (*Sophora tetraptera*, Aiton); farm of Fairfield, Saddlehill.

Ord. VIII. SPHÆRIACEI.

* Gen. 11. Hypoxylon, Bull.

Sp. 1. *H. concentricum*, Bolt. On dead trunks or branches of the "Orange leaf" or "Broad leaf" tree (*Coprosma lucida*, Forst.), Greenisland Bush; common. It generally occurs as a tumour, frequently resembling in size, shape, and colour, a rusty cannon-ball, but varying considerably both in size and form. The mass is hard and heavy; its exterior velvety, and covered with a dark brown dust, which soils the fingers like soot.

* Gen. 12. Nectria, Fr.

Sp. 1. *N. Otagensis*, Currey.§ On stockyard fences of "Goai" timber, ravine in the Chain Hills; on trunks of living trees, Greenisland Bush.

* Gen. 13. Sphæria, Hall.

Sp. 1. *S. Lindsayana*, Currey.‖ Parasitic on dead leaves of *Phor-*

† *Vide* footnote (‡), p. 18.
‡ Linds. New Lich. and Fungi of Otago, p. 427, plate xxx. figs. 16–7.
§ *Ibid.* p. 428, plate xxx. figs. 53–60. ‖ *Ibid.* p. 423, plate xxx. figs. 1–7

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mium tenax, Forst., the common "New Zealand Flax;" Glen Martin and Chain Hills.†

Sp. 2. *S. Otagensis*, Linds.‡ On stockyard fence of old "Goai" timber; Chain Hills ravines.

Sp. 3. *S. Martiniana*, Linds.§ On trunks of living trees, Greenisland Bush.

For reasons given fully elsewhere,‖ I propose grouping the remaining species under the provisional head of

FUNGO-LICHENES.

* Gen. 14. MICROTHELIA, Körb.

Sp. 1. *M. perrugosaria*, Linds. New Lich. and Fungi of Otago, p. 437, plate xxx. figs. 23–8. Parasitic on the apothecia of *Placopsis perrugosa*, Nyl.; on basaltic boulders, top of Kaikorai Hill (1092 ft.)

Sp. 2. *M. Cargilliana*, Linds. New Lich. and Fungi of Otago, p. 439, plate xxx. figs. 31–4. Parasitic on the apothecia of *Parmelia perforata*, Ach.; on trunks of trees ("Goai," &c.), living and dead, Saddlehill and Greenisland Bush. On the thallus of the same *Parmelia* occurs the parasitic Lichen, *Abrothallus Curreyi*, Linds.¶

*Sp. 3. *M. Ramalinaria*, Linds. Memoir on the Spermogones of the Higher Lichens, Trans. Royal Soc. Edin. vol. xxii. p. 130; New Lich. and Fungi of Otago, p. 440, plate xxx. figs. 44–6. Parasitic on the thallus of *Ramalina calicaris*, Ach.; on the trunks of trees ("Goai," &c.), living and dead, Saddlehill and Stoneyhill Bush. With this may be compared *Lecidea Alectoriæ*, Linds. Mem. Spermog., p. 135, plate i. figs. 12, 13.

Sp. 4. *M. vermicularia*, Linds. New Lich. and Fungi of Otago, p. 441; and (sub nom. *Lecidea*), Mem. Spermog., p. 143, plate v. figs. 19, 24, and 25. Parasitic on the thallus of *Thamnolia vermicularis*, Ach.; Tarndale mountains, Nelson Province; Herb. Dr Sinclair. This parasite is common on the same lichen in the Falkland Islands, according to specimens in my Her-

† *Vide* footnote (‡), p. 19.

‡ "Observations on New Lichens and Fungi, collected in Otago, New Zealand." Trans. Royal Soc. Edin., vol. xxiv. p. 425, plate xxx. figs. 8–15.

§ *Ibid.* p. 427, plate xxx. figs. 18–22.

‖ *Ibid.* p. 434.

¶ *Ibid.* p. 409, plate xxix. figs. 1–5.

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barium, collected by Dr Hooker during the "Antarctic Expedition" of 1839–43.

Gen. 15. PHYMATOPSIS, Tul. Linds. New Lich. and Fungi of Otago, p. 442.

Sp. 1. *P. dubia*, Linds. New Lich. and Fungi of Otago, p. 442, plate xxx. figs. 36–42. Parasitic on the apothecia and thallus of *Usnea barbata*, Fr., vars. *ceratina*, Ach., and *florida*, L. On trunks and branches of trees, Saddlehill Bush. Two species may be here included, the one papillæform, the other maculæform. The present data for determination are, however, imperfect.

* Gen. 16. CELIDIUM, Tul.

Sp. 1. *C. dubium*, Linds. New Lich. and Fungi of Otago, p. 449, plate xxx. figs. 47–52.

Parasitic on the thallus of—

1. *Sticta fossulata*, Duf. On trunks of dead trees, Saddlehill Bush.
2. *S. granulata*, Bab. On trunks of dead trees, Greenisland Bush; Signal Hill Bush, Dunedin.
3. *S. rubella*, Hook. and Tayl. On trunks of dead trees, Greenisland Bush.

Two or more species may here prove to have been included. The present materials for determination are imperfect (spores, spermatia, and stylospores are absent). But in superficial or external characters the forms of the parasite on the three species of *Sticta* are essentially the same.

III. *List of Mosses and Hepaticæ collected in Otago, New Zealand.* By W. LAUDER LINDSAY, M.D., F.R.S.E., F.L.S., &c.

The *Mosses* enumerated in the following list were collected in 1861, chiefly in the Greenisland district† of the province of Otago, New Zealand. A few were gathered in the Anderson's Bay district, opposite Dunedin; and one or two on Inch Clutha, in the lower Clutha district. The majority of the species were *sylvicolous* (*corticolous* and

† Many of the localities and circumstances of collection have already been described or referred to in my "List of Otago Lichens." Transactions of the Society, vol. viii. p. 349.

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terricolous), growing in the recesses of those patches of forest (or "bush") which have survived the destructive forces of nature, or the inconsiderate cupidity of man; more especially in the East Taeri Bush, Saddlehill Bush, Greenisland Bush, the bush which clothes the ravines of the Chain Hills, Anderson's Bay Bush, and Myres Bush, Inch Clutha.

Other terricolous species occurred in the marshes of the Chain Hills, Saddlehill, and Greenisl and Hillvalleys, or on the drier slopes of these hills and valleys themselves, as well as on Grant's Braes, in the Anderson's Bay district. *Saxicolous* forms were found in the ravines of the Chain Hills, or on the cliffs of the Greenisland coast.

The *Hepaticæ* were collected in the same Greenisland district, for the most part in the damp or wet shady places —sometimes swamps—to be found in the interior of forests (especially East Taeri and Greenisland Bush), or by the sides of streams or waterfalls in hill ravines (of the Chain Hills). The species gathered were mostly *saxicolous* and *corticolous*, though also occasionally *terricolous*.

In regard to their geographical distribution, it is worthy of note that only three out of forty-two species of *Musci*, or about 7 per cent., and one out of eleven species of *Hepaticæ*, or about 9 per cent., are *British*.

I am indebted to the kindness of my friend Mr Mitten, of Hurstpierpoint, Sussex (one of our foremost systematic Muscologists), for the determination of the species, as well as the classification or arrangement in the following lists, both of *Musci* and *Hepaticæ*.

I. MUSCI.

Fam. I. Dicranaceæ.

Gen. 1. *Dicranum*.

Sp. 1. *D. Menziesii*, Tayl.; Anderson's Bay Bush (Martin).
2. *D. dicarpon*, Nees; Anderson's Bay Bush (Martin).
3. *D. introflexum*, Hedw. (Linds. Otago Crypt., p. 282).†

Gen. 2. *Didymodon*.

* Sp. 4. *D. purpureus*, Hedw.; East Taeri Bush.

† "On some new or rare Cryptogams from Otago, N.Z." Transactions of the Society, vol. viii. p. 280.

* The asterisk * prefixed to names of species indicates that they are *British*.

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Fam. II. LEUCOBRYACEÆ.

Gen. 3. *Leucobryum.*

Sp. 5. *L. candidum*, Hampe; East Taeri Bush.

Fam. III. TRICHOSTOMACEÆ.

Gen. 4. *Syntrichia.*

Sp. 6. *S. princeps*, De Not.; top of the cliffs, Springfield, Greenisland Coast.

Fam. IV. GRIMMIACEÆ.

Gen. 5. *Grimmia.*

Sp. 7. *G. ptychophylla*, Mitten (Otago Crypt. 280).

8. *G. trichophylla*, Grev.; top of Kaikorai Hill (1092 ft.)

9. *G. basaltica*, nov. sp., Mitten, in Hand. Fl. N.Z. 125. On basalt near Dunedin; the only station in which it has yet been found in N.Z.

Fam. V. BRYACEÆ.

Gen. 6. *Webera.*

Sp. 10. *W. nutans*, Hedw. (Otago Crypt. 281).

Gen. 7. *Bryum.*

Sp. 11. *B. chrysoneuron*, C. Müller (Otago Crypt. 282).

12. *B. campylothecium*, Tayl. (Otago Crypt. 282).

Fam. VI. HYPNACEÆ.

Gen. 8. *Hypnum.*

Sp. 13. *H. tenuifolium*, Hedw.; in the Bush, Chain Hill ravines.

14. *H. aristatum*, Hook. fil. and Wils. (Otago Crypt. 281).

15. *H. (Achyrophyllum) aciculare*, Schw.; East Taeri Bush.

16. *H. chrysogaster*, C. Müller (Otago Crypt. 281).

17. *H. muriculatum*, Hook fil. and Wils.; Grant's Braes; July; fruit (Martin).

Gen. 9. *Meteorium.*

Sp. 18. *M. (Leskea) molle*, Hedw. (Otago Crypt. 282).

Gen. 10. *Trachyloma.*

Sp. 19. *T. planifolium*, Brid. (Otago Crypt. 281).

20. *T. arcuatum*, Hedw. Ibid.

21. *T. Menziesii*, Hook. Ibid. Peculiar to New Zealand, Dr Hooker informs me (Fl. N.Z. ii. 105; *Isothecium*, Hand. 465).†

† In my paper on "New and Rare Cryptogams from Otago," Trans. vol.

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Sp. 22. *T. comosum*, Schw. (*Isothecium*, Fl. N.Z. ii. 108, Hand. 466; Linds. Otago Crypt. 281).

Gen. 11. *Isothecium.*

Sp. 23. *I. Arbuscula*, Hook., and var.; Chain Hills; Grant's Braes; July; fruit (Martin).

24. *I. clandestinum*, Hook. fil. and Wils.; Linds. Otago Crypt. 281; but originally published as a New Zealand moss (in Fl. N.Z. ii. 111; *Hypnum*, Hand. 481), Dr Hooker informs me.

25. *I. ramulosum*, Mitten (Otago Crypt. 282).

26. *I. angustatum*, Mitten. Accompanies the preceding; corticolous (on dead trees) in the Bush, Chain Hill ravines.

27. *I. spininervium*, Hook.; Grant's Braes; July; fruit (Martin).

Gen. 12. *Hookeria* (Pterygophyllum).

Sp. 28. *H. nigella*, Hook. fil. and Wils.; Grant's Braes; July and Novem.; fruit (Martin).

Fam. VII. Neckeraceæ.

Gen. 13. *Neckera.*

Sp. 29. *N. lævigata*, Hook. fil. and Wils.; Greenisland Bush (Martin).

Fam. VIII. Leskeaceæ.

Gen. 14. *Trachypus.*

Sp. 30. *T. Hornschuchii*, Mitten (*Meteorium cuspidiferum*, Tayl., Fl. N.Z.); Saddlehill.

31. *T. flexicaulis*, Tayl. (Otago Crypt. 282).

Gen. 15. *Leskea.*

Sp. 32. *L.* (*Sciaromium*) *hispida*, Hook. fil. and Wils. (*Hypnum*, Fl. N.Z. ii. 107); in the Bush, Chain Hill ravines; Myres Bush, Inch Clutha; Greenisland Bush; Anderson's Bay Bush, and Grant's Braes; July; fruit (Martin).

33. *L. hastata*, C. Müller (Otago Crypt. 281).

Gen. 16. *Rhacopilum.*

Sp. 34. *R. strumiferum*, C. Müller (Otago Crypt. 281).

viii. p. 281, I have recorded, as apparently *not* previously found in N.Z., the following Mosses, which Dr Hooker subsequently informed me (letter of Oct. 28, 1865), were described under other names in his "Flora Novæ Zelandiæ," viz., *Trachyloma comosum*; *T. Menziesii*; *Isothecium clandestinum*; *Cyathophorum bulbosum*.

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Fam. IX. Mniaceæ.

Gen. 17. *Fissidens.*

Sp. 35. *F. rigidulus*, Hook. fil. and Wils.; in the Bush, Chain Hill ravines.

Gen. 18. *Rhizogonium.*

Sp. 36. *R. bifarium*, Hook.; East Taeri Bush.

Fam. X. Hypopterygiaceæ.

Gen. 19. *Hypopterygium.*

Sp. 37. *H. scutigerum*, Beauv.; Bush Chain Hill ravines; East Taeri Bush.

38. *H.* (*Lopidium*) *pallens*, Hook. fil. and Wils.; Anderson's Bay Bush (Martin).

Gen. 20. *Cyathophorum.*

Sp. 39. *C. bulbosum*, Hedw. (*Hookeria pennata*, Fl. N.Z.; Handb. 490; Linds. Otago Crypt. 281).

Fam. XI. Polytrichaceæ.

Gen. 21. *Pogonatum.*

Sp. 40. *P. aloides*, Brid. (Otago Crypt. 282).

Gen. 22. *Polytrichum.*†

*Sp. 41. *P. commune*, Hedw.; in marshy ground, in valleys and ravines; Saddlehill; Abbott's Creek, Chain Hills. Indistinguishable from *British* specimens, and quite as large and handsome as the finest forms I have seen at home.

Gen. 23. *Polytrichadelphus.*

Sp. 42. *P. Magellanicus*, Hedw.; banks of the stream, Glen Martin, Chain Hills.

Gen. 24. *Dawsonia.*

Sp. 43. *D. superba*, Grev.; label lost, and locality of collection hence uncertain.

II. HEPATICÆ.

Fam. I. Jungermanniaceæ.

Gen. 1. *Plagiochila.*

Sp. 1. *P. fasciculata*, Lindbg.; East Taeri Bush.

2. *P. arbuscula*, Lindbg.; Chain Hill ravines.

Fam. II. Ptilidiæ.

Gen. 2. *Trichocolea.*

Sp. 3. *T. lanata*, Hook. and Nees; Greenisland Bush (Martin).

† In his "Handbook Fl. N.Z.," Dr Hooker records *P. tortile*, Swartz, as occurring in my Dunedin Herbarium.

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Gen. 3. *Polyotus.*

Sp. 4. *P. palpebrifolius*, **Hook.; Chain Hill ravines.**

Fam. III. Platyphyllæ.

Gen. 4. *Madotheca.*

Sp. 5. *M. Stangeri*, **Gottsche.; Greenisland Bush (Martin).**

Fam. IV. Jubuleæ.

Gen. 5. *Frullania.*

Sp. 6. *F. falciloba*, **Hook. fil. and Tayl. (Otago Crypt. 283).**

Gen. 6. *Androcryphia.*

Sp. 7. *A. confluens*, **Tayl. (Otago Crypt. 283).**

Fam. V. Diplomitriæ.

Gen. 7. *Sarcomitrium.*

Sp. 8. *S. prehensile*, **Tayl. (Otago Crypt. 283).**

Gen. 8. *Symphyogyna.*

Sp. 9. *S. flabellata*, **Hook.; Chain Hill ravines.**

Fam. VI. Jecorariæ.

Gen. 9. *Marchantia.*

Sp. 10. *M. tabularis*, **Nees; swamps, East Taeri Bush; damp, shady places, Chain Hill ravines.**

Fam. VII. Anthoceroteæ.

Gen. 10. *Anthoceros.*

Sp. 11. **A. lævis*, **L.; East Taeri Bush.**

IV. *List of Ferns, Lycopodiaceæ, and Marsileaceæ collected in Otago, New Zealand.* By W. Lauder Lindsay, M.D. F.R.S.E., F.L.S., &c.

The Ferns recorded in the following list were collected for the most part in the Greenisland district of Otago, between October 1861 and January 1862. A few were gathered in the Tuapeka and Inch Clutha districts, at a greater distance from Dunedin—the former locality being about thirty miles in the interior, the latter near the coast. The majority of species were sylvan, luxuriating in the damp, shady recesses of the Bush, generally in narrow glens or gullies by the banks of hill streams. The arborescent species especially generally grew from the midst of a deep accumulation of leaf-mould—the formation, doubtless, of countless years—a soft, spongy, brown, rotten compost.* The patches of primitive forest, or "bush," in which my Otago ferns were mostly collected, were those covering portions of Saddlehill, Scroggs'

* *Vide* footnote (†), p. 31.

Hill, Stoneyhill, the Greenisland and Chain Hills, Anderson's Bay, the East Taeri Plain, and Inch Clutha. Several of the handsomest sylvan forms were also corticolous, climbing on or pendent from the bark of trees—mostly old, decayed, or dead, frequently in a condition of moist rot—one of the chief trees affected being the "Broad leaf" (*Coprosma lucida*, Forst., and *Griselinia lucida*, Forst.) Some were terricolous, though growing in the shade of the Bush; others were both sylvan and grew "in the open," to use an expressive colonial phrase; and these illustrated well the diversity of form produced by difference of habitat. Some terricolous Ferns grew only "in the open," in glens or gullies of the hills, or on the uplands of the Chain Hills, Saddlehill, Kaikorai Hill, or the Tuapeka ranges. Others were saxicolous, frequenting the crevices of exposed, often maritime, rocks (of basalt or mica slate) on the coast or cliffs between Ocean Beach, near Dunedin, and Greenisland Bluff or Peninsula; or of the Chain Hills; or they occurred in the damp shade of caves and cliffs of tertiary crag, limestone, sandstone, or conglomerate, on Saddlehill or the Greenisland Hills.

The localities or habitats in question will be found further described in my previously published lists of other groups of Otago cryptogams.*

The plants now recorded were examined and named in 1862–3 by Dr Hooker, while preparing his "Handbook of the New Zealand Flora" (Part I. 1864).

The most interesting section of the Otago Ferns is the group of arborescent species—the *Tree ferns* or "fern trees" of the colonist. Six out of eighty-eight species, or 6·81 per cent., of Otago Ferns are arboreous, and these tree-ferns rank, undoubtedly, as to beauty, and frequently also as to height,† girth, and usefulness, with the exogenous forest trees, with which they are generally more or less intermixed. In addition to the species observed by myself and recorded in the following list, *Cyathea Smithii*, Hook. fil., *Dicksonia squarrosa*, Swartz, and *D. antarctica*, Br., are common Otago tree-ferns—the *Cyathea Smithii* being indeed, according to Buchanan, the commonest species of that genus in Otago.

* List of *Lichens*, Trans. Bot. Soc. Edin., vol. viii. p. 349. *Marine Algæ*, do., p. 420. *Fungi*, do., vol. ix. p. 13. *Mosses* and *Hepaticæ*, do., vol. ix. p. 22.

† Sometimes 40 to 60 feet.

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C. Smithii is green and smooth-fronded; sometimes forked into two stems; trunk 20 feet high; wood hard, close-grained, heavy (Buchanan).

D. squarrosa is a very dark Fern with blackish stipes and rachis; frequently gregarious; cultivated in the new Conservatory, Kew. The most southern tree-fern in the world; the "Wheki," or "Weki," "Pehiakūra," or its abbreviation "Tūakūra" (Waik. dial.) of the North Island Maoris; the "Pakue" of the Otago Natives (Hector).

D. antarctica is dark green, sometimes forking in the stem; the "handsomest of all tree-ferns" (Hooker); the "Katute" (Hector), or "Tukirunga" or "Wekipunga" (Colenso), of the Maoris. This seems to be the principal tree-fern formerly used in house-building by the Maoris; preferred to the wood of exogenous forest trees, probably from its being more easily cut by their rude stone adzes and knives. Specimens of Maori domestic architecture are now mainly to be met with in old pahs in the North Island and in the Chatham Islands. The posts of the wharés or huts are of tree-fern trunks, which are frequently lashed together with various "bush ropes" or "supple-jacks,"* and thatched with "toi"† grass, while the interior is sometimes lined with tree-fern fronds interwoven with flax‡ leaves.

There are several points connected with the *climatological relations and geographical distribution* of tree-ferns in the South Island of New Zealand (provinces of Otago, Canterbury, and Nelson), which possess a special interest. Of these the most prominent is the *association of tree-ferns with glaciers, snow, and other evidences of an alpine and rigorous climate.* Writers on botany and geology, descanting on the beauties of tropical vegetation, or the peculiarities of southern or insular Floras, or on the characteristics of the carboniferous Flora and its nearest analogues of the present day, have hitherto been in the habit of associating the beautiful tree-fern vegetation of New Zealand with equability of climate, sub-tropical heat, and stagnant moisture. But it is no longer possible to hug this pic-

* Climbers or creepers on forest trees; species of *Rhipogonum; Parsonsia; Metrosideros; Plagianthus; Rubus; Clematis.*

† *Arundo conspicua*, Forst. ‡ *Phormium tenax*, Forst.

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torial delusion; for there are abundant proofs that in the provinces just named tree-ferns flourish in a climate in some respects as fickle and as rigorous as that of Scotland or the Swiss Alps. Nor are tree-ferns the only hitherto supposed sub-tropical tree-forms which are there found bordering glaciers. *Fuchsia* trees and cabbage palms (*Cordylines*) are associated with Araliaceous, Myrtaceous, and other trees hitherto regarded as exclusively the denizens of comparatively warm climates, in the neighbourhood of glaciers, as the firs fringe those of the Swiss Alps. My friend Dr Haast states that the largest glacier of Mount Cook, which gives rise to the Wairau river, descends as low as 500 feet above the sea-level on the west coast of Canterbury, and to within only eight miles of the sea; on both sides of which glacier "*luxuriant* forests of Fern-trees, Cordylines, Myrtaceæ, and other temperate and sub-tropical types are found."* The same distinguished explorer further refers to the occurrence on the west coast of Nelson, at no great distance from the glaciers in question of the Canterbury Alps, of "groves" of true palms (*Areca sapida*, Soland.), with other trees of an equally sub-tropical character. Comparable to the occurrence of tree-ferns beside New Zealand glaciers, is the fact recently recorded by Mr S. Clifford,† of "Tasmanian tree-ferns covered with snow" about Mount Wellington, near Hobart Town, at an elevation of 1500 to 2000 feet above the sea—the Ferns growing 18 to 20 feet high, close together in damp shady gullies, associated with the Sassafras tree (*Atherosperma moschata*, N. O. *Atherospermaceæ*).

The *altitudinal range* of tree-ferns in New Zealand is also, perhaps, somewhat greater than we have hitherto believed. Vincent Pyke, in his expedition to the West coast of Otago, *via* Lake Wanaka, in 1865, saw on the banks of the Burke River tree-ferns at an elevation of not less than 1200 feet above the sea. In the mountain forests and ravines of Nelson they ascend to the still greater height of 2000 feet (Haast).

The testimony of all explorers points to the fact, that tree-ferns are most abundant and luxuriant in the forests of

* "Report on the Mount Cook Glaciers of Canterbury," Nat. History Review, July 1864, p. 475.

† Seeman's Journal of Botany, May 1865, p. 158.

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the *west* coast. This has been noticed especially by Hector, Haast, Symms, and others, in regard to the bush which fringes the deep sounds or fiords of that coast, *e.g.*, Thompson's Sound and Charles' Sound, where they frequently attain a height of 30 feet, while the umbrella-like top of fronds has a diameter of 14 or 15 feet. This maximum abundance and luxuriance of tree-ferns on the west coast is associated by travellers with its superior moisture * and temperature—the atmosphere of the dense, dark, jungly forests being saturated with damp, while the soil is a mass of the richest vegetable mould.† There exist as yet no sufficient data for the determination of the precise climatological conditions of the west coast; and very meagre, indeed, are the materials obtainable for even an approximate exhibition of the general meteorology of Otago.‡ But if Dr Hooker's remark is correct, that Ferns are "natural hygrometers, and their luxuriance a *certain proof* of the dampness of a climate," the presence of Ferns in such beauty and plenty in the Otago bush must be held conclusive as to the humidity of the Otago climate. In connection with this, it must be noticed that in proportion as the forest is opened up to light and air by the woodman's axe, tree-ferns disappear, while the local climate becomes drier. Hence it happens that on the *east* coast, where the patches of bush are scant, and the bush itself has been thinned or "cleared" for the purposes of colonisation, tree-ferns, which were formerly abundant, are now rare, and of no great size or beauty (*e.g.*, in Willshire's Bay, mouth of the Clutha).

The *acclimatisation* of the New Zealand tree-ferns in the gardens and pleasure-grounds of Britain has lately been

* So markedly is this the case, that Haast punningly proposes changing the name of *west* coast to that of *wet* coast.

† Composed mainly of the dead and rotting leaves of phænogamous trees and shrubs, and of arborescent and other Ferns, with soft rotten tree-trunks and branches covered with Mosses and Hepaticæ—the whole mass soaked in moisture, and forming a deceitful tangled compost, into which I have frequently sunk up to my middle, and occasionally overhead.

‡ When I visited Otago there was only one series of regular meteorological records, viz., that made in Dunedin by the Rev. Dr Burns. Assuming that these were scientifically accurate and complete, they only serve to indicate approximately the meteorology of the capital; while *numerous local meteorological observatories* would be required to exhibit all the *local climates* and their mean or average—that of the province as a whole.

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attracting the attention of some of our most experienced horticulturists. My friend Mr Gorrie, the horticultural editor of "The Farmer," appears to regard them as sufficiently *hardy* to be suited for out-door growth throughout the year in this country, and he paints in glowing colours the possible effect on landscape gardening of their introduction. So different would a pseudo-tropical tree-fern vegetation be from that which at present characterises the gardens or policies of our noblemen's and gentlemen's seats, that "their addition would be hailed as a new and grand era in horticulture,"* forming—as he pictures, with more than the ordinary "ingenium perfervidum Scotorum"—"pleasure-ground *avenues*, which even the rich and exuberant verdure of the tropics could not surpass in beauty and elegance."† There are certain specious reasons for regarding the Otago tree and other ferns as hardy, and they constitute substantial grounds for experimenting on their acclimatisation in this country. But there are certain other conditions of their growth in their native country, which would not be imitated by the surroundings sketched in "The Farmer;" and this want of resemblance leads me to distrust the realisation of a consummation so desirable to all lovers of the novel and beautiful in landscape gardening.

The circumstances favourable to the success of such experimental acclimatisation are the following:—Mr Gorrie mentions that some of these tree-ferns have in this country successfully withstood a temperature of 20° Fahr. without fire heat, but under glass.‡ Certain other Ferns, and certain lowland phænogams of New Zealand, have *proved* hardy in Britain (in the open). Tree ferns occur in New Zealand and Tasmania associated with ice and snow; they ascend as high as 2000 feet—altitude being regarded as so far equal-

* Hardy Plants of the Antipodes, "The Farmer," June 27, 1866, p. 822.

† Hardy Plants of New Zealand, "The Farmer, Edin. Feb. 28, 1866, p. 280.

‡ *Cyathea dealbata*, *Dicksonia antarctica* and *squarrosa* have been "unharmed by a temperature of 20° in a cool glass-house, with a northerly exposure, further than by having the fronds slightly discoloured on their upper surface." The same may be said of *Lomaria fluviatilis*, which has also "stood for last two winters at the base of a wall with a westerly exposure." Again, *Aspidium Richardi*, which he describes as "an interesting acquisition to our *hardy* Ferns . . . . has stood this and the last three winters unharmed." (Letter of 28th January 1867.)

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ising the difference in latitude between Otago and Scotland; the Otago and Canterbury Alps are more than twice as high as those of Scotland—Mount Cook, the culminating point of the range (lat. 43° 30′ S.), attaining 13,000 feet, the presence of mountains of such elevation, capped with perennial snows, and flanked by gigantic glaciers, tending to modify the insular climate, and, as in the last case, assisting in the equalisation of latitudinal differences. Though the winters in the lowlands and on the coasts appear to be milder than those of Britain, in the interior they are more rigorous, resembling those of the Swiss Alps; while, except in so far as there is a less marked contrast between summer and winter, the climate of Otago does not greatly differ from that of Scotland. The experiment of acclimatisation would be assisted in its chances of success by imitating, so far as possible in this country, the conditions of growth of the Ferns in New Zealand, *e.g.*, by selecting as the localities of trial the milder districts of the south of England, or of the west coasts of Scotland and Ireland, which latter are at the same time moister, and, like the west coast of Otago, are distinguished by the variety, abundance, and luxuriance of their native Fern vegetation.

The unfavourable circumstances are, apparently—1. The difference in latitude between Otago and Scotland, amounting to about 10° (Otago lies between 44° and 47° S.; Scotland between 55° and 58° N.; Dunedin, 45° 53′ S; Edinburgh, 55° 57′ N.); 2. The difference in temperature (that of Dunedin, summer, 59°; winter, 42°; mean annual, 51°; Edinburgh, summer, 58°; winter, 37°; mean annual, 47°; the isothermal of 50° in the northern hemisphere passes through Central Ireland and the south of England, but in the southern it passes southward of Otago); 3. The preponderance of *sea* in the southern, and of *land* in the northern, hemisphere, with its corresponding effects on the climate of the same parallels of latitude in the north as compared with the south; 4. The growth of Otago tree-ferns in the dark shade of the dank, dense jungle.

On the whole, though I heartily concur in the desirability of making all due experiment, I am disposed to doubt whether the tree-ferns and most other ferns of New Zealand

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will be found hardy enough to "stand the severest British winters," unprotected from the unnatural influences of excessive light, cold, and dryness; though I have none as to their suitability for growth in conservatories, where their natural conditions of existence can be closely imitated. Mr Buchanan, whose long experience as an Otago settler, and whose position as Botanist attached to the Geological Survey of Otago, entitle his opinions to great weight, takes, apparently, an intermediate position between my less favourable anticipations and the more sanguine expectations of "The Farmer"—stating as his belief, that the five arborescent Ferns of Otago (*Cyathea*, three species; *Dicksonia*, two species) would grow in Britain in the open air, "if planted in dark woods." Experience alone can decide: and meanwhile, let us hope that some of our leading horticulturists, who possess the necessary opportunities, will initiate the experiment!

Of the smaller New Zealand Ferns, species more or less hardy in Britain under glass, if not in the open, may at least be looked for in the genera *Leptopteris*, *Nephrodium*, *Aspidium*, *Polypodium*, *Asplenium*, *Trichomanes*, *Hymenophyllum*, and *Lomaria*, as well as in the genus *Lycopodium*. Some of these are alpine or sub-alpine, ascending to considerable elevations, forming a group which is more likely to prove suitable for outdoor growth in Britain than the more tender shade and moisture-loving species of the coasts and lowlands. Haast remarks on the considerable altitudinal range of species of *Lomaria*, *Asplenium*, and *Aspidium* on the western alps of Nelson. Some of the *Lycopodia* are, in Otago, common on the higher ranges of the south-eastern districts, at or above 4000 feet, where snow frequently falls or lies (Buchanan); while several were found, intermixed with grasses, on the *plains* to the west of the western alps of Nelson (Haast).

The "Bush" in Otago is confined mainly to the east and west coasts, and the central lake basins; which latter, from the circumstances of their physical features, possess a local and peculiar climate of their own. To these parts of the province Ferns are mainly confined. The interior consists mostly of undulating hilly country, partly covered with grass, partly with "Fern" (the ubiquitous *Pteris aqui-*

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lina in its New Zealand variety). This fern occasionally grows much higher than a man, with corresponding strength, sometimes densely covering considerable tracts of country. I had occasionally to wade in its fields, and found it as difficult and exhausting to push my way through its tangled masses as through the flax swamps (of *Phormium tenax*). When dry, after summer droughts, it fires readily, burning with a rapidity and over an extent of ground somewhat resembling the prairie fires of North America.

The *classification* and *nomenclature* of New Zealand Ferns furnish us, I think, with some notable instances of the proneness to error of systematists in reference, *e.g.*, to the following points:—

1. Defining and limiting where nature, by a *continuity of variation*, draws no decided lines of demarcation.
2. Confusion of varieties, species, and genera.
3. Supposition that the plants of new botanical fields are necessarily or presumably *new species*.
4. Excessive and mischievous multiplication of *names*, and consequent confusion of *synonymy*.
5. Distinction between *book-species* and the species (or groups) of nature.
6. Artificialness and arbitrariness of botanical systematology.
7. Fallaciousness of botanical "characters."*
8. Indefinite or infinite variability, even in the same individual and in limited areas.
9. Imperfect knowledge of the geographical distribution of plants; of the extent of their variation with differences in their conditions of growth; of botanical bibliography; and of the researches and publications of their predecessors.
10. Insufficient allowance for variation produced by differences in latitude, climate, elevation, exposure, character of the habitat, and other external conditions.
11. Cosmopolite character or wide geographical range of many plants, with limited variation.

Young states (*e.g.*, *Gleichenia speluncæ*, Br.), or *seedling*

* The presence of germinating bulbs on the pinnules of *Asplenium bulbiferum* is the supposed essential or distinctive characteristic of the fern; but they appear to be as frequently absent as present, so that the supposed "character," not being constant, cannot be depended on.

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fronds (*e.g.*, *Polypodium tenellum*, Forst.), have been erected into *separate species.*

The *same species* has received as many as ten to thirty *different names*, according as it was found in different parts of the world. Dr Hooker, whose experience on such a subject is inferior to that of no living botanist, and whose testimony on questions relating to the geographical distribution and variation of species possesses a correspondingly high value, gives several characteristic illustrations in his admirable "Flora Novæ Zelandiæ." Of *Ophioglossum vulgatum*, L., he says no less than thirty species have been made; and he adds, "I confidently affirm that, were I to show the authors of many of the so-called *species* of *Ophioglossum*, preserved in the Hookerian Herbarium, their own specimens named by themselves, and substitute 'Britain' on their tickets for the distant countries from which they were brought, these authors would unhesitatingly pronounce *their* plants to be *O. vulgatum!*"* *Pteris aquilina*, again, has received at least twenty different names in systematic works—or, in other words, a different designation in every part of the world in which it occurs; while of another cosmopolite, *Lycopodium clavatum*, about a dozen book-species have been manufactured by name-mongers.

Confusions of species, or of varieties and species, abound more or less in the genera *Asplenium* (*caudatum* and *falcatum*, *obtusatum*, *scleroprium*, *lucidum*, *Hookerianum*, *bulbiferum*, *Richardi*, and *flaccidum*); *Lycopodium* (*varium*, *Billardieri* and *clavatum*); *Doodia* (all its three species pass into each other); *Lomaria* (*membranacea* and *fluviatilis*); *Aspidium* (*aculeatum*); *Pteris* (*Endlicheriana*); *Pellæa* and *Leptopteris* (their only two species appear to pass into each other); and *Hymenophyllum* (*unilaterale* and *Tunbridgense*). Of the New Zealand species of *Asplenium*, Dr Hooker remarks, "they have defied all attempts to be limited by words;" while Mr Berkeley speaks of their limits as "absolutely incapable of definition." Of *A. flaccidum*, which is, perhaps, the most variable Fern in the world, Dr Hooker says, "It would take many pages to enumerate half its protean forms;" . . . . and that . . . . "the most opposite charac-

* Moreover, one of its *species* has been made the basis of a *separate genus*—*Cheiroglossum*.

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ters are sometimes presented by *different parts of the same frond*."* Of *Lomaria procera*, he writes, "There are no limits to the variations of this protean plant, ... whose *varieties* (to an inexperienced eye) are more dissimilar than are other *species* of the same genus." The variability of *Aspidium aculeatum*, var. *vestitum*, he regards as "likely to give rise to as many discussions as its equally and similarly variable and very near ally *Polystichum aculeatum*, Sw., has done in England;" while he makes a like remark in regard to *Hymenophyllum unilaterale*, Willd., which often grows associated with *H. Tunbridgense*—"its real or supposed differences from which have given rise to endless discussions."

But such is the *continuity of variation* in New Zealand Ferns, that not only is it frequently impossible to define *varieties* and *species*, but the limits of *genera* are sometimes equally vague and unsatisfactory; whence a confusion of nomenclature and description occurs in systematic works, sometimes quite as marked in the major as in the minor divisions. Confusion of genera is to be found between *Polypodium*, *Nephrodium*, *Polystichum*, and *Aspidium* (*N. hispidum*, *Polypodium pennigerum*, *Polypodium sylvaticum*); *Polypodium* and *Hypolepis* (*H. tenuifolia* passes into *P. rugulosum*); † *Hymenophyllum* and *Trichomanes;* or *Darea* and *Asplenium*. The genus *Pteris* "has been divided," says Dr Hooker, "into so many *genera* . . . . that . . . . one might perhaps be found for each New Zealand species."

It were out of place here to enter into any special consideration of the infinite variability of New Zealand Ferns, or of its bearings on classification and nomenclature. It must suffice—as I trust elsewhere to discuss at length the subject of *continuity of variation* in plants, and its bearings on botanical systematology—meanwhile to record the general conclusions on this head, to which my study of New Zealand Ferns has led me, viz.:—

1. That in plants so variable, it is not only unnecessary but mischievous to give a name to every variety, unless this

* *Equally in the wild and cultivated state*, different parts of the same frond *A. bulbiferum* frequently exhibit extreme differences of development.

† Berkeley regards the latter as a mere variety or state of the former.

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is very constant, and its distinctive characters such as are capable of being rendered very evident to the student.*

2. That it ought to suffice to indicate the general directions or forms—with the degree—of variation.

3. That book-*species* are equally unnecessarily and mischievously abundant.†

4. That many of these may be more philosophically considered mere forms of variation of a comparatively few types.

5. That these types should be fixed ideals—abstractions—representatives of what all observation points to as the probable normal average condition of the head of a group; rather than prevalent natural forms, which necessarily vary with place and the conditions of growth.

6. That book-species, varieties, and genera—and that all botanical systematology—are necessarily artificial and arbitrary.

7. That nature is illimitable in her forms, and that other than an approximate and general cataloguing, naming, and description thereof, is unattainable; and were it attainable, is unnecessary for the purposes of the student.

8. That the local Botanist in New Zealand has it in his power to contribute important data towards the simplification of classification,—the reduction of names,—the establishment of fewer and more comprehensive types (whether genera or species), by the study of living forms over extensive areas, and under every modification of external conditions.

9. To him, therefore, is commended the careful revision of such genera as *Asplenium*, *Lomaria*, and *Lycopodium*, in reference especially to the philosophical nomenclature and arrângement of the groups which occur in nature, as contradistinguished from those which are described in books.

* Dr Hooker states that the varieties of *Lomaria procera keep their characters under cultivation.*—Handbook, p. 366.

† If in some genera we eliminate those plants, which have really good pretensions to be separately named as species—that is, are distinctly recognisable by well-marked constant characters of adequate value—it will be found that good species amount to a very small proportion compared with those, which cannot be so limited or defined—which pass more or less freely into each other. In *Asplenium, e.g.*, good species are not more than 25 per cent., or one-fourth of the whole.

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I. FERNS.

I. Cyatheaceæ.

Gen. 1. *Cyathea.*

Sp. 1. *C. dealbata*, Swartz. Christie's Bush, Saddlehill; Anderson's Bay Bush; November, in fruit.

The familar "Tree-fern," or "Fern tree," or "Silver Tree-fern" of the Otago settler; the "White Fern" of the Wellington settler; the "Ponga"* of the North Island Maori; characterised by the white under-surface of the fronds.

About Wellington its maximum height is 24 feet, the fronds varying from 8 to 12 feet long by 2 to 3 broad. It is there found at all elevations between the sea-level and the tops of the highest hills, in which latter position it appears more disposed to become gregarious than at lower levels.

Two or three forms or states occur scarcely deserving of rank as named varieties.

Sp. 2. *C. medullaris*, Swartz. Saddlehill Bush (Martin).

The "Grey Tree-fern" of southern, the "Black Fern" of northern, settlers (*e.g.*, in Wellington); the "Korau," "Pitau,"† "Mamāku,"‡ or "Mamāgu" (East Cape and Waikato dialects) of the Maoris, to whom the stem-pith was formerly a familiar article of food, and still is to a limited extent in the North Island. In the Wanganui district, the tree is cut down in spring, and sections of it are steamed in the native ovens; when sufficiently cooked, what is equivalent to the bark is stripped off, when the pith is found to be a soft spongy mass, having, says Dr Tuke, "a faint taste of apple-pie."

Cultivated in the new Conservatory, Kew.

Ralph § states that about Wellington its stem attains a height of 40 to 80 feet, with a girth of 6 to 7 feet. It there generally grows on the sides of gullies or dells—sometimes capriciously preferring one side only. The very different appearance of the young and old fronds has probably given rise to the idea that they belong to two separate species.

II. Hymenophylláceæ.

Gen. 2. *Hymenophyllum.*

Sp. 3. *H. multifidum*, Swartz. On ground, Saddlehill Bush; October, in fruit; approaches in size and in general aspect our *Trichomanes radicans*, Sw.

Sp. 4. *H. crispatum*, Wallich. In the Bush, Chain Hill ravines; among moss in damp shady places, East Taeri Bush; November, in fruit.

* A term probably also generic, applicable to "Tree-ferns" as a class.

† Sometimes applied also or only to the pith (Mantell).

‡ Corrupted into "Mamuk" by the settlers on the west coast of Otago and Canterbury.

§ On the Arborescent Ferns of New Zealand," Journ. Linn. Soc., vol. iii., Botany, p. 163.

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III. Polypodiaceæ.

Gen. 3. *Adiantum.*

Sp. 5. *A. affine*, Willd. Caves in crag (limestone), Woodburn, Saddlehill; caves and crevices in cliffs of tertiary sandstone—conglomerate, seaward shoulder of Saddlehill; in crevices of tertiary calcareous sandstone, Greenisland Bush; October to December, in fruit.

Gen. 4. *Hypolepis.*

Sp. 6. *H. Millefolium*, Hook. Banks of the stream, Glen Martin, Saddlehill; December, in fruit. Somewhat resembles, as does also the following species, our *Cystopteris fragilis*, Bernh., than which both, however, are generally taller. It appears to be common in the western districts of Nelson.

Sp. 7. *H. tenuifolia*, Bernhardi. On ground in damp shady places, East Taeri Bush; November, young, barren.

Gen. 5. *Pellæa* (*Pteris*, pr. p. Fl. N.Z.)

Sp. 8. *P. rotundifolia*, Forst. On ground, Greenisland Bush; November, in fruit.

Gen. 6. *Pteris.*

Sp. 9. *P. aquilina*, L., var. *esculenta*, Forst. Chain Hill ranges; November, young and barren; Stoneyhill Bush; December, in fruit.

In every district of Otago visited by me I found this fern covering large tracts of open, dry, hilly land, just as our "Bracken" does in the Highlands of Scotland.

Its rhizomes contain a considerable amount of starch—a circumstance which has led to their having been largely used by the Maoris as an article of food; and, to a limited extent, in the North Island, they are still so used. The rhizomes are either simply dried, or also roasted, and then pounded with mallets.*

So familiar is the Fern, with its economical applications, to the Maoris, that not only the plant itself, but different parts thereof, have special native names, as is the case in the parallel instances of *Phormium tenax* and *Typha angustifolia*. The Fern plant, as a whole, is the "Rāhurāhu"† (its common name in the North Island); "Rarāhu" or "Rarāuhe" (Waik. dialect); the first sprout of the plant after its stalks have been burned is "Koēāta" or "Mōnehu;" the rhizome itself is the "Pākakōhi," "Aruhe," "Ngarue,"‡ "Arue," "Arohi," "Aroi" (Dieffenbach), or "Roi," "Rohi," "Maroi," "Kaka" (Dieffenbach), of the North Island natives; the juice of the rhizome "Pararohi," (Dieffenbach); and the pounded rhizome, "Meke."

Sp. 10. *P. incisa*, Thunb. (which includes *P. Vespertilionis*, Lab., and *P. Brunoniana*, Endl., of Fl. N.Z). In the Bush, Manuka Gully,

* An excellent account of their preparation and use as food will be found in Dr Thomson's "Story of New Zealand," vol. i. p. 153.

† Also a generic term for Ferns (Dieffenbach).

‡ Also applied to Fern-roots in general (Dieffb.)

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Scroggs' Hill; November, young and barren; on ground, Saddle-hill Bush; December, in fruit.

Gen. 7. *Lomaria.*

Sp. 11. *L. procera*, Sprengel.

A. *major* forms (var. *β.* Hook. fil.).

In a damp shady wooded ravine in the Chain Hills; November, in fruit; 30 to 40 inches tall; very common and luxuriant in the Greenisland district.

B. *minor* forms (var. *δ minor*, Br., Hook. fil., Fl. N.Z. plate 75).

On ground, East Taeri Bush; November, in fruit; rachis, scaly, whereas in the major forms, in my specimens, it is naked; about 18 inches high; fertile frond, as usual, taller than the barren.

In my specimens, both in major and minor forms, the same frond is generally both fertile and barren, though separate fertile fronds also occur; in the former case it is invariably the *upper* or *terminal* pinnules, and the tips or outer half of the more median pinnules that are fertile; whereas Dr Hooker describes the *basal* pinnules only of the barren fronds as occasionally fertile. Pinnules subsessile.

Sp. 12. *L. fluviatilis*, Sprengel. In the Bush, ravines of the Chain Hills; November, in fruit; 20 to 24 inches tall; fronds straight.

Sp. 13. *L. pumila*, Raoul. Gullies in the Chain Hills; November, young and barren; 10 to 15 inches tall; common. So named in my Herbarium by Dr Hooker, who, however, in his "Handbook," gives Akaroa as the only station for it in New Zealand. Either the latter statement is a mistake, or the plant is not *L. pumila*. Its characters correspond better with those of *L. membranacea*, Colenso, with which seem to me to be allied *L. fluviatilis* and *L. alpina*, so far as I can judge from my own few specimens and the descriptions in the Handbook Fl. N.Z. I confess myself unable to see the propriety of establishing sections of the genus *Lomaria* distinguished by pinnate and pinnatifid fronds. The difference is only in degree —both modes of division occurring frequently in the same species, *e.g.*, *fluviatilis*, *membranacea*, *pumila*, and *alpina*. In the lower portions of the frond the pinnate division is usual; in the upper the pinnatifid—the extent of each mode of division varying in different, as well as in the same, species.

Contrasting the four species above mentioned, there is a general resemblance—with variations of secondary significance only—in regard, *e.g.*, to the length of stipe, clothing of the rachis, texture and consistence of the frond, size and form of the pinnules. In *pumila* the stipe is very short; in *fluviatilis* rather longer; in *alpina* sometimes nearly as long as the rachis. The rachis is much more scaly or chaffy in what Dr Hooker calls *pumila* than in *fluviatilis*; sometimes it is naked, and there are all variations between these conditions. The frond is more coriaceous in *alpina*; more membranous in *fluviatilis* and *pumila*; straight in *fluviatilis*, or flexuose in *membranacea*. It may be copiously or sparingly scaly; it may be scaly throughout its length, or only below. The pin-

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nules are variously substipitate or sessile; or adnate by a more or less broad base; or confluent, or decurrent.

Sp. 14. *L. lanceolata*, Spreng. On ground in the Bush, Chain Hills; October, in fruit; common.

Fertile frond about 12 inches, sterile 10 inches, high. In the barren fronds, which are variously pinnate or pinnatifid, as in other *Lomariæ*, the segments are much more membranous and green than in *L. discolor*. The pinnules of the fertile fronds are generally opposite above, and alternate below. There is a great general resemblance, save as to size (the New Zealand fern being the larger and handsomer), between this species and our *Blechnum boreale*, Sw., whose former name was *Lomaria spicant*, Desv. They appear to me to be too closely allied to permit of any proper separation between the genera *Blechnum* and *Lomaria*.

Sp. 15. *L. discolor*, Willd. Greenisland Bush; in a damp shady ravine of the Chain Hills; November, in fruit.

Fertile fronds upwards of 40 inches long, sterile 36 inches; very handsome, short, coriaceous. Save as to size and other unimportant or secondary characters, it does not appear to differ from *L. lanceolata*.

Sp. 16. *L. alpina*, Spreng. East Taeri Bush; November, young and barren; smaller forms 4 to 6 inches, larger 18 inches, high.

Sp. 17. *L. Banksii*, Hook. fil. Dobbin's Creek, Greenisland, Martin, who describes it as "everywhere abundant, both fertile and sterile, in open lands and swamps," in the Greenisland and Dunedin districts. The habitat does not agree with that given by Dr Hooker in his "Handbook" ("dark woods"), and it is possible Mr Martin may have inadvertently confounded this with some of the foregoing species.

Gen. 8. *Asplenium*.

Sp. 18. *A. obtusatum*, Forst. In clefts of the basaltic rock, Greenisland Bluff (or Peninsula); October, in fruit; the "Paretao" of the North Island Maoris (Colenso).

In the Greenisland district it takes the place, with *A. lucidum*, of our *A. marinum*, L., than which, however, both are much larger and coarser. I find no characters sufficient to warrant separation of *A. obtusatum* and *A. lucidum* as species. In my specimens, the former has smaller, more oblong pinnules, rounded at the tips.

Sp. 19. *A. lucidum*. Forst. On rocks, Ocean Beach, near Dunedin. The "Hūruhūruwhēnua" of the North Island Maori. The lower pinnules in my specimens are 3½ inches long; there is a tendency to a cuneate form of base, to subpinnatifid division, and to irregular serration of the pinnules—characters which are more fully developed in the nearly allied *polyodon*. The serratures of the pinnules are sharper, deeper, and more distinct than in *obtusatum*.

Var. *β Lyallii*, Hook. fil. Fl. N.Z., plate 77. In limestone caves, Woodburn, Saddlehill; November, fruit.

Whole plant about 10 inches high; a much smaller, more delicate, flaccid. greener plant than the type; approaching in some of its characters the *bulbiferum* group. Pinnules 1 to 1¼ inch long; subcuneate; sublobate – the upper base

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more generally incised or lobed than the lower; margins irregularly sinuate rather than serrate; apices somewhat rounded or obtuse, whereas in the type they are generally more or less acute; uppermost pinnules confluent.

Sp. 20. *A. polyodon*. Forst. Anderson's Bay Bush, near Dunedin (Martin). So named by Dr Hooker in my Herbarium. In his "Handbook," however, he refers the *polyodon*, Forst., to *A. falcatum*, Lamarck; which further he gives as a North Island plant only. My plant does not agree with the definition of *A. falcatum* as given in Handbook Fl. N.Z. If it belong to either, it falls more naturally under *A. caudatum*, Forst., which, however, is described in the "Handbook" as a Kermadec Island plant, not occurring at all in New Zealand. From the descriptions in the "Handbook," I should refer *A. falcatum* and *A. caudatum* to a single type.

My plant appears to me more nearly allied to *obtusatum* and *lucidum;* it is nearly as stout and coriaceous, taller and handsomer, —a circumstance due in some measure to its growth in the forest. The pinnules are, from their form and division, much handsomer; they are cuneate, sub-pinnatifid, deeply and irregularly serrate; sessile, or nearly so; longest pinnule in my single specimen, 3 inches; sori radiating from base of pinnule—the median ones extending nearly the whole length of the pinnule; stipes glabrous.

A. polyodon appears to me to be connected with *obtusatum* and *lucidum* by our *A. marinum*, as an intermediate form. The differences between the British and New Zealand species just mentioned seem to me very trivial—insufficient, indeed, to prevent their being referred to a single type. Our *A. marinum* is a widely diffused plant, in which considerable variation is to be looked for.

Sp. 21. *A. flabellifolium*, Cavanilles. Glen Martin, Saddlehill; Myres Bush, Inch Clutha; November, in fruit. Distinguished by the prolongation of the frond into a tendril-like filament, which takes root at its tip like the runner of a strawberry.

Sp. 22. *A. bulbiferum*, Forst. In limestone caves, Woodburn, Saddlehill; November, in fruit.

Var. β *laxa*, Br. Bush in the Chain Hills; November, fruit; common.

Var. δ *tripinnata*, Hook. fil. On ground, Greenisland Bush; November, fruit.

The variety so called in my Herbarium by Dr Hooker is not *tripinnate*, but has a frond nearly as decompound as in *laxa*, though it is stouter, with more lanceolate pinnæ, and more obtuse and symmetrically-cut segments. The distinction between *laxa* and *tripinnata* is not constant; and the naming of two such forms of an infinitely protean plant is simply confusing and unnecessary.

The definition of its variations, even with the aid of plates, I believe to be impossible; and were it possible, their separate naming would be absurd. It ought to suffice, in all plants

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so variable, whether flowering or cryptogamic, *to indicate the general directions or forms of variation only*. New varieties or states are constantly being discovered, *e.g.*, in the western districts of Nelson (Haast). On the west coast of Otago, where the climate is moist, the *A. bulbiferum* produces its characteristic germinating bulbs; whereas on the east coast, where the climate is much drier, these bulbs are rare (Buchanan). The main variations in my specimens relate to size and stoutness of the plant, and the size, form, and subdivision of the pinnules. Some of my plants are 1 foot, others 2 feet, high. The smaller forms are frequently very delicate, membranous, and green (bush-growers); while others are as stout as—and otherwise resemble in general characters—our *A. Adiantum-nigrum*, L. The frond is generally more or less decompound, the pinnules shortly stalked—the longest 3½ to 4 inches, subdivided into six to thirty segments, varying in length and breadth; obtuse at ends—the segments being further variously divided.

Sp. 23. *A. flaccidum*, Forst. Corticolous, terricolous, and saxicolous; abounding in the Greenisland district; on old "Broad-leaf" trees, Greenisland Bush; on rotten tree-trunks, East Taeri Bush; on trees, but also on the ground, Stoneyhill Bush; in crevices of mica-slate rocks, gullies of the Chain Hills; October and November, fruit. "Pohutukawa" of the North Island Maoris; a term also applied to *Metrosideros tomentosa* (Colenso).

Some of the pendent, larger tree-forms, are very elegant, and are known to settlers as the "Stag's horn Fern." The definition, description, or naming of all its variations, is utterly vain and futile. In size it varies from 6 to 10 inches. The larger forms have frequently a long naked stipe, terminating in a few linear pinnules, notched into a series of comparatively simple segments. The smaller forms generally have only a short stipe; the frond is broadly lanceolate; the pinnules numerous and also lanceolate, with crenate or sinuate margins. It is these forms especially which resemble our *A. Adiantum-nigrum*. The colour is sometimes peculiarly whitish or glaucous in the longer slender forms, with sub-linear pinnules; in the smaller it is more generally the dull green of *A. Adiantum-nigrum*. The frond is sometimes distinctly bipinnate.

Gen. 9. *Aspidium* (including the genus *Polystichum*, Fl. N.Z.)

Sp. 24. *A. aculeatum*, Swartz.

Var. *vestitum*, Hook. Bush in the Chain Hills, 50 inches tall; Greenisland Bush, 24 to 30 inches high; October and November, fruit. A very stout, rigid, handsome fern—resembling our *A. lobatum*, Sw., and the stronger forms of our *A. aculeatum*. Larger forms generally 25 to 40 inches, smaller 15 to 18 inches, high.

Sp. 25. *A. Richardi*, Hook. Named by Dr Hooker in my Herbarium *Polystichum aristatum*, Presl. (Fl. N.Z., plate 78). On rocks, Stoneyhill Bush; December, fruit.

In specimens cultivated by Mr Gorrie at Trinity, Edinburgh, the

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frond is dark in hue; sub-rigid and coriaceous, though not more so than is *A. aculeatum*; under surface sparingly covered with chaffy tomentum; brownish-black scales of stipe much mixed with long, chaffy hairs; lower pinnules again pinnate at base; upper pinnules all pinnatifid, there being a gradation from base to apex between the pinnate and pinnatifid characters; some of the secondary pinnæ occasionally with a very short obscure pedicel. I am not at all satisfied of the specific distinction between *aculeatum* and *Richardi*.

Gen. 10. *Nephrodium.*

Sp. 26. *N. hispidum*, Hook. (*Polystichum*, Fl. N.Z.) On ground, Anderson's Bay Bush (Martin).

Gen. 11. *Polypodium* (including the genera *Grammitis*, *Goniopteris*, *Niphobolus*, and *Phymatodes*, pr. p. Fl. N.Z.)

Sp. 27. *P. australe*, Mettenius (*Grammitis australis*, Br., Fl. N.Z.) On dead tree-trunks, East Taeri Bush; November, fruit.

In the form of its leaf it somewhat resembles young plants of *Scolopendrium vulgare*, Sm. It is saxicolous as well as corticolous, growing in the open, ascending to elevations of 5000 feet, and to a certain extent representing in Otago such of our ferns as *Ceterach officinarum*, Willd., and the *Woodsias*. Alpine forms grow frequently or generally in dense moss-like patches.

Sp. 28. *P. Grammitidis*, Br. On dead tree-trunks, East Taeri Bush; November, fruit.

Sp. 29. *P. pennigerum*, Forst. (*Goniopteris*, Fl. N.Z.) On ground, Greenisland Bush (Martin). Young, imperfect, and sterile. The "Piupiu" of the North Island Maori (from the Maori verb to tremble, wave, or vibrate—in allusion to its delicacy and elegance).

My only specimen was labelled by Dr Hooker *Goniopteris pennigera*, J. Sm.; but in the "Handbook" he gives its southern limit as Akaroa, and says he has seen no Otago specimen.

Sp. 30. *P. rupestre*, Br. (*Niphobolus*, Fl. N.Z.) On old or dead tree-trunks, Greenisland Bush; November, young; a climber, twining round tree-trunks like ivy, whose representative in that sense it may here be held to be.

Sp. 31. *P. Billardieri*, Br. (*Phymatodes*, Fl. N.Z.) On dead tree-trunks, Saddlehill Bush; East Taeri Bush; Bush in the Chain Hills; October and November, fruit. A climber, like *P. rupestre*, and still more than it resembling our ivy, in so far as it sometimes possesses an ivy-like palmatifid frond.

Even in the same plant the sterile frond is extremely variable. It is generally more delicate and membranous than the fertile frond —broader, and more simple in its divisions. It may be quite simple and sub-lanceolate, as in the young *Scolopendrium vulgare*; or it may be entire and sub-ovate below, dividing into two or three sub-simple and short segments terminally; or sub-lyrate; or irregularly pinnatifid at its apex; or it may be regularly or irregularly 5-fid or sub-palmate—the broader forms in the young state being very membranous. The fertile frond is in my speci

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mens pinnatifid, like that of our *Polypodium vulgare*, L.; the segments being lanceolate, sub-simple, with sub-sinuate margins, more or less coriaceous and stout.

IV. Osmundeæ.

Gen. 12. *Leptopteris.*

Sp. 32. *L. Hymenophylloides*, Presl. (*Todea pellucida*, Carm., Fl. N.Z.) In the damp shady Bush, ravines of the Chain Hills; 24 to 30 inches high; October to November, fruit; common; "Heruheru" of the natives (Colenso).

The frond is translucent, as in the genus *Hymenophyllum;* hence its very appropriate name. A very handsome fern, with a very dark-green deeply-cut frond; somewhat resembling, save in its greater size, our *Trichomanes radicans*, Sw. The smaller forms are 12 to 18 inches, the larger 30 to 36 inches, tall.

V. Ophioglosseæ.

Gen. 13. *Ophioglossum.*

Sp. 33. *O. vulgatum*, L.

Var. *costatum*, Br. Chain Hill ranges; January, fruit.

A small delicate form, compared with the larger coarser British plant, whose representative it here is; frequenting the same open hill pastures.

Gen. 14. *Botrychium.*

Sp. 34. *B. cicutarium*, Swartz.

Var. *Virginicum*, Hook. fil. Tuapeka ranges; ranges about south base of Kaikorai Hill; December and January, fruit. The "Patotara" of the North Island Maoris; a term also applied to certain Phœnogams (*Leucopogon Frazeri* and *Cyathodes acerosa*), f. Colenso and Lyall.

I found it mistaken for a young phænogamous plant, even by settlers possessed of considerable botanical knowledge and experience. It is certainly, especially in its young, undeveloped state, a puzzling plant, apt to be overlooked as a Fern. The whole plant, including root and fruit, is 3 to 3½ inches high. The root, like that of *Ophioglossum*, is bulb-like, resembling, on a miniature scale, the roots of various terrestrial Orchids.

II. LYCOPODIACEÆ.

Gen. 1. *Lycopodium.*

Sp. 1. *L. Billardieri*, Spreng. Pendent from old trees, Greenisland Bush; rare in Otago, according to Martin. Somewhat resembles in appearance our *L. selaginoides*, L., than which, however, it is a stronger plant.

Sp. 2. *L. clavatum*, L.

Var. *Magellanicum*, Swartz. North shoulder of Saddlehill, above Renwick's Station; Chain Hill ranges; January, fruit; common. The representative in Otago, both as regards its abundance, habitats, and general aspect, of our common British *L. clavatum.*

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Sp. 3. *L. volubile*, Forst. Greenisland Bush; October, fruit.

The "Wäekähu" or "Waewaekoukou" (Colenso), of the North Island Maori—a term, however, probably also applied to other common species of the genus. Stems slender, twining, often many feet long, climbing over trees and bushes. This and some other species, which festoon trees like certain mosses (species of *Meteorium* and *Trachypus*), are extremely graceful and beautiful ornaments of the New Zealand Bush.

III. MARSILEACEÆ.

Gen. 1. *Azolla.*

Sp. 1. *A. rubra*, Br. On a marshy pond, floating like *Lemna;* Jeffcott's Station, Stoneyhill.

When growing in large masses on extensive sheets of water, it presents the aspect of a beautifully variegated carpet. This plant may yet, from the rapidity of its growth, become so common and so troublesome in Otago that it may play the rôle there of the pest of our British rivers and canals—the *Elodea Canadensis*, Rich.—effectively choking ditches, and so interrupting the drainage and desiccation of land. In the adjacent province of Canterbury it would already appear to be doing this—spreading rapidly on the surface of its slow-flowing waters—impeding the drainage of its plains (Travers).

My friend Mr Grigor of Inch Clutha describes a *Chara* as growing in the Clutha river. I did not, however, see the plant, nor did I meet with any species of the genus in Otago. They occur, however, in the North Island, and they should at least be looked for in the streams, rivers, lakes, or swamps, which are so plentiful in Otago.

V. *New Localities for Rare Plants round Edinburgh.* By JOHN SADLER.

Mr Sadler read extracts from various letters he had lately received, recording new localities for some rare plants in the neighbourhood of Edinburgh. 1. Mr John K. Duncanson collected *Helminthia echioides* between Charleston and Crombie Point; *Meum athamanticum*, farm of Pitdinnie, near Cairneyhill; *Convallaria multiflora*, *Nymphœa alba*, *Nuphar lutea*, and *Potentilla fruticosa*, near Valleyfield; *Hesperis matronalis* and *Malva moschata*, south of Crossford; *Corallorrhiza innata*, woods near Culross, abundant; *Lysimachia Nummularia* and *Lamium maculatum*, near Dunfermline. 2. Mr Wm. Craig reported *Asplenium viride* from the South Medwyn, where he had met with it in considerable abundance in September last; also *Carduus heterophyllus*, and other species, from the same locality. 3. Dr

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M'Farlan had gathered several plants of *Lathyrus Aphaca* by the side of the Old Scone road, about a mile from Perth. 4. Mr John Sim intimated the discovery of *Sanguisorba canadensis* about a mile east of Perth. 5. Mr P. Neill Fraser reported *Allosorus crispus* from Dunearn Hill. 6. Mr Alex. Buchan sent specimens of *Centunculus minimus* from Little Cumbrae. Specimens of the above plants were exhibited.

VI. Mr Sadler read a communication from Dr G. Dickson on the preparation of skeleton leaves. A solution of caustic soda is made by dissolving 3 oz. of carbonate of soda (washing soda) in 40 oz. (2 pints) of boiling water, and adding 1½ oz. of quicklime previously slaked; boil for ten minutes, decant the clear solution and bring it to the boil. During ebullition add the leaves; boil briskly for some time, say an hour, occasionally adding hot water to supply the place of that lost by evaporation. Take out a leaf and put into a vessel of water, rub it between the fingers under the water. If the epidermis and parenchyma separate easily, the rest of the leaves may be removed from the solution and treated in the same way; but if not, then the boiling must be continued for some time longer. To bleach the skeletons mix about a drachm of chloride of lime with a pint of water, adding sufficient acetic acid to liberate the chlorine. Steep the leaves in this till they are whitened (about ten minutes), taking care not to let them stay in too long, otherwise they are apt to become brittle. Put them into clean water, and float them out on pieces of paper. Lastly, remove them from the paper before they are quite dry, and place them in a book or botanical press. Specimens so prepared by Dr Dickson were exhibited, and presented to the Museum.

Sir William Jardine, Bart., sent ripe specimens of the fruit of *Passiflora edulis*, *P. quadrangularis*, and *P. macrocarpa*, produced at Jardine Hall. They had been tested as articles of dessert, and pronounced to be good.

Mr Gorrie exhibited a ripe fruit of *Passiflora laurifolia*, or water lemon of the West Indies, grown and sent to him by P. L. Hinds, Esq. of The Lodge, Byfleet. In a letter

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which accompanied it, Mr Hinds remarks—"I have been rather amused to observe the inaccuracy of description handed down by various writers in regard to white spots on the orange-coloured fruit of this passiflora." On this fruit, during a long lifetime, he has seen many thousands, and never detected a white spot on any one of them. With respect to the *Passiflora macrocarpa*, he questions the statements made of its being a new fruit, being of opinion that it is neither more nor less than the true *P. quadrangularis*, with which he has been acquainted for upwards of sixty years, and is now freely producing it at his place from plants originally imported from the West Indian islands, and his fruit has varied from 5 lb. to nearly 8 lb. each. What is known and grown in this country as *P. quadrangularis* is quite a different species, much smaller fruited, and such as he has seen imported from Madeira.

Mr John Bisset of Keith sent specimens of *Brachypodium pinnatum*, gathered by him at Craighalkie, Tomintoul, Banffshire, on limestone, in August 1866. He also sent specimens of *Draba incana*, from greywacke, at Boyndie, Banffshire, a few feet above the sea-level, gathered on 10th August 1864, and also from schistose rock at Alnathside, Glenavon, in the same county. These specimens exhibited considerable variations from those found in high alpine districts.

Mr William Cameron, schoolmaster, Balquhidder, sent a specimen of *Elatine hexandra*, gathered in Loch Voil.

Mr J. F. Duthil mentioned the occurrence of *Verbascum Lychnitis* on the Castle rock at Stirling.

Mr M. Moggridge of Mentone sent specimens of *Lemna arrhiza* from near St James's Church, Walthamstow.

Dr Alexander Dickson exhibited two pots of jelly made from the fruit of *Mahonia Aquifolium*. The preserve was tasted by the members, and pronounced excellent.

Mr Simson, Eton Terrace, exhibited some remarkable varieties of British Ferns, apparently undescribed.

Mr J. F. Robinson, Frodsham, sent living specimens of *Schistostega osmundacea*, from sandstone caves on Overton Hills, Cheshire.

Mr Gilbert Stewart exhibited some monstrous forms of *Plantago lanceolata*.

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13*th December* 1866.—Professor BALFOUR in the Chair.

The following Gentlemen were elected Office-bearers for 1866–67 :—

President.

Is. ANDERSON-HENRY.

Vice-Presidents.

Professor MACLAGAN.
WILLIAM SELLER, M.D.
Professor ARCHER.
WILLIAM GORRIE.

Council.

ANDREW INGLIS, M.D.
WM. RUTHERFORD, M.D.
ALEXANDER BUCHAN, M.A.
ROBERT HUTCHISON.
ROBERT TRAILL.
Professor ALLMAN.
HUMPHREY GRAHAM, W.S.
A. CRAIG-CHRISTIE
J. KIRK DUNCANSON.
G. C. A. STEWART.

Honorary Secretary.........Professor BALFOUR.
Honorary Curator..........The PROFESSOR OF BOTANY.
Foreign Secretary...........ALEXANDER DICKSON, M.D.
Treasurer......................PATRICK NEILL FRASER.
Auditor........................WILLIAM BRAND, W.S.
Artist..........................NEIL STEWART.
Vice-Secretary and Curator............JOHN SADLER.

The following Candidates were duly elected Members of the Society :—

1. *As a British Honorary Fellow.*

The Rev. M. J. BERKELEY, M.A., F.L.S.

2. *As a Foreign Honorary Fellow.*

PHILLIPPE PARLATORE, M.D., Director of the Herbarium, Florence.

3. *As Resident Fellows.*

1. WILLIAM CRAIG.
2. JOHN ARCHIBALD.

4. *As Foreign and Corresponding Members.*

1. HENRY HUNTER CALVERT, British Vice-Consul, Alexandria, Egypt.
2. ALBERT KELLOGG, M.D., San Francisco, California.

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The following Donations to the Library were laid on the table:—

Pharmaceutical Journal and Transactions, Vol. VIII., Nos. 1–6. —From the Pharmaceutical Society, London.

Journal of the Linnean Society, Vol. IX., No. 38 (Botany).—From the Society.

Report of the Agricultural Board of Nova Scotia for 1865.—From Professor George Lawson, Halifax, Nova Scotia.

The following Donations to the Herbarium were announced:—

Collected and presented by Mr P. K. Vartan, medical missionary—Parcel of Dried Plants from Nazareth.

From Mr John Shaw, Glasgow—Specimens of some new and rare British Mosses.

Professor Balfour exhibited some parts of a work entitled "Wild Flowers of Nova Scotia and New Brunswick," by Mrs Miller and Professor Lawson, containing coloured drawings of the plants of these countries. He also referred to a work now being published by Miss Fanny Charsley, on the wild flowers of Melbourne, Victoria, with coloured drawings. He also referred to Th. Eulenstein's specimens of Diatomaceæ which are advertised for sale. He noticed a new work on the Flora of Europe, by Messrs Jordan & Fourreau, entitled "Icones ad Floram Europæ spectantes."

The following Communications were read:—

I. *Notes of an Excursion with Pupils to Braemar, in August* 1866. By Professor Balfour.

In this paper, Dr Balfour gave an account of a trip to Braemar in August last, in which he was accompanied by Messrs Barclay, Colvin, Shaw, Fraser, Smart, Naylor, Coore, Prankerd, Dixon, and Thomson. The party visited Glen Callater, Canlochan, Lochnagar, Ben Avon, Ben-na-Bourd, Ben-na-Mac-Dhui, and Cairn Toul, and collected a large number of alpine plants. Among the rarer species

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noticed were the following:—*Astragalus alpinus*, *Mulgedium alpinum*, *Thlaspi alpestre*, *Saxifraga rivularis*, *Carex vaginata*, *C. lagopina*, *C. rupestris*, *Arabis petræa*, *Potentilla maculata*, *Gentiana nivalis*, *Juncus castaneus*, *Luzula arcuata*, *Erigeron alpinus*, *Cerastium trigynum.* There was a large amount of snow on the hills; some patches on Lochnagar were several hundred feet in extent, and 10 feet in thickness. Specimens of the plants collected were exhibited.

II. *On the Reproductive Organs of Mosses.* By Mr Wm. Bell, Saharunpore. Communicated by Mr Sadler.

In this paper, Mr Bell reviewed the different theories held by authors regarding the reproductive organs of mosses, and he expressed a doubt whether it had been yet satisfactorily proved that the so-called antheridial and archegonial cells were really the reproductive organs of these plants.

III. *On* Taxus baccata variegata *Seedlings.* By Alex. J. Adie, Esq. Communicated by Mr M'Nab.

Mr M'Nab stated that, on 15th November last, Mr Adie of Rockville, Linlithgow, sent to the Botanic Garden some seedling variegated yews raised from berries taken from a plant of the golden yew. Many of the larger plants of golden yew in cultivation being male, he wrote to Mr Adie for information, and received from him the following notes:—" The parent plant is now 7 feet high, and does not appear to be either the *Taxus aurea* or *elegantissima.* The colour is intermediate between these two varieties of yew, but it is a better grower than either, although it has all the appearance of a plant raised from a cutting. I found it growing behind a shed in Messrs Eagle & Henderson's nursery in Leith Walk, and being struck with its good habit, I bought it for a trifle, as it appeared to be little thought of, although, from the place it was in, I think it must have had a pedigree of note when it came there. The plant was about 3 feet high, and it has been here for nine or ten years.

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My attention was first drawn to the berries by finding a self-sown golden seedling which is now 6 inches high, and about five years old. It has a good golden colour. Since then other self-sown golden seedlings have been found here. As I have a very favourable opinion of the golden yew as a highly ornamental plant among evergreens of the same class, and in places where the golden holly cannot be successfully employed, I made a search for berries among my plants, and found them only on the one in question, but on none of my numerous plants of *aurea* or *elegantissima* were berries seen. My first attempts to sow were not successful, the missel thrushes having stript the plant of its fruit. At a subsequent period I saved some and sowed them in the camellia house border, but the field mice dug them up and carried them off. I had therefore to sow again. In the spring of 1865 nearly three dozen seeds grew, and of these two-thirds were variegated. I sowed some more this spring; of the seeds that grew the golden variety were the most numerous, although the proportion in favour of the golden is not large. I find the variegated seedlings do not lift so well as their brethren in green, nor do they grow so fast; but I fear I have not managed them so well as might be, and hope to succeed better in future. Last autumn I got no berries, but this year they are plentiful. Notwithstanding my losses, I have still about twenty-six golden seedlings. The parent plant grows within ten yards of a handsome variety of the common yew, which sheds clouds of pollen, and it is also near plants of the common golden variety of the Irish yew."

IV. *Extracts from Botanical Correspondence.* By Mr John Sadler.

Mr Sadler read extracts from various letters which, in the course of correspondence, he had lately received:—1. From Mr R. G. Ramsay, Bridgend, Perth, intimating that last summer he had collected *Polypodium calcareum* in considerable quantity about two miles west from Aberfeldy. Specimens from Mr Ramsay were exhibited and presented to the Herbarium. 2. From Mr John Sim, Perth, noticing

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the occurrence of *Anacharis Alsinastrum*, *Silene armeria*, and *Petasites fragrans*, near Perth. 3. From Mr John Shaw, Glasgow, enclosing for the Herbarium specimens of the following rare mosses:—*Myurium Hebridarum*, *Campylopus Shawii*, *C. compactus*, *C. alpinus*, *C. Schwarzii*, and *C. polytrichoides*.

V. *On Abnormal Flowers in* Tropæolum majus. By Dr Alexander Dickson.

Dr Dickson exhibited four abnormal flowers of the common Indian cress (*Tropæolum majus*), each presenting a supernumerary spur. On these he remarked that, in *Tropæolum*, the posterior part of the receptacle between the insertion of the petals and that of the stamens is dilated so as to form the spur which is so characteristic in the genus. The position of the spur in a line with the posterior sepal has led many botanists to consider it as a process of that sepal, but the fact of its being situated *within* the insertion of the petals is conclusive as to its receptacular origin. In the flowers exhibited the supernumerary spur (as if to show its want of connection with any sepal) is placed exactly between a lateral sepal and one of the anterior sepals, sometimes on the one side of the flower and sometimes on the other. These additional spurs are precisely similar to the normal ones, except that they are a little shorter. This abnormality, although at first sight seeming to indicate a pelorian tendency, is no approximation to regularity, from the fact of the extra spur being differently placed, with regard to the sepals, from the normal one.

VI. *Botanical Intelligence.*

Dr Thomas Anderson transmitted a notice in regard to the Botanic Garden of Calcutta, in which he stated—

"*Piperaceæ* have been planted in a thatched shed as is practised by the natives of Bengal and other dry parts of India, and under this shelter are growing all the numerous varieties of betel cultivated in Bengal, and also several wild species.

The collection of palms, consisting of about eighty

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species, has been rearranged by bringing together, as far as was possible, all the different species scattered throughout the garden. Many large specimens, brought from distant parts of the garden, have been successfully planted in this group, which is now in a very satisfactory state, and will, in a few years, be one of the most striking features of the garden.

"The collection of orchids has been more than doubled in number during the past year, and is now a very extensive and valuable one. It has been placed in two of the thatched conservatories lately erected by the Public Works Department in lieu of those destroyed by the cyclone, and the plants have been arranged in them by being suspended in baskets from the roof at different heights over rockworks covered with ferns.

"A garden was formed in October last on part of the land restored by the Agri-Horticultural Society for the cultivation of all the annual indigenous Indian plants and small perennial plants. Nearly 1000 species are now illustrated in this garden. They are arranged in linear beds according to the natural system. The beds are 6 feet wide, and are divided by grassed foot-paths. On the remaining portion of this land Endogenous plants have begun to be arranged in circular groups; but I am unable to complete the illustration of this class of plants, or that of scandent species, for want of ground, and application will shortly be made for more of the Botanical Garden land in possession of the Horticultural Society. This new garden has already proved of great benefit to the seed department, as the seeds of the annual species, cultivated in a small space of ground like this, and carefully labelled, are collected with little difficulty.

"An avenue of mahogany has been formed along the road, parallel to the western boundary of the garden, leading southwards from the great banyan tree. This avenue consists of seedlings raised from seeds received from Trinidad in July 1865, and from seeds collected from the old trees in the Botanical Gardens in 1864. It is deserving of notice, that none of the mahogany trees produced any seed in 1865–66, although the trees blossomed in August and September 1865. I ascribe this to the exhaustion of the

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trees by the unnatural production of leaves after the cyclone in October 1864, and again at the natural period in the end of March 1865. Another avenue has been planted along the road leading from the great banyan tree to the old tree of *Ficus venosa*, which stands in the centre of the road leading to the Howrah Gate, and is formed of *Polyalthia longifolia*. The *Casuarina* avenue, extending from the *Ficus venosa* to the Howrah Gate, and which was destroyed by the cyclone, has been replanted. A second avenue of *Casuarinas* has been planted along the semicircular roads running right and left from the main entrance ghât. In the palmetum, a very long avenue has been formed of the palmyra palm, *Borassus flabelliformis*, and on the road which winds through the centre of the palmetum has been made an avenue of the noble Cuban palm, *Oreodoxa regia*. The tree of the latter species, now 60 feet high, from which the seedlings for planting were obtained, was presented to the gardens by Lord Auckland when Governor-General. These, and other avenues which I intend forming, will be most useful in protecting the garden from storms. I have been careful to record their formation, in order that in after years there may be no doubt about their age."

Dr Anderson also sent a notice of the Cinchona cultivation at Rungbee. He states that the number of Cinchona plants in the Government plantations on 1st September 1866 was as follows:—*Cinchona succirubra*, 172,787; *C. Calisaya*, 998; *C. micrantha*, 15,067; *C. officinalis*, including varieties, 185,258; *C. pahudiana*, 5092—total, 379,202.

Dr Cleghorn sent a memorandum on the supply of wood-fuel to the Punjaub and Delhi Railways.

The possible sources of supply, as mentioned in the correspondence submitted by the Punjaub Government, are —1. Coal in the Salt Range and Central Provinces (Nerbudda). 2. Rukhs or Fuel Reserves. 3. Canal Plantations. 4. Outer Himalayan Forests.

Coal and Wood.

The employment of coal in any shape (lignite or anthracite) would produce a great reduction in the demand for firewood, and would be attended with much advantage to the country in the preservation of the existing woods.

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Coal of Salt Range.—It is feared, however, from the reports of Dr Oldham, Director of the Geological Survey, Dr Jameson, and other competent authorities who have visited the Salt Range, that the coal near Pind Dadun Kahn and other localities is not workable to any great extent, and it appears that only 3415 maunds of this coal were consumed by the Punjaub Railway during nine months of 1865. By others it is maintained that this apparently small deposit should be reserved for the proposed line to Peshawur, which passes close to the Salt Range, where the coal would be delivered at much less cost.

Coal of the Nerbudda.—It seems more probable that economy in the consumption of fuel may be promoted by the introduction of coal from the Nerbudda (700 miles), which might perhaps be specially arranged between the two companies when the Central India line is completed. On the other hand, the East Indian Railway Company might carry coal at a low rate of freight, seeing that the opening of the Delhi line will feed their traffic and enhance their receipts.

Comparative Cost of Coal and Wood.—Coal is now used on the East Indian Railway up to Delhi—the transport being over its own rails. Whether it can be used on the Delhi line depends entirely upon the rate at which the East Indian Railway will consent to carry it for a foreign line. If the agent is correct in anticipating that the average price of wood will rise to 40 rupees per 100 maunds, or 33 rupees 8 annas for 84 maunds of wood (the working equivalent of 1 ton of coal), then coal delivered at Ghazeabad for 26 rupees 12 annas would certainly displace wood for a long distance of the Delhi line, perhaps up to Lahore.

Importance of Substituting Coal for Wood.—Before deciding on the extent to which planting is required, the possible substitution of coal for wood must be *fully* considered, and, from the foregoing calculations, it seems to be possible. If compelled to give up all idea of coal, we must then utilize existing jungles, and develop new sources of supply. Under any circumstances, and considering the requirements of the population, it is desirable to control the monopoly, which coal must otherwise have in a few years.

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Rukhs or Fuel Reserves.

Great Value of Rukhs.—The great and increasing importance of these fuel reserves, the need of husbanding their resources and of turning them to the best account, is admitted by all. The Punjaub Government have ordered that Rukhs are not to be sold or alienated without special report and permission—the object being to retain a sufficient area as State property, and to bring all the best portions into the highest state of production. They, indeed, form a basis for future action in the present difficulty, and must be systematically cropped or judiciously thinned and replanted.

Treatment of Rukhs.—Selected tracts should be ploughed or trenched, and seedlings planted at 4 or 6 feet apart from tree to tree, and the plot surrounded with a proper fence or ditch, so as entirely to exclude cattle. The kinds of trees most profitable to grow are those indigenous species which are known to produce good fuel, and to possess the reproductive power in the highest degree.

Indigenous Trees.—These are enumerated and fully discussed in Dr Stewart's report on Rukhs, dated September 1864, paragraphs 1 to 12, viz.:—1. *Prosopis spicigera*, Jhand. 2. *Acacia modesta*, Phulai. 3. *Butea frondosa*, Dhak. 4. *Capparis aphylla*, Karîl. 5. *Salvadora oleoides*, Wán, Jál, Pilu. 6. *S. indica*, Kaura Van. 7. *Tamarix indica*, Pilchi, Jhau. 8. *T. orientalis*, Furwa, Farás. In addition to these, are—*Acacia arabica*, Kikkar; *Dalbergia Sissoo*, Táli; *Zizyphus Jujuba*, Bêr—probably the three best woods; but they are doubtfully native, and do not occur spontaneously in sufficient quantity to affect greatly the supply of fuel.

Australian Eucalyptus.—As a rule, indigenous trees furnish a larger weight in a given time than exotics; but various species of the extensive genus *Eucalyptus*, called in Australia "*Gum Trees*," are strongly recommended, on account of celerity of growth, by the secretary of the Agricultural and Horticultural Society, Punjaub, particularly *E. giganteus* and *E. globulus*, the "stringy bark" and "blue gum;" some thousand trees have been reared from seed both in the Government Gardens at Lahore and at Madho-

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pore, and have grown with great rapidity. Consequently, Dr Henderson has, with commendable zeal, endeavoured to introduce those trees into the districts in masses. As it will be some years before they bear fruit, an annual importation of seed from Australia and Southern India will be necessary. The seedlings now in the nurseries should be carefully planted out in the fuel plantations, and a few of them periodically measured.

Adaptability of Australian Trees to the Punjaub.—It is an interesting and encouraging fact, that several Australian plants now naturalised in Southern India have been found to grow well in the arid plains of the Punjaub. Some trees of that continent possess in a remarkable degree the power to resist the drought of the Punjaub hot season, and *vice versa.* Punjaub plants are found to thrive in Queensland, Moreton Bay, and other parts of Australia. Several species of *Acacia* and *Casuarina*, which flourish in the desert districts of the interior of Australia, and have been planted extensively upon the hills of the Madras Presidency, might be tried with advantage. These have been successfully introduced into Southern India, and private plantations are now undertaken for profit. If the young seedlings are sheltered the first season from the frost and protected from camels, they will probably thrive and be valuable acquisitions.

The pubescent silver-wattle tree of Victoria (*Acacia mollissima*) seems particularly suited for the Punjaub. It is a quick grower, and spreads so rapidly by underground suckers that it would be impossible to eradicate the copse again, which would yield a constant succession of crops of useful fuel.

Trees suited for Canal Plantations.—The Sissoo, Babool, Siriss, and other *Acaciæ* grow well upon canal banks. Sissoo appears to thrive better within, and Babool without the reach of infiltration. The former naturally affects islands in river channels, and the latter is found in arid wastes. The *Eucalypti* and other Australian trees would grow well on the spoil bank not irrigated, or with little water, and doubtless all of these would spread to some extent over the plains in a few years. The mulberry is easily propagated by cuttings, and furnishes excellent fuel.

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Dr Balfour laid before the Society a document which had been sent from the India House relative to the preparation of young men for the forest department in India. Dr Balfour considered that it was most important to train up young men for this department, but he saw no reason why they should be compelled to study forestry in Germany and France, and not be allowed to prosecute their studies in this country. He was satisfied that ample opportunities were presented in Britain for the acquisition of knowledge in all departments of science requisite for forest work, as well as in practical operations. There are many excellent foresters in Britain who would train young men, and there are excellent nurseries in which the treatment of cinchona could be well studied. He hoped that the Secretary of State for India would see the propriety of not confining the studies to Germany and France, to the exclusion of Britain. Let young men study where they choose, but let them be carefully examined as to their scientific knowledge and their practical information. If the examination was conducted in a garden, means would be at hand for carrying it on in such a way as at once to bring out the capabilities of the candidates. By leaving the place of study open to candidates, the Government would also be saved expense in the matter. Any who choose to study on the Continent might go there. The German and French languages are not absolutely essential for the Indian forest department. It would be better that the candidate should be instructed in Hindustani, or in some of the Indian dialects, and this could be well done in any seat of learning in Britain. Botany, chemistry, natural history, along with practical work in a botanic garden or nursery, could be well prosecuted in Britain.

Dr Balfour made some remarks on the Granadilla, and exhibited Jacquin's drawing of *Passiflora quadrangularis*. In the characters referred to by Jacquin, he alludes to the fact that the inner lining is easily detached from the inside of the fruit, along with the pulp and seeds. The fruit is said to be the size of a goose egg, while a variety called *sulcata*, with a transverse groove in the fruit, produces fruit the size of a child's head. There seems to be a good deal of confusion as to the plant called *Passiflora macrocarpa*.

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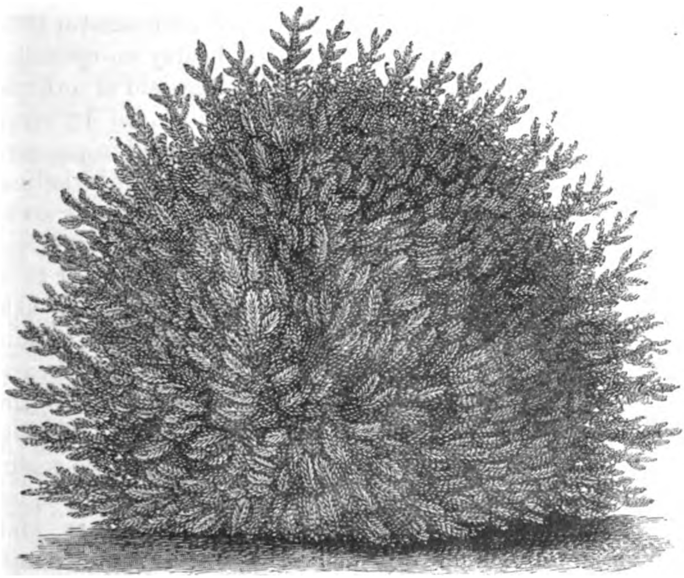
Mr M'Nab exhibited a plant of the new dwarf Arbor Vitæ, described and figured in the "Illustrated Farmer and Gardener's Almanack" for 1867, pp. 102, 103, and made the following remarks regarding it:—

"Lately passing through the extensive nursery grounds of Messrs P. Lawson & Son, my attention was directed to a large quantity of a peculiar looking dwarf shrub growing in one of their enclosures. On inquiry I found that they had been recently received from Messrs Ellisanger & Barry, of



America, under the name of the Tom Thumb Arbor Vitæ. The parent plant, of which the above are cuttings, is supposed to be an accidental seedling from the *Thuja occidentalis* or American Arbor Vitæ. Although most of the leaves are of a heath-like appearance, still several small shoots are here and there seen which unmistakably refer it to the American Arbor Vitæ. It is a curious fact that the heath-like leaves have a slight smell of the juniper, while the smell of the typical leaves is identical with the American Arbor Vitæ. This horticultural curiosity has a compact, rounded habit. It is to be sent out next autumn

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by the Messrs Lawson under the name of *Thuja occidentalis ericoides.*"

Professor Balfour stated that it had been resolved to form a botanic garden of hardy plants at Inverness, and read the following communication which he had received regarding it:—

"Messrs Gunn & Petrie, nurserymen and florists, of this town, have kindly placed at my disposal, gratis, in their nursery in Ness Walk, whatever space may be requisite in order to form a collection of our native plants, where these will be scientifically arranged. Several enthusiastic botanists have already promised me their hearty co-operation; and I now respectfully beg to solicit the aid of others in any part of the country who would oblige me by simply becoming correspondents, and lending their aid in procuring specimens of rare plants within their district. If ladies or gentlemen, gardeners, and others interested to any extent whatever in the study, would send their names and addresses either to Dr Aitken, Northern District Asylum, or to me, they will confer a favour. No subscription will be asked of them—but information and specimens of any rare native plants which may be within their reach. This, if heartily entered into, will, in a comparatively short space of time, add one more little attraction to our town, afford facilities for instructing the youth at all our schools in the science, and provide visitors and strangers with a ready means of forming the acquaintance of the numerous rare plants which are to be found in the north and west of our country. —I am, yours, &c., Jos. Robertson, *Rector.*

"High School, Inverness, 28*th Nov.* 1866."

Professor Balfour stated that the Royal Agricultural Society of England were anxious to have an essay on plants most capable of resisting drought.

Sir William Jardine sent cones of apparently the Scots fir, which he had taken from peat at a considerable depth below the surface near Dumfries.

Dr Ridpath, of the R.M.S.P. Oneida, sent living plants for the Botanic Garden of nine species of orchids, two Billbergias, and twelve ferns, from Rio Janeiro.

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Mr Sadler exhibited the fruit of the Quince from Pitcaithly House, Bridge of Earn, where it has ripened in the open air for the last three years. Mr Sadler also noticed the occurrence of *Lolium temulentum* (the tares of Scripture) in large quantity in a corn field at Pitcaithly last August.

10th January 1867.—William Gorrie, Esq., Vice-President, in the Chair.

The following Donations to the Library were announced:—

Transactions of the Royal Scottish Society of Arts, Vol. VII. Part II.—From the Society.
Transactions of the Pharmaceutical Society of London, Vol. VIII. No. 7.—From the Society.
The Naturalist's Note Book, No. 1.—From the Editor.

The Secretary read a letter from Rev. M. J. Berkeley, thanking the Society for his election as an Honorary Fellow.

Professor Balfour noticed the death of Alexander Bryson, Esq., and of the Rev. Thomas Blizard Bell, members of the Society, and also that of Mr Robert Dick of Thurso, who had been a contributor to the Society's Herbarium.

The following Communications were read:—

I. *On the Glumaceæ** *of Otago, New Zealand.* By W. Lauder Lindsay, M.D., F.R.S. Edin.; F.L.S. Lond.

Nat. Ord. I. GRAMINEÆ.

The grass-lands of Otago are mainly confined to the plains or "flats," and the downs or uplands under 1000 feet, of the lowlands; the hill ranges, with their valleys, between 1000 and 3000 feet;

* I have appended the *Junceæ*, as being the natural allies, in many respects, of the *Glumaceæ*. The *Junceæ* are more appropriately considered along with the *Gramineæ* and *Cyperaceæ* than with the higher Phænogams.

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and the lake and river terraces of the interior. On the mountains, immediately above the limits of arboreal and shrubby vegetation (the *Fagus*-forest and scrub), where snow lies longest during winter, at an elevation in Otago usually of about 3000 to 3500 feet, and in Nelson of 4200 to 4700, the settlers recognise a belt of grassy vegetation, known as that of the "Snow-grasses." These consist only partially, however, of grasses proper (*e.g.*, species of *Danthonia* and *Agrostis*): including, though to a very limited extent, certain *Cyperaceæ*, *e.g.*, *Schœnus pauciflorus*, Hook. fil.*

The grasses exhibit the same occasional peculiarities of local distribution, which are characteristic of so many of the higher Phænogams of Otago, especially of some of its forest trees. For instance, Sullivan remarks that what he calls "Oat-grass" (probably some species of *Danthonia* or *Trisetum*), while abundant between the Lindis Gorge and the Otamitita river in the interior, is not seen between that river and Oamaru on the east coast. Again, M'Kerrow remarks that while some of the valleys opening upon the Te Anau and Manipori Lakes are well-grassed, others are grassless.

Buchanan is of opinion that some of the more fibrous grasses (species of *Triticum*, *Agrostis*, *Arundo*, and *Danthonia*), which abound on the lower hill-ranges at elevations over 1000 feet, might be used as a source of supply of paper material. But there are various strong reasons why it is extremely unlikely these native grasses should be able successfully to compete with other paper materials, which are both much more abundant and cheaper. The grasses in question are rapidly disappearing before the introduced, cultivated, and so-called "artificial" grasses of Britain. They could only prove a *permanent* source of supply, therefore, if *cultivated;* and there are many indigenous fibrous plants, which promise infinitely better results in this direction than any of the local grasses. In their present sites of growth, the cost of collection and transport would alone render them unsuitable for competition in the market with rags or other current material.

Several grasses are recorded as indigenous by Dr Hooker, which are also British. Not a few British grasses have undoubtedly been introduced, and are now more or less extensively naturalised: while some are probably both indigenous and introduced. The problem here offers itself for solution to the local botanist, viz., whether, or how it is possible to distinguish the *native* from the *naturalised* condition of the same species? For, on the one hand, grasses, regarded by Dr Hooker as introduced, occur under circumstances in which it is, to say the least, extremely difficult to conceive of their diffusion from remote settlements; while, on the

* The latter is the "true Snow-grass" (according to Buchanan) of the Otago settlers: it abounds on barren soils at elevations of 2000 to 4000 feet in the interior.

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other, those recorded as indigenous are found in localities, which give rise to the legitimate conjecture that they have been introduced. For instance, two British species of *Festuca* occur in Otago—*F. duriuscula*, and *F. bromoides*. The former is recorded by Dr Hooker as native; the latter as "certainly introduced," and "nowhere native" (Handbook, p. 341). I found both growing in the same habitats, and intermixed. It was impossible to determine that the one was native and the other introduced. So far as regards their botanical characters, they appeared identical with British specimens; and, from their occurrence on the sheep and cattle runs of settlers, were probably introduced rather than indigenous. Of *F. duriuscula*, I find it recorded in my Field-book that my Otago specimens closely resembled forms of *F. ovina*, L., collected by myself at North Queensferry, Fifeshire, on similar hill-ranges, in June 1859. On the other hand, of *F. bromoides* I have it recorded that my Otago forms have less general resemblance to British specimens of that species than to those of *Bromus diandrus*, Curt. Again, *Kœleria cristata*, Pers., is recorded in the Handbook Fl. N.Z. (p. 335), as native, though Dr Hooker adds it is "possibly introduced only." But in a letter (January 31, 1865), he says of it, "I have increasing reasons for considering it introduced." Nevertheless, the plant occurs high on the alps (4000 feet) of Canterbury and Otago, most remote from cultivation or settlements. *Poa annua*, L., is regarded as introduced; but it was the most extensively distributed grass I met with in Otago, growing in a great variety of habitats, and in a corresponding multiplicity of conditions. *Phalaris canariensis*, L., was gathered by Forster in 1772, long before the colonisation of New Zealand (Otago was colonised so recently as 1847), but three years subsequent to Cook's first voyage (1769). It is difficult in such a case to understand how it came to be introduced, and yet it is included in Dr Hooker's list of naturalised grasses. I found it growing in Otago apparently as wild as those British grasses to be hereafter mentioned, which are considered truly indigenous. *Anthoxanthum odoratum*, L. has been gathered at elevations of 3000 to 4000 feet on the glacier-surrounded Mount Cook, which is 13,000 feet high—(Haast). It is extensively distributed throughout New Zealand, and it is one of the grasses I found growing in great profusion and luxuriance in several parts of Otago. Specimens indistinguishable as to size and general aspect from my Otago plant were collected by myself in August 1850 on the meadows bordering the Elbe below Blankenese, Holstein (near Hamburg). It is included, however, in Dr Hooker's category of naturalised grasses; as is also *Bromus mollis*, L., which has been found on the Canterbury Alps at 4000 feet (Travers). On the other hand, the following are recorded by Dr Hooker as native: *Agrostis canina*, L., *Alopecurus geniculatus*, L., and *Deschampsia cæspitosa*.

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Palisot. I do not think the problem is now capable of satisfactory solution in all cases. In certain cases there may be strong probability that the plants were introduced (*e.g.*, *Lolium perenne*, L., *Anthoxanthum odoratum*, L., or *Poa annua*, L.); but I do not admit the *conclusiveness* of the evidence, according to which certain British species of *Festuca*, *Agrostis*, *Alopecurus*, and *Deschampsia*, are determined to be native, and those of *Kæleria*, *Phalaris*, *Bromus*, and *Festuca* to be merely naturalised. It is equally impossible to assert that the former are not native, or the latter also native. All that I hold is, that in the present stage of colonisation—in the present state of our knowledge of the botany of New Zealand—proof of a sufficient and satisfactory kind to establish either one set of propositions or the other is probably impossible of attainment.

The New Zealand *Gramineæ* illustrate well that *Continuity of Variation*, so characteristic of New Zealand plants in general, which frequently sets at defiance all the efforts of the systematist to classify particular plants or forms, whether as variety, species, or even genus. It seems to me a fruitless and absurd effort to name separately the infinite and inconstant variation-forms of a supposed species or type; while the supposed book-species, and even in certain cases, genera themselves, are much too numerous for the proper purposes of science or the student. The whole family, as it occurs in Otago and in New Zealand, is eminently deserving of the attention of the local botanist, to whom it naturally falls to establish more comprehensive species or types—more exact and liberal definitions, where these are possible, based on fuller knowledge of the range and form of variation of species.

In no group of New Zealand Phænogams is there such difficulty of determining the specific applications of *Maori terms* as in that of the grasses. This arises probably from the comparatively much greater difficulty in them of discriminating species, and even sometimes genera. "Ōtaōta"* is a general term for grass intermixed with flax, fern, and other plants (Williams): "Taru-taru," a term also applied to "weeds" in general (Dieff.): "Turutu," "a reed for making baskets," according to Dieffenbach, while Williams assigns it to the very different plant *Dianella intermedia*, Endl., N. O. *Liliaceæ*: "Wiwia," for long grass (Dieff.)† The following terms indicate particular species or kinds (Williams and Dieffenbach), which, however, are unknown to me:—"Pāpa," "Pīhi" (Rarawa dialect), "Tārakōi," "Tāramāro," "Rare," "Rau." "Toë-toë" is a more familar term, applied apparently to "reeds" or reed-like grasses (whereof *Arundo conspicua* is the

* A term, however, which Dieffenbach defines more generally as "all wild herbs, plants, weeds."

† *Vide*, footnote, page 77.

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type). Williams gives the following compounds of "Toë-toë," which are probably specific, though I have no means of determining to what particular grasses they respectively apply. "Toë-toë-kīwi," "Toe-toe-tāhae, "Toe-toe-rāutahi" (East Cape dialect), "Toe-toe-wātumanu," "Toe-toe-pāinanga-mōho."* These are illustrations of the futility of expecting help in the determination of species by the native names of New Zealand plants. In such cases as the above, and in many others, the effort is simply hopeless in its results; not only is the labour lost to the student, but he involves himself in inextricable and mischievous confusion.

Gen. 1. *Arundo.*

Sp. 1. *A. conspicua*, Forst. Base of Saddlehill. December, young, W. L. L. Taeri swamps (Martin); Clutha swamps; common on the grassy river and lake terraces and "flats" of the interior (Buchanan).

The only "reed" proper of New Zealand, whose culms were formerly much used, like "Raupo"-stems, in thatching and lining wharés, and are still so used in the Chatham Islands (which cannot yet be said to be "colonised").† A tall, handsome, strong, hardy grass, "now becoming pretty well known in British gardens,"‡ in which it rivals the elegant "Pampas grass," *Gynerium argenteum* (Gorrie).

Variously known in Otago as the "Tohé-tohé," "Toë-töe,"§ "Tohi-tohi," "Töi-töi;"‖ the "Puketoi" of the gold-diggers of the interior and west coast; the "Kakaho"¶ of the North Island Maori. It is probably of this that Buchanan speaks as "the graceful *Stipa* or feather grass." Whether or not it indicates the possession of nutritive principles of any kind, it is a fact recorded by Sullivan, that on one occasion (near Haast's glacier) the members of Dr Hec-

* The mode of spelling here introduced is merely for the purpose of distinguishing the elements of the compound words. Williams spells "Toë-toë" and all its derivatives as one word.

† The wharés of the earlier settlers in the Dunedin district of Otago appear also to have been thatched occasionally with the stems of this reed, associated or not with *Leptocarpus simplex.*

‡ Now regularly sold by British nurserymen as an ornamental and hardy grass.

§ Also applied to *Cyperus ustulatus*, A. Rich. (Lyall.)

‖ Not to be confounded with the simpler term "Toi," which refers to *Cordyline indivisa.*

¶ A term defined as "Reeds" by Dieffenbach—this being, however, the only New Zealand genus and species properly described by the word "Reed," though the term is also popularly applied sometimes to the "Bulrush," or "*Reed*-mace"—*Typha angustifolia.*

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tor's exploring expedition (*via* Lake Wanaka) to the west coast were reduced to dining on a soup made from the roots of this grass and pieces of sheepskin.

The plant, as I saw it, has a general resemblance to our *Phragmites communis*, Trin. (save as to the dark purple of the spikelets in the latter), and to *Calamagrostis epigejos*, Roth. Dr Haast records his having found what he considers a new species about the Roto-iti Lake, in the province of Canterbury; but the Handbook Fl. N.Z. mentions only one New Zealand species.

Gen. 2. *Danthonia*

Includes what are at once some of the commonest and coarsest grasses of Otago; more especially abundant in the lower downs or uplands. Some of them are designated "Snow-grasses" (*e.g.*, *D. flavescens*, Hook. fil.), occurring on the mountains above the limit of arboreal vegetation, and marking the winter snow-line—ranging not unfrequently between 2000 and 4000 feet (*e.g.*, *D. Raoulii*, Steud., and *D. Buchanani*, Hook. fil.) The species more or less resemble and represent our British genera *Avena*, *Arrhenatherum*, and *Bromus*. They are most variable, and I do not think the *definitions of species* are sufficiently comprehensive or exact. In grasses so variable, it appears to me a waste of labour to *name* varieties, forms, or states, which are generally most inconstant, and graduate imperceptibly into each other; and where such definitions are attempted by systematists, it is equally a waste of effort on the part of the student to try to follow them either in the field or closet.

Sp. 1. *D. Cunninghamii*, Hook. fil., (*D. antarctica*, Fl. N.Z.) Chain Hill ranges. December, in flower; 30 to 40 inches high.

One of the largest, coarsest, and commonest native grasses I met with. Larger forms resemble our *Avena fatua*, L., and *Arrhenatherum avenaceum*, Beauv.; smaller, our *Agrostis canina*, L.

Sp. 2. *D. semiannularis*, Br. Flanks of Saddlehill, 15 inches high; banks of the Clutha, Clutha Ferry, 20 inches. December, in flower.

Some of its forms resemble and represent our *Avena pubescens*, L.

Var. *pilosa*, Br. (*D. pilosa*, Fl. N.Z.) Uplands about Fairfield, Saddlehill, 6 to 10 inches high; banks of the Clutha, Clutha Ferry, 10 inches. December, in flower.

Gen. 3. *Dichelachne.*

Sp. 1. *D. crinita*, Hook. fil. Stoneyhill uplands, 30 inches high; Glen Martin, Saddlehill; banks of the Clutha, about Finegand, 50 to 60 inches. December, in flower.

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One of the commonest, and at the same time tallest, handsomest, and coarsest grasses I met with in Otago. The only taller grass or reed I saw was *Arundo conspicua.* Resembles and represents, but on a much larger scale, our *Polypogon monspeliensis*, Desf.

Gen. 4. *Echinopogon.*

Sp. 1. *E. ovatus*, Palisot. Saddlehill uplands, 15 inches high; Finegand Bush, Lower Clutha, 40 inches. December, in flower; W. L. L. Frequent on flats or meadows of the interior (Buchanan).

One of the characteristic grasses of Otago; in its tallness, harshness, and rigidity, resembling *Dichelachne crinita.* Save in respect of size, its forms also somewhat resemble our *Lagurus ovatus*, L. (without the hairiness of the latter's panicle.): various species of *Hordeum* (*e.g.*, *H. murinum*, L.): *Phleum alpinum*, L. (though more bristly looking): or *Cynosurus echinatus*, L.

Gen. 5. *Hierochloe.*

Sp. 1. *H. redolens*, Br. Saddlehill Bush, 20 inches high. November, in flower.

Resembles somewhat our *Holcus lanatus*, L., and *H mollis*, L., which, however, want the glistening spikelets of the *Hierochloe.* In its fragrance resembles and represents our *Anthoxanthum odoratum*, L., which occurs in New Zealand only as naturalised, according to Dr Hooker. Frequently abundant on the lower grassy downs or pastures of the interior (Buchanan). The "Kāretu" of the North Island Maori.

H. alpina, Roem. and Schultes (*H. borealis*, Fl. N.Z.) occurs as a sub-alpine or alpine grass in the central Lake district. In Iceland, where it is known as the "Reisgresi," its fragrance causes it to be used for scenting clothing, for which purpose it is placed in fascicles in the chests, drawers, or presses in which such clothing is deposited. As one of the most familiar Icelandic plants, it has been sent to me by correspondents from Reykjavik.

Gen. 6. *Agrostis* (including *Deyeuxia*, Fl. N.Z.)

Embraces some of the most graceful of the smaller grasses of Otago. Its species are distributed mostly on the lowland downs or ranges; but some rank among the "Snow-grasses," and are mainly sub-alpine (*e.g.*, *A. parviflora*, Br.; *A. pilosa*, A. Rich.; and *A. avenoides*, Hook, fil.)

Sp. 1. *A. æmula*, Br. (*Deyeuxia Forsteri*, Fl. N. Z.) Uplands about Fairfield, Saddlehill; Chain Hill ranges, 15 to 40

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inches high; banks of the Clutha, about Myres, Inch Clutha, 10 to 15 inches. December, in flower.

One of the commonest and most graceful grasses I saw in Otago. In general not a tall plant, though I have seen Bush forms 3 to 4 feet high. Young specimens resemble *Apera interrupta*, L., while certain forms are like *Aira caryophyllea*, L.

Sp. 2. *A. quadriseta*, Br. Flanks of Saddlehill, 15 inches high. December, in flower.

Resembles some forms of our *Alopecurus agrestis*, L.

Gen. 7. *Poa.*

Its book-species seem to me unnecessarily and improperly numerous. Very few stand out distinctly from the others, unconnected by passage forms. All the New Zealand forms I have seen admit, I think, of reduction to a very few types. The variations of the species are yet very imperfectly known; whence it happens, I suspect, that dwarf alpine forms, which sometimes have a very different aspect and habit from the larger, more luxuriant lowland forms, are apt to be regarded as separate species. Moreover, several British species have been introduced, and are now so extensively naturalised as to surpass in extent of diffusion the native forms. I do not think that we are yet sufficiently acquainted with the variations of these British species in New Zealand, many of which have at least a very close resemblance to some of the native forms. Named book varieties of the indigenous species appear, for the most part, to be too inconstant in their characters to possess adequate scientific value, and their precise definitions, therefore, seem a fruitless expenditure of time and labour.

Sp. 1. *P. Lindsayi*, Hook. fil., Handbook, p. 340. Flanks of Saddlehill; abundant. December, in flower.

I have examined all the specimens contained in the Kew Herbarium, which are not numerous, and are mostly from the alps of Canterbury or Otago.

There are two forms—the larger 7 to 8 inches high, the smaller about 3½ inches. Leaves glaucous-green, only about 1 inch long, very narrow; frequently with involute margins. Panicle 1½ to 3 inches long; branches frequently very flexuose or zigzag. Spikelets purplish, sometimes as distinctly so as in the British *Molinia*.

Sp. 2. *P. imbecilla*, Forst. Chain Hill ranges, 6 to 8 inches high; Stoneyhill uplands, 20 to 25 inches; Fairfield uplands, 15 inches. December, in flower. Frequently 1 foot tall, W. L. L. Abundant sometimes on the lower grassy downs or sheep-pastures of the interior (Buchanan).

Extreme states are represented by a tall, delicate, graceful form,

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with a slender, capillary panicle, resembling our *P. nemoralis*, and its variety *Balfourii*, Parn., as it occurs in my British Herbarium; and by a low, more robust, straggling or spreading form, with divaricate panicle resembling our *P. annua*, L. Generally the grass is tallish and graceful, with long filiform leaves and pale-green spikelets.

Sp. 3. *P. breviglumis*, Hook. fil. Flanks of Saddlehill; marshes at foot of the limestone cliffs, Woodburn, Saddlehill. Resembles the preceding, and appears to be a transition form between it and *P. Lindsayi*.

Sp. 4. *P. Colensoi*, Hook. fil., Handbook, p. 340. Introduced here on the authority of a specimen in the Hookerian Herbarium, so labelled, collected by me on the banks of the Clutha about Myres Station, Inch Clutha. A small grass, resembling our *P. annua*, or the New Zealand *P. australis;* occurring in two forms—larger, about 8 inches, and smaller, 2 to 3 inches, high.

Sp. 5. *P. australis*, Br., var. *lævis*, Br. (*P. lævis*, Fl. N.Z.) Top of Kaikorai Hill, 3 to 10 inches high, with rigid, erect culms. Stoneyhill uplands; banks of the Clutha, Clutha Ferry, 5 to 10 inches; in the Bush, M'Neill's Station, Clutha Ferry, 8 inches to 2 feet. December, in flower.

One of the commonest species I met with on upland pastures. Indistinguishable in some of its forms from *P. anceps*, save in respect of minor trivial differences affecting the capillarity of the panicle, fewness of the florets, and breadth of the leaves. Certain other states greatly resemble conditions of *P. annua*.

Sp. 6. *P. anceps*, Forst. Banks of the Clutha, about Finegand, 20 inches high. December, in flower.

Usually a tall, handsome grass, resembling our *P. nemoralis*, or *P. pratensis*. Dr Hooker describes five separately-named *varieties*, depending chiefly on the kind and length of leaves, especially in relation to the culm, the tallness of the culm, size of spikelets, and character of panicles. But in this and similarly variable grasses, it is better, I think, simply to indicate, without affixing separate names, the general directions or forms of variation. Moreover, I do not think the relation of this species to certain others (*e.g.*, *P. australis*), is at present satisfactorily defined in reference to the question of unity or plurality of type.

My Otago specimens agree most nearly with the characters of var. *foliosa* of the Handbook Fl. N.Z.; but the endeavour to refer such plants to such named varieties is seldom satisfactory, in consequence of the abundance of passage-forms, which partake of or possess the characters of two or more *varieties*, or characters diverse therefrom. I believe an im-

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mense amount of valuable time is thrown away, on the one hand, in defining inconstant varieties, and on the other, in endeavouring to refer to book varieties particular conditions of growth.

Gen. 8. *Festuca.*

Sp. 1. *F. duriuscula*, L. Flanks of Saddlehill, 20 to 30 inches high. December, in flower.

Sp. 2. *F. scoparia*, Hook. fil. (*Schenodorus littoralis*, Fl. N. Z., and named in my Herbarium by Dr Hooker, *F. littoralis*). Sand dunes, Willshire's Bay, mouth of the Clutha, 20 to 30 inches high. December, in flower.

A tall, handsome, littoral grass, intermediate in size and general appearance between and representing here our *Elymus arenarius*, L., and *Triticum junceum*, L., more nearly approaching the latter. Dr Hooker, in the Handbook, gives no South Island locality for *F. scoparia*, Port William being in Stewart's Island; while he records *F. littoralis*, Br. as exclusively a *North* Island plant. There seems, however, every reason to believe that *F. scoparia* is not uncommon in Otago and Southland, on the eastern and southern coasts.

Gen. 9. *Triticum.*

Sp. 1. *T. scabrum*, Br. Saddlehill uplands, 15 to 40 inches high; banks of the Clutha, at the Clutha Ferry. December, in flower.

Gen. 10. *Trisetum.*

Sp. 1. *T. antarcticum*, Trin. Saddlehill uplands, 2 feet high; banks of the Clutha, about Finegand, 16 inches. December, in flower, W. L. L.

A common and beautiful grass, resembling our *T. flavescens*, L., and *Aira flexuosa*, L., though taller and handsomer. Frequently luxuriant on the flats or meadow lands of the interior (Buchanan).

Gen. 11. *Deschampsia.*

Sp. 1. *D. cæspitosa*, Palisot. Banks of the stream flowing through Glen Martin, Saddlehill, 40 to 50 inches. December, in flower.

A very handsome plant, apparently identical with specimens of our familiar British *Aira cæspitosa*, L., collected by myself at Burntisland, Fifeshire, in July 1848. Abundant on the lower grassy downs or pastures of the interior (Buchanan). The plant is recorded as indigenous by Dr Hooker, and it may really be so. But it is at least quite as probable that it occurs also (or even only) introduced; and in such locali-

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ties as I met with it—on farm-lands—there is quite as great a probability of its being naturalised as in the case of *Anthoxanthum odoratum*, *Poa annua*, *Festuca bromoides*, *Phalaris canariensis*, *Kœleria cristata*, or other British grasses, some of which are found in the remote, inhospitable and almost inaccessible alps of the interior and west coasts.

Nat. Ord. II. CYPERACEÆ.

Gen. 1. *Carex.*

Some of the Otago species or forms are characterised by their peculiar habit, great size, or the coarseness of their leaves, with cutting or toothed edges, capable of inflicting a formidable wound on the unwary hand which grasps them. These forms usually inhabit swamps, in which they sometimes constitute the sole or chief form of phænogamous vegetation. According to Buchanan, other forms are common on the higher ranges of the S.E. districts, at or above 4000 feet, where snow frequently falls or lies. Two of the New Zealand *Carices* are British—*C. stellulata*, Good., and *C. teretiuscula*, Good., of which the latter at least occurs in Otago.

Sp. 1. *C. virgata*, Sol. Banks of the stream about Fairfield, Glen Martin, Saddlehill; banks of the Clutha about Myres, Inch Clutha. November to December, in flower and fruit. 24 to 40 inches high.

Has a general resemblance to our *C. axillaris*, Good. Occurs frequently in the same habitats with its var. *secta*, with which it also grows intermixed and is liable to be confounded. Edge of leaf much less serrate or scabrid than in var. *secta*.

Var. *secta*, Boott. (*C. secta*, Fl. N.Z.) East Taeri swamps, 24 inches tall; Woodburn ravine, Saddlehill, 20 to 24 inches; Kaikorai lagoons, 30 inches. October to December, in flower and fruit. Swamps of the Matukituki valley, Wanaka Lake, common (Sullivan).

The commonest, and by far the coarsest and largest, of all the marsh sedges I saw in Otago. The familiar "Tussock* grass," "Grass tree" † or "Maori heads" of the Otago settler. The term "Purēirei" (Waikato syn. "Purēkirēki), "a tuft of grass in a swamp," according to Williams, is more applicable, and is probably applied to the "tussocks" of this

* Government surveyors and travellers frequently speak very erroneously of "Tussac" instead of "Tussock" grass; the true "Tussac" grass being unknown in New Zealand.

† A term also applied by the Otago settler to *Panax crassifolium* in its young state.

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or other swamp *Carices* than to the tufts of any of the *Gramineæ*. The so-called "tussocks" are frequently pyramidal columns, 8 to 10 feet high, and 1 to 1½ foot in diameter, bare and black—made up, or consisting, of the root-tufts, a matted mass of interlacing roots. They are crowned with a plume of very strong, rigid leaves, frequently over 30 inches long, which possess a minutely serrate edge like *Demoschœnus spiralis*, inflicting a wound nearly as severe, when unwittingly grasped for the vasculum or to assist the traveller in his passage of the treacherous "tussock swamp." These "tussocks," or "Maori heads," with somewhat the aspect on a small scale of a tree-fern, or a Ti-Palm, constitute a peculiar feature of the swamp vegetation of Otago; and some of them are important, by preparing the way for higher vegetation —filling up by their growth and decay the swamps in which they occur, *e.g.*, *C. Gaudichaudiana*, (Buchanan.) They frequently grow from amidst deep pools of dark boggy water and ooze: and the settler, who has occasion to cross such a "tussock swamp," can only progress by jumping from the top of one "tussock" to that of another, at the risk of a most unsavoury, if not sometimes dangerous, plunge. The special correspondent of the *Otago Daily Times*, who accompanied Dr Hector's overland expedition to the West Coast in January to March 1863, speaks of "the Honeycomb district, which signifies eight miles of pools of water, . . . with high 'tussocks' of grass judiciously planted by nature in the intervals, ingeniously devised so as to assist the progress of travellers . . . now in hades, now in the celestial regions." The same traveller speaks frequently of these "treacherous" swamps—of the presence and dangerous character of which he regards the "Maori heads," ominously nodding here and there above their surface, as diagnostic. "It is well," he observes "that these natural indications are so prominent, otherwise horse and rider, in the endeavour to travel what to all appearance is solid ground, would be irrecoverably engulphed in an unknown depth of mire." And, indeed, all narratives of exploring expeditions into the interior contain numerous pictures of travellers wading waist-deep in such "sloughs of despond," leading floundering horses, or, with utmost difficulty, rescuing them and their loads from impaction. Where they grow from a soil that is simply boggy,

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the tussocks are generally altogether smaller, especially as regards the column of root-tufts, which supports the foliage. In this state the plant resembles somewhat the "Tussac grass" of the Falkland Islands (*Dactylis cæspitosa*), as I have seen it naturalised in the Outer Hebrides (about Stornoway, in the Lews, June 1866).

Though usually or essentially a bog or marsh species, it also occurs by the sides of streams in shady, wooded dells, and in the recesses of the Bush. In such habitats especially, it somewhat resembles our *C. teretiuscula*, Good., and sometimes our *C. vulpina*, L., but it is much coarser than either.

Sp. 2. *C. ternaria*, Forst. Banks of the Clutha, about Finegand and Myres (Inch Clutha); ravines about base of Saddlehill; marshy grounds about base of Stoneyhill; 30 inches high and upwards. November to December, in flower and fruit.

Somewhat resembles our *C. riparia*, Curt.

Sp. 3. *C. trifida*, Cav. Banks of the Clutha, about Myres, Inch Clutha. November, in flower and fruit.

Sp. 4. *C. Forsteri*, Wahl. Banks of the Clutha, about Myres. November, in flower and fruit.

Sp. 5. *C. lucida*, Boott. East Taeri Bush; about Dunedin. November, in flower and fruit.

Sp. 6. *C. testacea*, Sol. Banks of the Clutha.

Sp. 7. *C. Gaudichaudiana*, Kunth. Banks of the Clutha.

Gen. 2. *Uncinia.*

Sp. 1. *U. Banksii*, Boott. East Taeri Bush. November, in flower.

A slender grass-like plant, 6 to 10 inches high, with a filiform, graceful spike, which is much less conspicuous than the grassy foliage.

Sp. 2. *U. australis*, Pers. Finegand Bush, Lower Clutha; and Myres Bush, Inch Clutha; 20 to 24 inches high. November to December, in flower and fruit.

A dwarf rigid *Uncinia*, of which only imperfect specimens occur in my Herbarium, 6 to 10 inches, with the aspect and habit of *Kobresia caricina*, Willd., or *Blysmus compressus*, Panz., may prove referable to *U. compacta*, Br., var. *divaricata*, Boott. I suspect that this or other species of the genus are yet to be found—in the woods especially—of Otago.

Gen. 3. *Demoschœnus.*

Sp. 1. *D. spiralis*, Hook. fil. Sand dunes about mouth of the Kaikorai. October, in flower and fruit.

The "Pingao" of the North Island Maori; the "Noli-me-tangere" of Otago *Cyperaceæ*, having a very strong leaf,

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whose serrated edge lacerates the hands or feet severely. The plant apparently takes the place here of our *Carex arenaria*, L., and *C. incurva*, Lightf., than which it is greatly larger and coarser. Like them it has a long creeping root, which overspreads the sand dunes. Dr Hooker's record of its geographical distribution is at least ambiguous—apparently restricting its southern limit to Canterbury (Handbook, p. 303). There is no doubt it is more or less common much farther south—probably extending to the extreme south of the South Island.

Gen. 4. *Lepidosperma.*

Sp. 1. ***L. tetragona***, Hook. fil. (*L. australis*, Fl. N.Z.) Marshy grounds about base of Saddlehill; uplands about Fairfield. October to December, in flower and fruit.

Has somewhat the appearance of a *Scirpus* (*e.g.*, *S. triqueter*, L.) The record of its geographical distribution in the Handbook (p. 307) would make it appear that it does not extend farther south than Canterbury; whereas, like *Demoschænus spiralis*, it probably reaches to the extreme south of the South Island.

Gen. 5. *Isolepis.*

Sp. 1. ***I. nodosa***, Br. Lagoons and marshes of the Kaikorai about its mouth. October, in flower and fruit.

Has much the aspect of a *Juncus*. The Maori term "Wi-wi" seems to be applied to it in common with *Leptocarpus* and *Juncus*.*

Sp. 2. ***I. riparia***, Br. (?) (Named in my Herbarium, *I. setacea* by Dr Hooker). Banks of the Clutha about Myres, Inch Clutha. November, in flower and fruit.

Gen. 6. *Eleocharis.*

Sp. 1. ***E. gracilis***, Br. Banks of the Clutha about Myres. November, in flower and fruit.

Somewhat resembles in size and general appearance our *Isolepis fluitans*, R. Br.

Nat. Ord. III. RESTIACEÆ.

Gen. 1. *Leptocarpus.*

Sp. 1. ***L. simplex***, Br. Lagoons and marshes of the Kaikorai, about its mouth. October, in flower and fruit.

The familiar "Wi-wi" of the settler; a generic term, however, apparently applied by the Maoris to the whole tribe of "rushes.'† A plant 30 to 40 inches high, whose jointed and

* In Tasmania has been recommended as a paper-material.

† Dieffenbach gives the word "Wi" as signifying "a rush," and "Wi-wi"

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sheathed culms give it somewhat the aspect of an *Equisetum* (such as *E. hyemale*, L.); and it may be held in great measure to represent that genus in Otago. In the earlier days of settlement, the roofs of the wharés, or huts of the colonists, in Greenisland were thatched with this "rush," associated or not with the "reed" (*Arundo conspicua*), or bulrush" (*Typha angustifolia*).

Nat. Ord. IV. JUNCEÆ.

Gen. 1. *Juncus.*

According to Buchanan, some of its species are common on the higher ranges of the S.E. districts, at or above 4000 feet, where snow frequently lies or falls (probably *J. Scheuchzerioides*, Gaud., and *J. Novæ Zelandiæ*, Hook. fil.). In the Kaikorai marshes and lagoons between Abbott's Creek and the sea, in the roadside marshes near Dunedin, and in similar localities throughout Greenisland, I met with forms closely resembling, if some of them were not really, the common British *J. maritimus*, Lamarck; *J. communis*, E. Meyer; *J. acutiflorus*, L.; *J. compressus*, Jacq., or *J. conglomeratus*, L. The two first are given in the Handbook Fl. N.Z. as indigenous, as is another species, which I found abundant, *J. bufonius*, L. *J. maritimus* and some other species are known to the natives as "Wi-wi"—a term, however, which they apply also to *Leptocarpus simplex*.

Sp. 1. *J. planifolius*, Br. Roadside marshes, Caversham, Dunedin; Otokia Road, Saddlehill; Christie's Bush, Saddlehill. November and December, in flower and fruit.

Resembles and represents here our *J. lampocarpus*, Ehrh.

Sp. 2. *J. bufonius*, L. Roadside marshes, Caversham; marshy grounds about base of Stoneyhill. December, in flower and fruit.

Sp. 3. *J. vaginatus*, Br. Marshy grounds about base of Stoneyhill; Woodburn ravine, Saddlehill; banks of the Clutha, about Finegand. December, in flower and fruit.

So named in my Herbarium by Dr Hooker, who, however, in the Handbook (p. 289) records it as a *North* Island plant only. Resembles our *J. communis* and *J. acutiflorus*, and the group which they represent in Britain.

Sp. 4. *J. australis*, Hook. fil. Occurs in similar marshy grounds with some of the preceding.

Gen. 2. *Luzula.*

All the Otago forms I have examined seem to me indistinguish-

plural, "rushes:" whence the word "Wiwia," a snare made of rushes. He also mentions "Titi" as a synonym for "rushes."

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able by any good characters from our *L. campestris* and its varieties or conditions *congesta* and *multiflora*, as these occur in my British Herbarium from various localities in the Edinburgh and Fife districts. I find no distinctions that I can regard as specific, and hence I refer *all* to a single variable type, whose variation-forms in general do not deserve separate nomenclature.

Sp. 1. *L. campestris*, DC. Abbott's Creek, 4 to 6 inches high; Fairfield uplands, 8 to 10 inches; Stoneyhill uplands, 15 inches. November, in flower; December, in fruit.

Spikes frequently large and agglomerated (var. *congesta*), or sparse (var. *multiflora*).

Var. *picta*, A. Rich. (*L. picta*, Fl. N.Z.) Uplands around Saddlehill and Stoneyhill; October and December, in flower. 4 to 6 inches high on Saddlehill, 6 to 8 inches at Fairfield, and 12 inches on Stoneyhill.

Closely resembles the type, save in its more cymose inflorescence.

Sp. 2. *L. Oldfieldii*, Hook. fil. Sand dunes about mouth of the Kaikorai, 4 inches high. October, in flower.

A dwarf, altogether a coarser, more *Carex*-like plant than the preceding.

II. *Notice of a Species of Trichoscypha, and of a Species of Sarcocephalus from Old Calabar, sent by the Rev. Alexander Robb.* By Professor BALFOUR.

Professor Balfour stated that the Rev. Alexander Robb, a missionary at Old Calabar, had sent home some specimens of plants from that district which are of interest to botanists. Two of them he exhibited to the meeting; the first a species of *Trichoscypha*, an Anacardiaceous genus, described by Dr Hooker. The fruit, however, had not been seen by Hooker, and was therefore omitted in the description. Mr Robb had sent the fruit, which is a drupe, about the size of a pigeon's egg, of an orange-red colour; and Professor Balfour has forwarded a specimen to Kew, in order that the generic characters may be completed. Professor Oliver says that the plant is probably *Trichoscypha Mannii* of Hook. fil. In a letter to Dr J. A. Smith, Mr Robb says—"I do not doubt that the plant described by Hooker is the same as this. It was at the Gaboon

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that the late Rev. John Baillie saw it. There he tasted the fruit, which the ladies of the American Mission preserved in sugar as a jam. He saw the trees near Creek Town, and was anxious to get the flower to send to Dr Balfour. Gustav Mann was at the Gaboon, and no doubt he got the flowers there. The flower grows directly out of the stem, from near the root upwards, at intervals. The bunches of fruit are sometimes large. The flowering rachis is elongated to 2 or 3 feet, and covered with flowers. The plant is not common in Old Calabar. The natives have no name for it. At the Gaboon it is called ' balola.'"

The next plant is a species of *Sarcocephalus*, and Professor Oliver, who is examining the West African flora, thinks it is *Sarcocephalus esculentus*. It is a Cinchonaceous plant, nearly allied to *Nauclea*. The flowers are sessile, on a globular receptacle. It is a climbing shrub, with opposite stipulate leaves and terminal capitula, which in fruit become the size of a peach. Mr Robb says that the colour of the styles is pure wax white, the most fairy-like things he ever saw. The smell of the flower is very fragrant. The tree grows in a curious articulated manner, like the bamboo. The flowers are deciduous, and the fruit matures into an apple shape full of a pulpy substance, with numerous small seeds enclosed. It is edible, and called "peach" by the negroes.

III. *Note on* Vellozia elegans, *from the Cape of Good Hope.* By H. Fox Talbot, Esq. Communicated by Professor Balfour.

Mr H. Fox Talbot transmitted to Dr Balfour some time ago a flower and leaf of a plant which had been sent to him. There was some difficulty in determining the genus and species at the time. Mr T., however, at his suggestion, had taken a living specimen to Professor Oliver at Kew, who was enabled to decide that it was a *Vellozia*, and Mr T. proposed to have it ere long figured in the *Botanical Magazine* under the name *Vellozia elegans.* Mr T. has presented a living plant to the Edinburgh Royal Botanic Garden.

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IV. *Remarks on a Substance called "Puttoo Manga," found in the White Ant Nests in Travancore.* By Dr J. SHORTT. Transmitted by Dr ALEX. HUNTER, Madras.

The author remarks:—Much interest has been excited of late about a substance found in the burrows of the white ant, and which is known by the Tamil name of "*Puttoo Manga*," or white ant mango. It is frequently found to exist among ant-hills in Travancore, the Western Coast, and Coimbatore. The first specimen sent home to this country was by Dr Waring, who, on opening the centre room of his house at Travancore, for the purpose of building two walls, and digging to the depth of 3 feet below the surface, found several holes scooped out in the earth, perfectly smooth and circular, and of a sufficient size to admit a man's hand, and observed hanging down from the sides of these cavities several clusters of dark-coloured fruit-like looking bodies of various sizes and shapes. On exhibiting them to native practitioners, they eagerly took possession of the greater number, calling them "*Puttoo Manga.*" It appears that these are found, though rarely, under the foundations of old buildings, and that they are believed to be either formed or produced by white ants; they are in high repute, and greatly sought after, as medicinal substances. Such was the account that accompanied the only three specimens that were in possession of the Pharmaceutical Society of London in 1860, and contributed by Dr Waring. These specimens were submitted to the Rev. M. J. Berkeley, who pronounced them to be of a fungoid nature. This has since been confirmed by Messrs Currie and Hanbury.

The substance is known to the natives by the name of "*Puttoo Rai*," or "*Mail Manga.*" It is common in the Malabar and Coimbatore districts—one out of every fifteen or twenty ant-hills explored produced this growth; but it is not found in the Carnatic. This may be accounted for by the greater dryness of the climate in these parts, and the absence of that moisture and heat so necessary for fungoid growths. The natives state that it is occasionally met with in dark crevices, and in the recesses of rocks and

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caves; but my experience does not confirm the latter fact as yet.

Dr Pulney Andy and Mr W. Karney, my assistants, have, at my request, obtained for me several specimens from the Malabar and Coimbatore districts, and to them I am indebted for such information as they could procure in these districts.

V. *On the Varieties of Variegated Greens, &c., as Ornamental Plants.* By Mr M'Nab.

Mr M'Nab exhibited some specimens, from Mr Robertson, of the variegated triple-curled, laciniated, and proliferous kale plants, in colours varying from almost pure white and green to beautiful rose-pink, purple, and red. For bringing into more general notice the cultivation of these new favourites, the country is particularly indebted to the energetic labours of Miss Frances Hope, of Wardie Lodge, whose garden at this season is a perfect marvel of beauty, and has been so during the winter months for several years. Miss Hope has been instrumental in producing, at Wardie, some of the most remarkable varieties yet seen in cultivation. Mr Melville, the gardener at Dalmeny Park, has also done much to improve the breed of this now useful race of winter decoration plants. For a long time the tall cut-leaved varieties were very generally grown in gardens and shrubberies, but now we have four distinct races, classified by Mr Gorrie under the following heads:—Laciniated, plumose, ramose, and proliferous or composite. The latter is certainly very peculiar, the proliferous growths proceeding, as they do, in compact clusters from the primary and secondary ribs of all the leaves. The colours in most of the above classes are also very rich, and when artistically arranged—more particularly as the cold season advances—a very pleasing effect is given to the flower garden. In the selection of plants to be seed producers, very great care is required to see that all possess good qualities either in colour or style of leaf; as one with bad properties, if allowed to get into a flowering state, will have a tendency to destroy a whole breed. But what will be found much

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more destructive to the successful saving of pure seed is the seeding of a field of any of the brassica tribe in the neighbourhood, more particularly if they happen to be the common German greens or any of the savoy tribe. If such should happen to be the case the progeny of the new varieties, which have been obtained with care, will very soon become degenerated and worthless. Any very choice variety (after it has done its duty in the flower garden) should be planted at the base of a wall to seed, and separated from all other kinds; but even this caution will not always produce a satisfactory result. The only method to preserve a favourite variety is to take the leaves and tops off, which will cause them to make numerous side shoots, which, when removed, are rooted as cuttings. All the ordinary good varieties intended for seed-bearing plants should also be placed against a wall, covering them with a net, but just before the seed vessels ripen, to prevent them becoming a prey to birds. It is not absolutely necessary that the plants be protected while in bloom. If good kinds are selected and placed side by side to flower, a slight intermixture will have a tendency to produce novelties much more than by isolating them. While planting the young seedlings in rows for the purpose of bringing them forward, previous to taking their place in the flower garden, any that appear inferior should be thrown aside. The young seedlings generally succeed best in an open, airy field, where they are less liable to become leggy or drawn up, as happens in a close walled garden. On the return of autumn, selections can be made suitable for the various clumps, agreeable to the taste of the party in charge of the arrangement. After running through a course of gay colouring, and the season over, the duplicate plants (not required for seed) may be boiled and economically employed for feeding pigs.

VI. *Notice of the State of Open-Air Vegetation in the Royal Botanic Garden.* By Mr M'Nab.

Since the last meeting of the Botanical Society (13th December 1866) the weather up to the end of the month was unusually mild, as indicated by the following observa-

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tions:—The thermometer on the night of the 18th of December stood as high as 54°, on the 21st of December at 50°, and all other nights to the end of December it varied from 36° to 47°, except on the 31st December, when the night temperature fell to 31°. Owing to this very mild state of the weather, attended with a succession of heavy rains, the leaf buds of many plants swelled much more than is usually seen at this period of the year. Up to the 31st of December, scarlet geraniums were standing almost untouched, and with flowers seen here and there on them. Verbenas and other summer decoration plants were in the same state, as well as chrysanthemums, stocks, wallflowers, *Gentianella*, purple aubretia, primroses, oxlips, *Hellebores* or Christmas roses, *Garrya elliptica*, *Jasminum revolutum*, *Polygala Chamæbuxus*, and many autumn-flowering roses. Since the 1st of January a very great change has taken place. Heavy snow fell on the 2d, which was followed by intense frosts, thus putting a stop to all the early symptoms of vegetation. The following will show the minimum temperatures during each successive night since the commencement of the year:—January 1st, 25°; 2d, 16°; 3d, 19°; 4th, 19°; 5th, 11°; 6th, 26°; 7th, 31°; 8th, 33°; 9th, 32°; 10th, 30°.

Mr M'Nab read to the meeting a letter received from Mr Constable, relative to a destructive blight affecting the orange trees on the estate of Henry Greenwell, Esq., Sandwich Islands. Mr Constable states that last year, 1865, the orange trees on Mr Greenwell's property alone were so profitable, that he realised £2000 from the sale of the fruit to Californian merchants. This year, 1866, ruin is staring him in the face from the fatal appearance of some blight (but he does not state whether insect or mildew), which has not spared 20 out of 20,000 of his trees. He seems to apprehend the loss of nearly all the orange trees on the island, as in the case of the potato disease, or the oidium or vine blight. Mr Greenwell is most urgent for books or pamphlets of a practical kind, entering fully into the question of syringing and powdering. There is doubtless much information on this subject scattered throughout magazines and scientific journals; but Mr Constable thinks

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the search will be endless; and adds, that if any information can be got on the subject, he will be happy to communicate the same to Mr Greenwell.

Mr Gorrie presented specimens of a rose which he found growing on the side of the old road which divides the counties of East and Mid Lothian, between Melville Hall and Bellyford Burn, in the month of August last. Although he had transmitted specimens to several botanists, they had been unable to refer the plant to any described species. It is about 8 feet high, upright, stiff, and dense in growth, with a few spreading suckers rising around it; leaves slightly scented, like those of the common sweetbriar, *Rosa rubiginosa*, Linn., from which it is otherwise quite distinct.

Mr J. Kirk Duncanson presented specimens of several rare plants gathered in the neighbourhood of Edinburgh, and exhibited a frond of *Lastrea Filix-mas*, having one of its lower pinnæ developed like a second frond. Miss Mackenzie presented a specimen of *Mahernia odorata*. Mr John Sim presented a specimen of *Petasites fragrans* from the neighbourhood of Perth. Mr Robinson Munro sent for the Museum a turnip which, in progress of growth, had become hollow, and into which the leaves of the plant had developed downwards.

14*th February* 1867.—WM. GORRIE, Esq., Vice-President, in the Chair.

The following Donations to the Library were announced:—

Proceedings of the Natural History Society, Dublin, Vol. IV. Part 3.—From the Society.

Journal of the Royal Horticultural Society, London, Vol. IV. Part 1.—From the Society.

Proceedings of the same, Vol. I. No. 6.—From the Society.

Transactions of the Pharmaceutical Society, London, Vol. VIII. No. 8.—From the Society.

Transactions of the Royal Society of Victoria, Vol. VII.—From the Society.

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Proceedings of the Royal Society of Edinburgh for Session 1864-65, and 1865-66.—From the Society.

Maori-Latin Index to the Hand-Book of the New Zealand Flora.—From Dr Mueller, Melbourne.

Memoir on the Genus *Jussiæa*, by Charles Martins, Montpellier.—From the Author.

The following Donations to the Museum at the Royal Botanic Garden were noticed:—

From Daniel Hanbury, Esq.—Specimens of the following Funguses used in China for medicinal purposes:—1. *Pachyma cocos*, Fries, "Indian bread" or "Tuckahoe," "Fûhling" of the Chinese; 2. *Mylitta lapidescens*, Hor., "Luy-wan" of the Chinese; 3. *Chooling;* 4. *Sclerotium stipitatum*, Berkel. and Currey, "puttoo manga," or "mail manga," found in the white ant's nest. Also seeds of *Myroxylon peruiferum*, and a specimen of cacao butter.

Professor Balfour announced that there had lately been added to the Museum a series of models illustrating the different forms and parts of flowers, which had been executed by M. Brendel of Breslau.

The following Communications were read:—

I. *Obituary Notices of James Smith, Esq. of Jordanhill; of Dr G. A. Martin, Isle of Wight; and of George Ure Skinner, Esq. of Guatemala.* By Professor Balfour.

James Smith was born in Glasgow on the 15th of August 1782. He was the eldest son of Archibald Smith, an eminent West India merchant, and of Isabella Euing, known as the correspondent of Mrs Grant of Laggan, and who died a few years ago in her 101st year.

Mr Smith was educated at the grammar-school and the University of Glasgow, where he acquired an excellent classical education, and imbibed a taste for physical science. He was for many years a partner in the West India house of Leitch, Smith, & Co., in Glasgow, but never took any active part in business. His tastes directed him to literary and scientific pursuits, and to the fine arts. He devoted his attention early to geography and navigation. His taste for the latter subject led him to adopt yachting as a

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recreation, and he was the first gentleman in the west of Scotland who owned a yacht. His first cruise in a yacht of his own was in 1806, his last in 1866. In 1806 he made a cruise in a yacht of 12 tons, which accommodated himself and his companions, Professor Milne and Dr Ure; and in this voyage, which lasted several weeks, they went as far as the Isle of Skye. He was one of the earliest members of the Royal Yacht Club, now the Royal Yacht Squadron, and was one of the earliest and latest commodores of the Royal Northern Yacht Club.

He was a successful yachtsman, and carried off many prizes. At the same time he used his yacht for the purposes of science, and was always ready to aid by means of it those who were prosecuting scientific researches. In his scientific yachting Mr Smith was accompanied at different times by Dr Scouler, Captain Brown, Mr George B. Sowerby, Edward Forbes, and the Rev. Dr Landsborough. He studied navigation with great zeal, and he possessed a most valuable collection of books on the literature and history of navigation, and of the early voyagers. Mr Smith served in the Renfrewshire Militia, and was on duty at the Tower when Sir Francis Burdett was imprisoned there.

He joined the Royal Society of Edinburgh in 1822. On 23d December 1830 he was elected Fellow of the Royal Society of London. In the same year Mr Smith became President of the Andersonian Institution, and he devoted his energy to its improvement, especially as regards the medical and natural history department. The Museum of the Institution was originated by him, and he contributed largely to its contents. His earliest published scientific paper was a notice in the Transactions of the Antiquarian Society of Edinburgh, of an undescribed Vitrified Fort in the Burnt Isles in the Kyles of Bute, discovered by him accidentally when landing from his yacht.

In 1832 Mr Smith originated scientific meetings for the discussion of various geological questions. At that time the diluvian theory of Buckland was much canvassed, and was vigorously opposed by the late Dr Fleming, one of the members. The discussion of this subject led Mr Smith to examine the valley of the Clyde. Mr Smith examined the theory, and testing it by observation of phenomena in the

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west of Scotland, he came to the conclusion that the facts, considered as the evidence of diluvial action, were proofs of the elevation of portions of land from under the sea. The transported blocks, and the rounded and polished surfaces of the rocks, were as yet unexplained phenomena; and in the beds of fossil shells, found at great elevations and remote from the sea, it was obvious that a great part of Scotland had once been under the ocean. Mr Smith examined the localities in which these shells occurred, formed a catalogue of them, and compared them with those now found in our seas. He employed his yacht for dredging in the deeper parts of the sea, so as to ascertain the character of the shells. He ascertained that a number of shells found in the beds of clay in different parts of the country no longer existed in the British seas, but were still living in the seas of Greenland and Spitzbergen; and he drew the inference that the occurrence of these shells indicated the existence at a former period of a colder climate than now prevails. In 1836 he communicated his researches to the Geological Society. On the 21st January 1837 he became a member of the Wernerian Society, and he contributed several papers to that Society. The health of Mr Smith's family led him to take up his residence from 1839 to 1846 in the south of Europe, and at Madeira. While abroad he published papers on the tertiary fossils of Lisbon and on the rock of Gibraltar. During his residence at Malta he took occasion, by means of his yacht, to investigate the voyage of St Paul, and he published a most valuable work on the subject. The book is entitled the "Voyage and Shipwreck of St Paul, with Dissertations on the Life and Writings of St Luke, and the Ships and Navigation of the Ancients." With an aversion to all that was vague and indefinite, and a lover of scientific precision, he circumscribed his subject within its strict limits, and carefully excluded everything irrelevant. The problem thus originated was then investigated in its minutest details, and every source of information was put under requisition. In addition to this he brought to bear on the subject a variety of qualifications which are rarely combined in one individual. An excellent seaman, familiar with the theory of navigation, and minutely acquainted with all the details of the working of

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a ship, he was fully qualified to explain the naval tactics of the ancients. These advantages are apparent throughout this unique and most interesting work. He produced an exhaustive lecture, which can leave no doubt in the mind of the reader that the sacred narrator of the voyage was present at the events which he describes; and that Luke, the beloved physician, was also a good observer and an accurate describer of the events which came under his notice. The book is a remarkable instance of originality, ingenuity, and sagacity, and of the application of practical knowledge of seamanship and geology to the elucidation of a point of literary and theological interest. The work shows philosophical exactness in ascertaining the meaning of particular expressions, nautical skill, and precise information regarding the size and structure of ancient ships of burden. It contains scientific and official documents bearing on the navigation of the Levant, and on modern shipwrecks on the coast of Malta. There are also careful observations in respect to its currents, and accurate soundings along the bay, identified with that of St Paul's shipwreck, notices of medals in the British Museum, and records of the Admiralty. All these, and even more, have been brought with wonderful toil and patient industry to contribute to the illustration of this portion of the sacred narrative.

Mr Smith afterwards wrote a "Dissertation on the Life and Writings of St Luke," and then a "Dissertation on the Origin and Connection of the Gospels." This latter work was published in 1853.

In 1862 Mr Smith published "Researches on Newer Pliocene and Post-tertiary Geology." In this volume he brings together a series of papers on the more recent geological deposits, the result of upwards of thirty years' observation, conducted chiefly in the basin of the Clyde, a locality rich in the fossils of the glacial period. These papers had been communicated to various societies. The following are some of the subjects treated of:—

1. "Indication of the Changes of Level in the west of Scotland," read to the Geological Society, Nov. 16, 1836, and printed in their Proceedings, vol. ii. p. 427.

2. "On the Last Changes in the Relative Levels of the

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Land and Sea of the British Islands," read to the Wernerian Society, April 2, 1838.

3. "On the Phenomena of the Elevated Marine Beds of the Basin of the Clyde," read to the Wernerian Society, 26th January 1839. To this paper is appended a Catalogue of Shells from the Glacial Deposits of Britain and Ireland; Catalogue of Recent Marine Shells of the Firth of Clyde, &c.

4. "On the Newer Pliocene Deposits in Scotland and the Western Islands," read to the Wernerian Society, and published in their Memoirs, vol. viii. p. 108.

5. "On the Climate of the Newer Pliocene Tertiary Period," read to the Geological Society, 24th April 1839.

6. "On the Relative Age of the Tertiary and Post-tertiary Deposits of the Basin of the Clyde," read to the Geological Society, November 6, 1839.

7. "On the Geology of the Island of Madeira," read to the Geological Society, January 6, 1841.

8. "On the Geology of Gibraltar," read to the Geological Society, November 26, 1844.

9. "On Recent Depression in the Land," read to the Geological Society, February 24, 1847.

10. "On Scratched Boulders," read to the Geological Society, June 4, 1845, and April 19, 1848, and May 17, 1848.

11. "On the Occurrence of Marine Shells in the Stratified Beds below the Till," read to the Geological Society, April 24, 1850.

12. "On a Split Boulder in the Island of Little Cumbrae," read to the Geological Society, February 26, 1862.

Mr Smith was a Fellow of the Royal Societies of London and Edinburgh, of the Geological Society of London, the Royal Geographical Society of London. He was also President of the Geological Society and of the Archæological Society of Glasgow. He was one of the early members of the Wernerian Society, and at the breaking-up of that Society he was elected a Fellow of the Botanical Society on 9th December 1858.

Mr Smith enjoyed vigorous health till the spring of 1866, when he had a slight shock of paralysis. A second attack

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in November terminated in his death on 17th January 1867, at the age of 85.

Mr Smith was married in 1809 to Mary Wilson, grand-daughter of Dr Alex. Wilson, Professor of Astronomy in Glasgow. By her, who died in 1847, he had nine children, of whom three only survive, Archibald Smith, late senior Wrangler and Fellow of Trinity College, Cambridge, a member of the Chancery Bar, and two daughters. He leaves also issue by two deceased daughters—one the wife of Mr Walter Buchanan, late M.P. for Glasgow, and the other the wife of the late Mr Hamilton of Minard.

I have to record the death of Dr George Anne Martin, of Ventnor, Isle of Wight, one of the early Fellows of the Society, having joined us as a Non-resident Fellow on 14th April 1836. He became a Resident Fellow on 12th May 1837, during his residence in Edinburgh. He prosecuted his medical studies at the University of Edinburgh, and took the degree of M.D. in 1837, contributing a thesis on Scorbutus. He became a Member of the Royal Medical Society. During his studies here he devoted much attention to botany, and joined in many excursions. After leaving Edinburgh he settled as a medical man in the Isle of Wight, by the advice of Sir James Clark. He continued to practise at Ventnor ever since, and had acquired high reputation as an able and valued practitioner. He was marked for personal kindness and liberality to all those who came under his care, and notably to the poor. At the begining of last winter I introduced to him a friend who had gone to Ventnor for health, and nothing could exceed the kind attention which he showed. He was assisted in practice by his brother, who still resides at Ventnor. Dr Martin continued to retain a warm love of science. I visited him in 1846, and explored most of the botany of the Isle of Wight under his auspices. He wrote a work on the Undercliff, more especially in reference to its climate, geology, and botany. He took occasional trips to Scotland, and enjoyed a residence for a few weeks in the Braemar district, where I met him on one occasion.

For some years he had been in very delicate health, but he laboured in practice to the last. Owing to a series of

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accidents, in one of which he received a concussion of the spine, and in another badly fractured one of his legs, he was very infirm and lame, and was thus prevented from taking active exercise. He was taken seriously ill, on 28th December 1866, with an apoplectic attack, and he lingered till 7th January last, when he expired at the age of sixty.

He appears to have promoted in no small degree the prosperity of Ventnor, and his loss has been felt by the inhabitants as a public calamity. The large attendance at his funeral showed the respect which was entertained for him. He was an upright, warm-hearted, painstaking, and conscientious physician, and was most attentive to every case that came under his care. Besides being an able medical adviser, he was a kind friend in the time of need. The numerous invalids who resorted to Undercliff highly appreciated his services, and his reputation was spread far and wide.

A friend, who knew Dr Martin well, thus writes:—"In the practice of his profession no man ever had a more just appreciation of what was due to it and his patient. He utterly disdained and rejected with scorn and indignation the base artifices by which some men ingeniously advance their pretensions. No self-seeker, thoroughly conversant with his profession, and having a just confidence in himself, he was free from mean jealousy, and was ever ready to seek the opinion and co-operation of others, whenever assistance might, he conceived, be useful to his patients, whose interests alone he regarded as paramount to all other considerations. In private society he was an agreeable and entertaining companion, lively, witty, possessing a good memory, and a keen sense of the ludicrous; he was full of information, his conversation was sparkling, and few were more ready at repartee. His innate respect for the feelings of others was always exhibited, and he was a thorough gentleman in every position of life."

George Ure Skinner, Esq., a partner in the house of Klee, Skinner, & Co., Guatemala, an done who had done much for natural history, and specially for botany, was born at Newcastle, 18th March 1804. He was the second son of the late Very Reverend Dean John Skinner of Forfar

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(author of the "Annals of the Episcopal Church of Scotland"), the grandson of the late Bishop John Skinner of Aberdeen, nephew of the late Bishop William Skinner of Aberdeen, who died in 1857, and great-grandson of the Rev. John Skinner, author of the words of "Tullochgorum," "The Ewie wi' the Crooked Horn," "John o' Badenyon," &c. &c., who died in 1807, aged eighty-six. At the age of fourteen, Mr Skinner's spirit of adventure led him away from home, and from that time he continued to maintain himself by his own exertions. He was anxious at first to enter the Navy, but he yielded to his father's wish, and became a clerk in the bank of Barclay, Bevan, & Co., London. He afterwards became a merchant in Leeds. He went to Central America as a merchant in 1831, where he entered into partnership with Mr M. Klee, for many years Chargé d'affaires for Hanover and Prussia. Amid all his busy work he never lost sight of the interests of science, and he introduced many very valuable and beautiful plants into this country—more particularly orchids. Of the latter plants there are many species named after him, such as *Lycaste Skinneri*, *Cattleya Skinneri*, *Epidendrum Skinneri*, and *Barkeria Skinneri.* He rendered valuable assistance to Mr Bateman in the publication of his splendid work on the Orchids of Guatemala. Mr Bateman, in his account of *Cattleya Skinneri*, writes thus:—"Until within the last few years the interior province of Guatemala has continued quite a *terra incognita* to the admirers of *Orchidaceæ*, who were ready, nevertheless, to regard it as a rich storehouse of these favourite plants, in consequence of the known beauty of the tribe in Mexico and Panama—the two extremities of that remarkable isthmus, of which Guatemala is itself the centre. The small number of Europeans, and almost total absence of English residents, had rendered the attainment of any precise information as to its natural history all but impossible; and to have despatched a botanical collector on a mission to a country whose flora possessed only a conjectural interest, was too wild a speculation even for Orchidomania to venture on. Things might still have remained in this tantalising state, had we not accidentally heard that some insects had been received in Manchester from a gentleman of the name of Skinner, the owner of extensive estates in Guatemala,

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and the partner of a flourishing mercantile firm in the same country. This piece of intelligence immediately brought with it a faint gleam of hope, for as entomology and botany are kindred sciences, we were at no loss to persuade ourselves that he who had done so much for the one might possibly be tempted to lend a helping hand to the other. We accordingly addressed a letter to Mr Skinner, in which we frankly described the circumstances of the case, and humbly craved his assistance. This letter, addressed as it was to an entire stranger, and on a troublesome errand, we could scarcely expect to see otherwise than coolly received, if not altogether disregarded. That such, at least, is the fate of most epistles of its class, a host of disappointed suitors will bear us out in asserting. Must we add, that even the promises of zealous aid which the more fortunate applicants receive, are not unfrequently lost sight of amid the difficulties that oppose their fulfilment, or are dissolved under the enervating rays of a tropical sun. But with Mr Skinner the case was far otherwise. From the moment he received our letter he has laboured almost incessantly to drag from their hiding-places the forest treasures of Guatemala, and transfer them to the stoves of his native land. In pursuit of this object there is scarcely a sacrifice which he has not made, or a danger or hardship he has not braved. In sickness or in health, amid the calls of business or the perils of war, whether detained in quarantine on the shores of the Atlantic (in 1837 he was detained in quarantine in the Castle of St Philip, in the Bay of Dulcé, for a fortnight), or shipwrecked on the rocks of the Pacific, he has never suffered an opportunity to escape him of adding to the long array of his botanical discoveries. And assuredly he had not laboured in vain, for he may truly be said to have been the means of introducing a greater number of new and beautiful *Orchidaceæ* into Europe than any one individual of his own or any other nation. As the channel through which his discoveries have found their way into his mother country, it would ill become us, in this place, to enlarge upon the generous, kind, and spirited manner in which he uniformly acted towards us. We must, therefore, request his acceptance of the only acknowledgments which it is in the power of the science he has so much befriended to bestow. Unfortunately there is

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already a Peruvian genus called (but not after our friend) *Skinneria;* we can therefore do no more than select some species which may not do discredit to his name, and we confess we are unable to conceive one better fitted for our purpose than the magnificent *Cattleya* represented in our plate." In Guatemala he was the first to set on foot the cultivation of Indigo and Cochineal. His other plans were thwarted by the incursion of Canera with his troops, who finally took possession of the capital. Under Canera's rule Mr Skinner was treated with attention and respect. Mr Skinner left Britain on 3d December last for Central America, and, in a letter to his relative, Bailie Skinner of Edinburgh, at that time, he stated that he was about to cross the Atlantic for the thirty-ninth time, with the intention of returning to Britain in the early spring of this year, finishing with America, and proposing then to retire for the rest of life, if God pleased to spare him. On reaching Aspinwall, Panama, he was seized with yellow fever, and died there on 9th January last, at the age of sixty-two. He had been a widower for a few years, but has left behind him two young daughters, three brothers, and a sister to lament his loss.

Among the orchids sent home by Mr Skinner, besides those already mentioned as being named after him, we may enumerate the following:—*Odontoglossum grande*, *O. Uro-Skinneri*, *O. rubescens*, *O. pulchellum*, *Schomburgkia tibicinis*, *Epidendrum Stamfordianum*, *E. cnemidophorum*, *E. alatum*, *Stanhopea saccata*, *Lœlia rupestris*, *Cycnoches ventricosum* and *Egertonianum*, *Oncidium ornithorhynchum*, *Sobralia macrantha*. Besides orchids, Mr Skinner sent home other plants, as attested by the *Aquilegia Skinneri* and *Uro-Skinneri*, species named after him by Lindley, and *Megastigma Skinneri*. There have been at least thirty species of birds introduced by Mr Skinner, among these may be noticed the Mountain Curassou (*Oreophasis Derbyanus*), the Honduras Turkey, and the Quezal (*Trogon refulgens*).

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II. *Notice of some* Diatomaceæ *from Iceland.* By Dr W. R. M'Nab.

The author stated that, while recently examining an *Alga* which was collected by M. Ed. Jardin in the Logarness—the hot stream coming from the Great Geyser, in Iceland—he had discovered a few *Diatomaceæ* amongst the filaments of the plant. They belonged chiefly to the genera *Epithemia*, *Cymbella*, *Stauroneis*, *Pinnularia*, *Synedra*, and *Gomphonema*. All the larger species of these genera were exactly the same as those occurring in Scotland in cold water. The geographical distribution of the *Diatomaceæ* is an interesting subject, and it is also curious that besides possessing, as certain species are known to have, a very wide area of distribution, they can also endure a great difference in temperature, such as exists between the waters of Scotland and those coming from the Great Geyser.

III. *Some Account of Botanical Travels in Oregon.* By Mr Robert Brown. Communicated by Mr J. Sadler.

In this communication, dated Victoria, Vancouver's Island, 9th Feb. 1866, Mr Brown gave some account of his botanical travels in Oregon between 2d Sept. and 9th Oct. 1865. The part of the country travelled embraced from Rogue River Valley over the mountains to Crescent City, in California, and from thence by San Francisco to Victoria. He noted the various features of the country and manners of the people, and recorded the more interesting plants he met with. He concluded by giving the measurements of the sizes of the principal *Wellingtonia* trees in the famed Californian grove, as taken by Dr Chas. J. Jackson and Mr Joseph B. Meader in August 1865.

IV. *Notes regarding* Polypodium calcareum *as a Scottish Plant.* By Mr Sadler.

Mr Sadler stated that the discovery of *Polypodium calcareum* near Aberdeen in 1861, by Mr John Sim, and near

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Aberfeldy in 1866 by Mr Ramsay, and recorded in the *Transactions* of the Society, had given rise to doubts in the minds of some as to the plant being indigenous in these localities. He had investigated the subject as far as possible, but could find no traces of its having been introduced in either instance. The Aberdeen plants were found growing in an old limestone quarry on Scotston Moor, and the Aberfeldy plants abundantly on the rubbish from a limestone quarry. Professor Dickie was inclined to believe that the Aberdeen fern had been planted, and Mr Taylor, of Allan Vale, says that a gentleman's gardener planted *Asplenium Trichomanes* on the wall at Scotston Gate, where it now grows plentifully. Mr Sadler exhibited specimens of the plant from both localities, and concluded by reading extracts from letters on the subject which he had lately received from Mr Ramsay, Mr Sim, and Mr Taylor.

V. *Report on the State of Open Air Vegetation in the Royal Botanic Garden.* By Mr M'Nab.

Mr M'Nab remarked:—My last report to the Botanical Society was on the 16th of January 1867. The ground at the time, and for nearly two weeks afterwards, was covered with snow, and a succession of frost of different degrees of intensity prevailed, but on no occasion did the thermometer fall so low as on the night of the 4th of January, when it indicated 11°, being 21° below the freezing-point. The lowest thermometer markings since the 16th of January are as follow:—On the 17th, 20th, 21st, 22d, and 23d of January, falling respectively to 24°, 23°, 20°, 15°, and 25°; the lowest since the beginning of February being on the 11th, when the morning temperature marked 32°. The highest morning temperatures since the January meeting were on the 24th, 25th, 28th, and 29th, indicating respectively 37°, 36°, 43°, and 41°; while the highest since February commenced were on the 1st, 2d, 3d, 4th, 9th, and 13th, marking 39°, 37°, 36°, 47°, 37°, and 47°. As much discussion has recently taken place about the time the thermometer was at its lowest during the month of January, the following readings of the thermometer in the Edinburgh Botanic

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Garden may be worthy of notice, and tend in some districts to settle this point. During the early part of the night of the 4th of January the thermometer was observed to be gradually falling, and had every appearance of reaching a very low point. It fell to 11° at 9.30, and remained the same till 11.30; at 12 o'clock it rose to 14°, at 3 A.M. to 20°, and at 7 A.M. to 27°. Readings on register thermometers are generally taken at daylight during the winter months, as the lowest points are generally about that time. If it had not been for a constant watch over the thermometer during the above night we would not have known the time it was at the lowest point, and marked it as if on the morning of the 5th. During the time the second snow-storm came on, the ground was hard with frost, which greatly retarded the progress of our spring herbaceous vegetation. The first snowdrop seen in bloom was on the 31st day of January, and that only on a south exposed grass bank, where the frost got speedily out, but in all other situations throughout the garden it was the 5th day of February before they began to show flowers profusely. The first flower of *Eranthis hyemalis* and *Hepatica triloba* appeared on the 2d of February; *Sisyrinchium grandiflorum* on the 4th of February; *Leucojum vernum* and *Galanthus plicatus* on the 5th of February; *Helleborus purpurascens* and *Arabis albida* on the 6th of February; and *Crocus Susianus* on the 11th of February. It appears that the temperature of the 4th of January was much lower in many parts of England than what we experienced, even below what was observed on the morning of the 24th of December 1860, when —6° was the lowest point indicated. In some parts of England the thermometer during the January frost fell from 4° to 10° below zero, and the damage to vegetation, as notified in the leading horticultural journals, has been very considerable. The extent of mischief done by frost does not show to its fullest extent for days and often weeks after, the injury depending much on the state of the weather. If followed by a few warm sunny days, the mischief done will show itself at once; but if dull, cloudy, and cold weather should follow, weeks often pass before the full extent of the losses can be ascertained.

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As far as we can yet judge of the amount of damage done at Edinburgh, it may be considered as trifling. Amongst herbaceous or suffruticose plants, stocks and wallflowers which stood above the level of the snow have suffered severely. The various species of *Tritomas* have been much cut up. *Veronica Andersonii*, *lobelioides* and *salicifolia* are also much injured, as well as pentstemons and perennial lupines.

Amongst shrubby plants, none of the conifers show any symptoms of injury. The leaves of the common laurustinus in some localities are more or less blackened, as well as the leaves of some of the delicate hybrid rhododendrons. The young and tender leaves of variegated hollies are likewise much browned. The plants which as yet show the greatest amount of injury are the cork trees and evergreen oaks; the leaves appear very white, and much twisted, particularly the leaves of those trees partially injured but not cut down after the frost of 1860. The cut down specimens soon became covered on the surface of the ground with a dense growth of healthy vigorous shoots; none of these in the meantime show signs of injury. The *Garrya elliptica*, which was in full flower on the 4th of January, looks very bad in some places, all the flowers destroyed, and the leaves on many of the plants look very sickly. Some of the soft growths on roses are a little injured, but the ordinary spring pruning will soon put them right again.

Michael Connal, Esq., Glasgow, presented raw and refined specimens of beet-root sugar, and remarked that the demand for this article at present in the market was very great. In 1866 there were imported into the Clyde alone 25,285 tons. This principally came from France, but a proportion of it also from Belgium, Germany, and Austria. The approximate sum paid to the continental growers for this quantity is £610,000. The probable import into the United Kingdom during 1866 was about 35,000 tons in all. Mr F. O. Licht, of Magdeburg, estimates as follows the continental beet-root crop, as compared with the ascertained production of former seasons, showing a diminution in the probable supply of about 60,000 tons:—

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	Estimated.	Ascertained Productions.		
	1866–67.	1865–66.	1864–65.	1863–64.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Zollverein, ...	200,000	185,695	170,660	155,180
France, ...	200,000	274,000	149,014	108,467
Austria, ...	65,000	70,000	84,564	60,916
Russia, ...	65,000	50,000	42,500	35,000
Belgium, ...	27,500	41,550	21,864	20,031
Poland and Sweden, .	15,000	15,000	11,595	10,000
Holland, ...	4,000	3,500	2,500	2,500
Total Tons, ...	576,500	639,745	482,697	388,094

Professor Balfour stated that so extensive had the trade in beet sugar become, that there was now a French magazine on that subject published every month.

Mr Alexander Craig-Christie explained a new mode of preparing museum specimens of wood. The specimens which he exhibited showed the wood in transverse and longitudinal sections, rough, polished, and turned by the lathe.

Mr D. W. Roberts exibited a series of nature-printed leaves and flowers, which he had prepared according to the process patented by Dr Dresser and Dr Lyon Playfair. Oil paint, according to the colour of the impression wished, is placed over a sheet of paper, and the leaf or flower is then pressed on this paper until every part of its surface comes in contact with the paint. It is then carefully transferred to a sheet of smooth soft cartridge paper on which it is rubbed with the painted surface next the paper. By this means a pretty accurate impression of the leaf or flower is obtained.

A letter was read from Baron Von Hohenbuel, having reference to the *Æcidium Adoxæ* of Greville.

Dr Treutler exhibited specimens of *Saxifraga rivularis*, which he collected on Ben Lawers in September 1865.

Mr J. F. Duthie sent specimens of *Centunculus minimus*, collected at North Sannox, Arran, in September 1866, the first time it had been met with in that island.

Thomas Patton, Esq., presented two cones of *Pinus monticola*, ripened at Glenalmond, Perthshire. One cone was of a red colour, while the other was of a yellowish

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brown. They were taken from different trees, the cones of which are invariably the same every year as the two exhibited.

Mr John Sim, Gateside, Strachan, sent specimens of *Hypnum giganteum*, from Scotston Moor, near Aberdeen, where also he had collected *Centunculus minimus*, *Thrincia hirta*, &c.

14*th March* 1867.—ISAAC ANDERSON-HENRY, Esq., President, in the Chair.

The following Gentleman was duly elected a Corresponding Member of the Society:—

Rev. ALEXANDER ROBB, Old Calabar.

The following Donations to the Library were laid on the table:—

Transactions of the Pharmaceutical Society of London, No. 93.—From the Society.

Proceedings of the Royal Horticultural Society of London, Vol. I. (New Series), No. 7.—From the Society.

Report of the Proceedings of the International Horticultural Exhibition and Botanical Congress, held in London from May 22d to May 31st, 1866.—From the Managing Committee.

The following Donations to the Museum at the Royal Botanic Garden were announced:—

From Mr Fowler, Castle Kennedy Gardens—Cone of *Picea religiosa* ripened at Castle Kennedy. This is believed to be the first instance of the tree producing cones in Scotland.

From Sir William Jardine, Bart.—Sarracenia Powder, a decoction of which is used medicinally.

From Robert Brown, Esq.—Section of Stem of *Paullinia jamaicensis*, "Supple Jack" of the West Indies; Fruit of *Jatropha Curcas*; "Sumach" used in tanning, &c.

The following Donations to the Herbarium were noticed:—

From Robert Brown. Esq.—Parcel of Plants (principally ferns)

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collected in the Republic of Nicaragua, Central America, in 1866.

From Charles Howie, Esq., Largo—Specimens of *Campylopus alpinus*, collected on Ben-Wyvis in 1864.

Mr Anderson-Henry, on taking the Chair, thanked the Society for his election as President.

The following Communications were read :—

I. *On the Hybridisation or Crossing of Plants.* By ISAAC ANDERSON-HENRY, Esq.

This may be truly characterised as the age of inquiry and investigation. Into every department of natural science men, well qualified for the work, have of late years come forward, most of them honestly intent on the pursuit of truth, to stick by its revelations, uninfluenced by theories of others, or the natural bias of their own minds. But few men who have proceeded far and discovered much are wholly free from yielding to the latter tendency. None have made such progress in discovery in this field of practical botany, or by better-tested experiments, perhaps, than our great countryman; and if ever man was more enticed than his fellows—I should rather say, his followers—in that field to run ahead and be drawn into speculations, he is that man. Dissent as we may, and will, from the conclusions to which his speculative generalisations lead, all of us must, with pride, acknowledge that Darwin has thrown more light into this department of natural science than was ever done before by any, or by all, who preceded him. What Newton was in the starry spaces, he has been in the fields below. And if Newton enunciated no theory to which his fellow-men refused assent, the same could not be said of some other philosophers scarcely less distinguished. We have all heard how Kepler, having made his extraordinary discoveries in the motions of heavenly bodies, since known by the laws which bear his name, which, though he could not at first establish by proof (yet their truth has since been amply confirmed), gave loose to fancy so far as to believe that the planetary bodies, even *this* earth on which we live,

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and move, and have our being, were themselves living creatures; and have we not all heard of the theory of Laplace, who even led Sir John Herschel, and after him a train of master minds, into the faith (which it was utter heterodoxy even to question) of innumerable creations going on, on every hand, in the remoter heavens, till Lord Rosse, one fine night, with his powerful telescope, resolved the nebulæ in Orion, and dissolved the nebular hypothesis for ever? In fact, it seems the besetting sin of great and original minds, just by seeing farther and discovering more than their less enlightened brethren, to run astray and get bogged in erratic ground; and that either as a sequence of such discoveries or as a prelude to them—some starting with the truth and steadfastly adhering to it so far as facts will carry them, and theorising for the rest; while others, to attain remote conclusions by a jump, boldly set forward in pursuit of the *elixir vitæ*, or that stone by which all metals might be transmuted into gold. And these last, pursuing an *ignis fatuus* from the beginning, stumbled in the end upon discoveries, which, however, have since been turned to good account.

If running into error, either at the outset or in the end, give any just title to distinction, I too might put forward a claim, securely based upon these double grounds; for were I to contrast my successes with my failures, it would be as setting off units against thousands.

I started in my experiments about or before the year 1840, and in firm reliance on the truth of the *Lamarckian doctrine*, as I subsequently wrote in an article I furnished, on Hybridisation, to M'Intosh's "Book of the Garden." I stated my belief that "nature in the beginning, as conjectured by Linnæus (I should have said Lamarck), was occupied by but few original types of the innumerable vegetable forms which have been transmitted to us. How these few first types have become varied and multiplied from classes to tribes, from tribes to genera, and from genera to species and endless varieties, belongs to those mysteries of divine agency which set all inquiry at nought," &c.* Yet I could not discard the faith (natural enough), that by skilful manipulation, and studying the times and seasons favourable and unfavourable to such operations, I could make nature

* "Book of the Garden." vol. ii. p. 819.

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stretch a point so as to restore union, if not unity, between and among things related by cousinship some fifty times removed; and by this means transmit among flowering plants all that was beautiful in colour and elegant in habit, from any one vegetable form to any other at all akin to it. In like manner, among fruits, how easy did it appear to infuse the rich *aroma* of the strawberry into every cognate thing. When I look over my *notanda* of fifteen or twenty years back, I see veritably recorded in my experiment books such and such things to be done in this way—of which, perhaps, the simplest might be to cross certain species of the *Rubus* with the *Fragaria*, among which genera the raspberry in the former and the *hautbois* in the latter tribe looked promising. Again, having got a small trailing species I raised from Andean seeds (*Rubus glabratus*), I meant to cross it with *R. arcticus*, or with *R. Chamæmorus*—in short, I formed great designs of intercrossing the *Rubus* family, one with another, on a large scale, and felt certain of a successful issue. Though I failed in all of these, I never doubted my ability, and certainly it looked among the most feasible of things, to improve the bramble by crossing it with the raspberry. And although I have heard that such a union has been accomplished, I remain an unbeliever; for, among all the most intractable things I ever took in hand, I found the intercrossing of any one species of *Rubus* with another (and I have tried them in all possible ways, and under the most favourable circumstances) the most impracticable, and as yet, I have only to record universal failure. I may, however, return to this tribe hereafter.

Some of my earliest efforts, however, were among what have been since denominated "florists' flowers," such as the calceolaria, the dahlia, the fuchsia, &c.

At that time every colour had been brought out in the dahlia save blue; and some began to speculate upon such a colour being realised, though none, so far as I was aware of, ever suggested the means of accomplishing it. This, however, seemed to me no great matter to achieve. I looked over the tribes bearing the nearest affinity to it, among its natural family, the *Compositæ*, having the desired colour, and I found many flowering plants, such as *Aster*, *Agathæa*,

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Kaulfussia, &c., having various tints of blue, sufficient, as I thought, for my purpose. With the pollen of these upon a white dahlia a blue might, I believed, be obtained; but it was calling spirits from the vasty deep, for neither blue nor even white, not even a ripened seed, ever came of it.

I need not allude here to similar efforts with similar results among other tribes; for, as an untaught experimentalist in botany, I felt fettered by none of its laws, and became a law unto myself, believing that failure now might be success again, and so I went forward. Unvarying failure, however, damped my zeal bit by bit, and I began to see that I could not transfer a colour alien to any one genus from another genus remotely akin to it, to which such colour was common. Yet ere I leave this subject I may observe a rather unusual freak of nature, which I set down as due to an experiment of a somewhat similar kind. At the period I refer to, now upwards of twenty years ago, we had few species of fuchsia save *F. globosa* and *fulgens*. It was the rage then, as it partly is still, to bring out large blooms; so, with that object in view, as well as to infuse some intermixture of colour, I crossed, or attempted the crossing, of *F. globosa* with a yellow-flowered *Œnothera*. I cannot vouch for the cross being true, for the progeny was a plant to all external appearance a fuchsia, like *F. globosa*, its female parent, having flowers of the ordinary *globosa* form and size, but with lightish green tips on the tetrapartite calyx. Now, although I could not regard this plant as a hybrid or mule, yet I could not reject the evidence of these light tips so far as to believe the *Œnothera* had not influenced them. The fuchsia and *Œnothera*, though so unlike, stand in no remote degree from each other in the tribe *Onagrariæ*, a tribe, be it remembered, of but few genera.

Well, this was like the "glorious nibble" to the zealous angler, who fished all day on the faith of it. But it helped to keep me from further seeking to outrage the modesty of nature, as in my effort to change a white into a blue dahlia. Yet for that wild dream of fancy I was not wholly without warrant, or without a colourable pretext, for ere I gave into it I had, by crossing a red-flowered calceolaria on one with purely white flowers, produced a change in the purity of the

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untouched flowers of the latter plant, many of which soon thereafter became flushed with a roseate tint. I communicated the result to Dr Neill, who, I remember, felt great interest in it, instancing something of a like nature produced by grafting operations, communicated to him by Mr Brown, of Perth.

Ere I pass from the field of my dreamland, it is right to observe that any efforts I made at that time to transmit perfume from one plant to another led to no satisfactory results, just from having no plants then near enough related to effect it. That it may be done, however, and done effectually, I have since again and again proved, as others too have proved among rhododendrons, by crossing *R. ciliatum* with *R. Edgworthii*. I made this out long before these Sikkim species came to help us—viz., by crossing our common European alpine species, *R. ferrugineum* and *R. hirsutum*, with *R. formosum* (otherwise *R. Gibsonii*), a beautiful Indian species; and the like result I obtained by crossing the latter on *R. atrovirens*—of all which crosses I have still many plants in my garden, all quite hardy, and which flower abundantly every year. In these latter hybrids the perfume is faint compared with what it is in the *Edgworthii* cross; but of the *Rhododendra* hereafter.

To revert to my earlier operations. Finding that nature would not do as I bid her, I resolved, as far as possible, to find out her way, and do as she bid me. I felt she had a clue to unravel if I could only find the end of it; so I took in sail, lowered my expectations, and betook myself to merely muling.

To go no farther back with my experiments than 1842, I tried to accomplish breeds between several kinds of fuchsia and *Epilobium*, a genus certainly not far remote from the fuchsia, especially the *F. excorticata* of New Zealand. The *F. corymbiflora*, then new, I drafted into service likewise, crossing it with *Œnothera serotina*, &c. I wrought with *Œ. rubra* and also *Œ. alba*, to whose agency I had a notion the first pure white fuchsia (named *Venus victrix*) was in some way due. I also wrought with *Epilobium angustifolium*, and some time after this with *Zauschneria californica*, still more closely allied to the fuchsia. But I failed in all to effect an intermediate. In some cases where I in-

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verted the cross, making the fuchsia the male parent, there appeared to be seeds partially ripe, borne by the *Epilobium*, but nothing ever came of them. I was reluctantly obliged to abandon this family altogether. One great object I had in view was to effect a change in the colour of the bloom, as well as in the habit and hardihood, of the fuchsia.

In the following year (1843) I changed my tactics. The fuchsia *Venus victrix* having a small flower, I entertained the hope, by crossing it with a fine large flowered variety, called *F. splendida*, to produce a larger variety, with all the purity of that still the purest of all the white varieties. The better to secure this, the thought struck me of shading both the pollen and seed-bearing plants. With this view I shaded the female plant (*Venus victrix*) by covering, with thin muslin bags, its emasculated blooms, and, at maturity, fertilised these with the unsunned pollen of *F. splendida*. I did get ripened seeds, and sowed them, but nothing came of them—at least I obtained no purer white flowered seedlings. I inverted the cross, making *F. Venus victrix* the female, and *F. fulgens* the male parent, but with no better success. I, however, got ripe seeds by this cross also.

I, again, that same year, to get better expanded flowers, tried a modified form of muling, and effected crosses between *F. cordifolia* (*mater*) and F. *fulgens* (*pater*), adding the pollen of the latter to that of the *Œnothera serotina*. I got ripe seeds, but of these, though sown, I have no record; and I have since been fully satisfied that in such cases foreign pollen added to native is impotent.

I hope, gentlemen, you will bear with me while I follow out some more of these operations, which, however discouraging to me hitherto, were yet, at least some of them, not wholly so disheartening as to preclude hope. There is no denying of the truth: I had pinned my faith, right or wrong, to a theory, to make the whole world (I mean the vegetable part of it) kin. I had drank too deep of the Lamarckian spring to lose heart without further trial.

So, persevering in muling, I had got mulish in the belief in my ability in the end to surmount all, at least many, of the difficulties I had met with. But I will not tax your forbearance with the innumerable and literally fruit-

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less experiments I made in this field, and of most of which I kept no record; so I shall pass on to some more favourable results I accomplished some few years afterwards.

I find from my note-book for the year 1847, that I made some attempts among the *Scrophularineæ*, a family most of whose extant tribes stand in much closer relationship to one another than the *Onagrarieæ*. The *Torenia asiatica*, a most beautiful plant, introduced about that time from India, offered to me a very tempting opportunity of forming by it a union with a Californian plant of a nearly allied genus—namely, the *Diplacus puniceus*. And I may here notice a fact I have found of almost universal occurrence among my experiments, that when I had to cross an American with an Asiatic species, it took much more kindly than crossing either of these, especially the former, with European species; and lest I shall not have another opportunity of recurring to this subject, I may here observe also the decided preference of plants of the southern hemisphere to intercross among themselves, however remote their original homes may be—*e.g.*, I found how much easier it was to cross Australian and New Zealand plants with their allies of South America, than with European or kindred things in the northern hemisphere. I have also observed that proper American species have greater aversion to cross with European than with Asiatic species, and that Asiatic species have no less aversion to intermix with European kinds.

There is only one instance, I remember, of effecting a successful cross between an Asiatic and a European species, and that was in crossing a small species of rhododendron with yellow *Helianthemum*-like flowers, being a form of *Rhododendron lepidotum* called *R. elæagnoides*, of the Sikkim ranges, on *R. ferrugineum*, a European kind. Of this cross I raised two plants; one died, and I kept the other for years; it flowered with me, the blooms being dirty red, splashed with a pale yellow tint. It was an odd looking thing, and I afterwards sent it to Kew as a botanical curiosity. What became of it there I never heard.

In the early summer of 1847 I crossed the *Diplacus puniceus* with *Torenia asiatica*, and on 3d August I got, as I believed, a pod of ripened seed, but I found I had pulled it too early, and the seeds do not appear to have sprung,

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at least I have no note of it if they did. I may observe here that it was and is my custom always to remove the native anthers long before maturity, deferring the cross generally for three or four days, or even a week thereafter —in fact, till the stigma was fully matured—always marking it as so emasculated; and this was carefully done here. From another pod of the same cross, but not so marked, I obtained nine plants, but what became of these I have no record; very likely they were failures.

I further tried, and succeeded in crossing another *Torenia* —viz., *T. intermedia*—with the *Mimulus*, making the latter the seed-bearer. Of this cross the pod contained seventeen seeds, which I sowed on 17th September 1847, and at October 19th I had nine plants finely vegetated. But of these I have no further record. I perhaps lost them during the following winter; for in the few proper mules I have succeeded in raising I ever found them most difficult to rear. In this cross, as well as in the following, I had, I find, made sure against self-fertilisation by timeous removal of the male organs.

I further, in 1847, attempted a cross between the *Digitalis purpurea*, var. *alba*, and the *Torenia asiatica*, making the former the seed-bearer, and got something like immature seeds, which I sowed, but nothing came of them. In the same summer of 1847 I effected another small success by obtaining one pod of ripe seeds of *Isotoma axillaris* crossed with *Lobelia ramosa*. These I sowed on 18th September, and at 24th November I potted off nine small seedlings. On September 30th, I obtained of the same cross another ripened pod containing sixteen seeds, which I do not observe I had sown.

On December 4th, of same year, I obtained another pod of ripened seeds from the same *Isotoma axillaris*, crossed in this instance with *Lobelia coronopifolia*, from which I raised ten plants, potted off 12th January 1848. What came of them I have no record; but I have found out, much to my cost, that of few things sown as late as October, and before January, can much account be given in the following March. Yet those who, like myself, have only been able to gather such seeds so late, are placed on the horns of a double dilemma—they must either sow at once, at great

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risk, or put off till spring, when, with longer keeping, the vital principle, weak at first, may be gone.

Yet the fact of seeding and raising such things at all was encouraging, and tended to make me more observant of the ways and means by which success might be made more certain. That climate, and especially some peculiarly favourable states of the atmosphere, had much to do with it, I felt every year more and more certain. I had by this time found that crosses which I could easily effect at one time were utterly impracticable at another, and that this ill-conditioned state would sometimes extend over whole summers. But of all times and seasons, I found such weather as frequently preceded thunder, and, oddly enough, which sometimes followed it—when there was a genial balmy texture in the air, not so much from sun heat, as sometimes arises from the presence of a larger portion of electricity than is usual, when every living thing seems more than ordinarily alive and happy—to be the season of all others for a bold experiment, and I seldom failed to improve it. Such a season happened in the spring of 1850; but before I relate a small success I then achieved, I must relate another observation which had been forced upon me from some of my manifold efforts in this way, and I think it will be better I state it by giving it as set down in my note-book, under dates April and May 1850:—"Discovered that the short stamens of *Rhododendron cinnamomeum*, and particularly of *R. catawbiense*, crossed the small *Rhododendron* (*Rhodothamnus*) *Chamæcistus*." By the short stamens of *R. cinnamomeum* I had further crossed the same pigmy species of *Rhodothamnus* with a large white-flowered Indian species; the cross being performed in the beginning of March 1850, which I noted as then (19th May) well on towards ripening.

Off the above muling operations I got some pods of ripened seeds, especially where the *Rhodothamnus* was crossed by the large Indian rhododendron, than which none to all appearance could be more perfect—yet nature had been too far strained. I sowed the seeds, and though I preserved the seed-pot for years, not one seed ever vegetated. I was, however, more successful with another cross, which I felt impelled to try by the extraordinary mule

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raised by Mr Cunningham, of Comely Bank, and about which so much mystery was observed—and for one good reason, as I have since learned, that he himself, crossing at the time so many things, one with another, did not precisely know its parentage, further than that the seed was borne by a *Menziesia* crossed, as he might believe, by the *Rhodothamnus Chamæcistus.* I have now reason to believe, from having wrought much in this section of the *Ericaceæ*, that the seeds of his mule called *Bryanthus erectus* were borne, not by the *Menziesia cærulea*, as was generally believed, but by *M. empetriformis* crossed by *Rhodothamnus Chamæcistus ;* for I had myself been trying a similar cross, before I knew of Mr Cunningham's, between *M. cærulea* and the same *Rhodothamnus*, which, however, had failed. Having, thereafter, when in his nursery, been shown Mr Cunningham's mule by himself, though he declined to say what the parentage was, I felt assured that I was not far off the truth when I told him my belief that it was the very cross I had been attempting, which he, however, would not admit. But, not to be baffled, I set to work afresh, but now inverting the cross, making *M. cærulea* the seed-bearer ; for before it was the *Rhodothamnus.* It succeeded. I obtained ripened seeds in June 1850, and in September following I had four young plants, which, however, were unfortunately devoured one night by a snail. In this I had another instance of success being secured by inverting a cross.

From this time forward I dealt liberally with the short stamens, believing, as I still do, that with these—I mean the pair of shortest stamens which occur in numerous families of plants—the larger species may be made to intermix with the smaller species of its tribe, where otherwise no union could be effected.

But there is one singular result which I think I have fully established as ensuing from the use of these short stamens, especially where the kinds crossed are *homogeneous*, or not remotely allied, and where there is no great disparity in size between their sexual organs.

Pursuing the use of these diminutive organs, especially where I crossed a larger on a smaller species, I find that I had, in the spring of 1855, manifestly used the short sta-

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mens of *Rhododendron Edgworthii* in effecting a cross on *R. ciliatum* (both Sikkim species), with the object of warding off the tall reed-like growth of the former, and securing the dwarfer, bushier habit of latter species in the progeny. I gathered and sowed the seeds of this cross on 7th November 1855, and I have still three plants alive of this brood, the height of two of them being only 4, and that of the other 4½ inches. These are now in their twelfth year, and have never shown the smallest tendency to bloom. [Two of them are now on the table before you.] I have no doubt of these being the produce of the short stamens.

Earlier in the same autumn I gathered and sowed seeds of the same cross, effected, I have no doubt, with pollen from the longer stamens, for the plants are taller than *R. ciliatum*, and shorter than *R. Edgworthii*, the male parent, of whose delicious perfume the flowers largely partake.

My attention was first called to the like effect of dwarfishness being produced from the use of the short stamens in the pelargonium tribes by an article written by Mr Beaton in 1861, in the "Journal of Horticulture;" and it is not unlikely that the same law holds in other races where the short stamens occur.

I was first induced to use these pigmy stamens of the larger species from the belief that their pollen must necessarily be smaller and finer in its granules than that of the larger anthers, and therefore more likely to pass down through the ducts of the female organs of the smaller kindred species. I cling to this idea still, and, if I am correct in it, may not the several pairs of anthers—*i.e.*, the intermediate and longest styled anthers—have severally their separate functions? Much patience is needed for pursuing experiments here, but it is worth the trial. May not the colour and perfume of flowers, and the size, fecundity, and aroma of fruits, too, depend upon the proper selection here? In all my difficult crossing operations latterly I used the pollen of all the anthers, leaving nature to select for herself.

This suggests to me a matter I may as well treat of here as afterwards, and which is referred to by Mr Darwin at page 545 of the latest edition of his "Origin of Species," where he holds the sterility of hybrids to be a different case

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from that of a first cross, the reproductive organs of hybrids being more or less functionally impotent, and for which he shows apparently very valid reasons. Yet I may refer to a pretty well-known hybrid of my own as affording, in its case, no failure from either of its parents in this respect. The *Veronica Andersonii*, a hybrid between *V. Lindleyana* (*mater*) and *V. speciosa* (*pater*), yields seeds, perhaps, in larger abundance and of equal fertility with those of either of its parents. Another brood which I raised, between *Veronica decussata* (*V. elliptica*, Hook.), of the Falkland Islands, and *V. speciosa*, of New Zealand, bears seeds in equal abundance with its parents, and likewise of equal fertility. These were, of course, seeds of original hybrids. But I found in another hybrid, which I effected many years ago, between our own alpine veronicas—viz., *V. saxatilis*, having rich bright blue flowers, and *V. fruticulosa*, having white flowers, striated with pink—which I honoured with the name of our honorary secretary, *Veronica Balfouriana*, having blue flowers striated with red, that the seeds of the second generation from it, at least of one whose flowers diverged from the colour of either of its parents in becoming red, no seeds of that red descendant, though tried over and over again in successive years, ever vegetated.

I may now, ere I quit this subject, observe a very singular phenomenon in increased fecundity in seed-bearing of a first-cross. When the beautiful and fragrant *Rhododendron Nuttallii* was introduced from Assam into our gardens, I shared, in common with others, a desire to try what could be made of it by crossing with other species; and of its progeny in this way I have two or three broods, some of them now of 2 and 3 feet high. These operations were performed in the spring of 1862. On the 12th January 1863 I pulled from *Rhododendron Dalhousiæ* a seed-pod so crossed with *R. Nuttallii*, the size of which I carefully measured, and found it was 1⅝ inch in length, by 2 inches in girth; whereas the largest normal seed-pod gathered, equally ripened from the same *R. Dalhousiæ* at the same time, I found to be only 1¼ inch long, by 1½ in girth. But the most remarkable thing of all about this cross was that, though the seeds were fully ripened, and in such abundance as I never before saw equalled in the family, and though,

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when sown, the seedlings came up thick as chickweed, yet every one of them died off in the seed leaf or second pair. Though they came up in thousands I could not preserve one of them. Yet, singularly enough, I have raised no end of another brood, obtained by crossing *R. formosum* with *R. Nuttallii* with another hybrid of my own, obtained by crossing with *R. Dalhousiæ.* The fertility here was due, I have no doubt, to the infusion of the "blood" of *R. formosum.* As a proof of this, I at the same time sowed the seeds of a cross between *R. formosum* (pure) and *R. Nuttallii;* the seedlings came up in double profusion. Are these results due to a nearer or remoter vicinage of original *habitat?* for all are Himalayan species, the *R. Dalhousiæ* being from the Sikkim, the *R. formosum* from the Khosia, and the *R. Nuttallii* from the Assam or Bhotan ranges.

But I am digressing sadly. My object in the experiments above noted has mainly been to show that nature abhors all alliances in relationship beyond the closest affinities. Members of many genera, besides those so close as the well-known instances of the apple and pear, the gooseberry and currant, obstinately resist all intermixture by crossing. I have already noticed, in addition, the bramble and raspberry, and I could add many others equally closely allied, but equally intractable. I may return to this question of unaccountable *antipathies* in a subsequent paper, where I may notice some equally unexpected *sympathies* between unlikely species, of which I may here note only a single instance.

Having two very distinct species of *Browallia* in my garden—one a shrub, growing from 4 to 6 feet in height, viz., *Browallia Jamesonii*, an orange-flowered species; and another, a tiny blue-flowered herbaceous annual, from 6 to 9 inches high, both from the Andes—it occurred to me to try a cross between them. I made the cross on the *B. Jamesonii*, having previously most carefully emasculated the blooms. The cross was made on the 17th June 1865. I gathered the seed on 5th July that year, but the seeds, though well formed, being immature, never vegetated. This cross I mean to try again; for the seeds, though not ripe, were no mere embryos, which often occur in such extreme crosses.

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I cannot close this part of my paper without suggesting to others an experiment I intend to attempt myself, if spared, on a small scale this ensuing summer, and that with a view to bridging over some of those gaps over which nature will not of herself be made to leap. I have been again and again surprised how near, and even afar off, allied things will incorporate, by the simple act of grafting—an act by which the sap and every vital principle which sustains the one must now animate both, and yet the two living things so made one will not, in their separate state, unite by any act of crossing yet resorted to. Hence it occurred to me that a union might be tried between the two separate subjects by fertilising the flowers of the ingrafted plant with the pollen of that species which forms its stock. For example, I have several pear trees ingrafted on the common white thorn, which flower and bear abundantly every year. I mean to try how far the pollen of the latter (*Cratœgus Oxyacantha*) may not fertilise the other, and produce an intermediate. I wish much that others would try what could be done in similar cases. The *rationale* of this experiment is strongly supported by a circumstance noticed in Loudon's "Gardener's Magazine," vol. xiv. p. 430, of a male plant of the *Carica Papaya*, a diœcious plant, having borne female flowers at the extremity of the racemes of a male plant, which was accounted for by the fact of the plant having been, two years before, inarched on a female plant of the same species, that part which bore such female flowers having grown subsequent to the act of grafting. The familiar case, too, of the *Cytisus purpurascens* or *Adami*, a hybrid between the common laburnum and *Cytisus purpureus*, affords another striking instance of the influence of the stock on the scion. For when grafted, as it generally is, on the more vigorous laburnum, shoots sometimes of a mixed character, partaking of both stock and scion, and sometimes of the laburnum, pure and simple, with its proper foliage and flowers, spring out from the branches of the *C. purpurascens*.* Other instances might be given, but for the purpose in view those cited may suffice.

* Since writing the account, I have just read of the *Cytisus purpurascens* or *Cytisus Adami*, and stating, as I have done, on the authority of a notice given of it in Lindley and Moore's "Treasury of Botany," of its being a *hybrid*, I

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I am yet but on the threshold of a vast subject, with what relates to pure hybridisation—*i.e.*, the crossing of one species with another distinct species of the same genus—and the crossing of varieties scarcely touched upon. With some of my experiments in these still ample fields, I may tax your patience in some other paper at a future time.

II. *Notes on some of the Compositæ of the Andes, and more particularly on Chuquiraga insignis.* By Professor JAMESON, of Quito. Communicated by ISAAC ANDERSON-HENRY, Esq.

Compositæ are found in all parts of the world, from the northern polar regions to the sultry plains of the tropics. In Northern Europe and Asia, on the Alps and Pyrenees, they are herbaceous. Throughout the whole range of the Andes many are shrubby and arborescent. The latter occur more generally between the limits of 8000 and 12,000 feet above the sea-level. Near the snow line (15,000 feet) we meet with a vegetation of shrubs composed of *Chuquiraga*, *Loricaria*, and *Diplostephium*, associated with the woolly plants, called *Frailejon* (*Culcitium nivale* and *rufescens*),

have this morning read another account of its origin in *The Farmer* of yesterday, where, reporting the proceedings of the last meeting of the Royal Horticultural Society, it is stated, "Mr Lee, Cliveden, Bristol, sent most remarkably dissimilar examples of apples from the same branch of a tree of orange Pearmain, which was a fertile subject of comment at the meeting. The tree was the true variety, and the other samples were of a russetty cast, instead of the bright crimson colouring common to the original. Rev. Mr Berkeley instanced *Cytisus Adami* as a sport of a similar character, which is believed to have been produced by grafting *Cytisus purpureus* on the laburnum, and by some accident one cell of the stock and one of the graft having each become divided, and then united together, the result had been a plant partaking of the nature of both. Mr Berkeley suggested that it would be most interesting to know the stock upon which the orange Pearmain had been worked." Whatever be its origin, the facts I have stated, and which probably many of us have seen with our own eyes, of the same tree producing three kinds of flowers, and two, if not three, different kinds of leaves, there can be no doubt of these having resulted from the operation of grafting. The two kinds of fruit, too, of the Pearmain seem to have arisen from the same cause. And it would seem, also, that many of the sports we see and hear of in roses, in changing colour, and betaking themselves to a climbing habit, are due to the same cause.

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which, with the *Wernerias*, advance to the limit of perpetual snow.

The first division, *Labiatæfloræ*, established by Lessing in the year 1839, comprises a small number of beautiful plants, few of which are known to the horticulturist. The genus *Mutisia*, described and named by the younger Linnæus in honour of Dr Celestino Mutis, the distinguished New Granadian botanist, presents species which, for the size and colour of their flowers, call forth the wonder of the traveller. The *Mutisias* are generally furnished with tendrils, by means of which they cling to trees and shrubs, adorning the woods on the western flank of the volcano of Pichincha.

The species of *Onoseris* occur in greater variety at Alansi than anywhere else, and also possess considerable merit. *Onoseris hyssopifolia* adorns the sandy ravines of Pomasqui and San Antonio.

The genus *Perczia*, named *Clarionea* and *Homoianthus* by various authors, presents species that occur on the higher ridges of the Cordillera, between 13,000 and 14,000 feet above the sea-level. One of these, *Perezia multiflora*, here called *Escorzonera*, is considered a useful remedy in catarrh, acting as a sudorific.

The *Chuquiraga*, comprised in this division, is, in a medicinal point of view, the most important of the group. For the following remarks bearing on this subject I am indebted to Dr Rafael Barahona, Physician to the Military Hospital, and Professor of Physiology in the University of Quito:*—

"This plant, which grows plentifully on our mountains, claims much interest in a medicinal point of view, for which reason I feel desirous of communicating to you the result of a few observations derived from its employment as a remedial agent in the military hospital and in private practice.

"The infusion of *Chuquiraga* taken by an individual in his usual state of health, operates as a mild tonic, increasing the appetite and promoting digestion. It appears to act as a stimulant on the circulating and organic nervous systems,

* Account of the medicinal properties of *Chuquiraga insignis*, by Dr Rafael Barahona, Physician to the Military Hospital, and Professor of Physiology in the University of Quito. In a letter addressed to and published by the author of the *Synopsis Plantarum Æquatoriensium*, vol. ii. p. 160.

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augmenting the force of the pulse, and giving more energy to the cerebral functions, diffusing a general and equable distribution of warmth over the body, with a tendency to perspiration.

"Having noted the physiological effects of this plant, I naturally felt desirous of employing it as a remedial agent; and I now proceed briefly to state the class of diseases in which its administration has been found advantageous.

"In consequence of its action on the organic nervous system, it possesses much efficacy in the cure of intermittent fever. In certain cases it seems preferable to the cinchona, particularly when the patient appears cachetic and bloodless—symptoms that usually occur when the malady has been of long duration, or when it has been treated by the injudicious administration of cinchona. In such cases I have found, by experience, that cinchona is not only inert, but positively hurtful. Dr Pereira, in his 'Materia Medica,' makes the following remark:—'I have observed that it (the cinchona) proves less successful, and often quite fails, when the complexion is chlorotic or anæmic. In such cases chalybeates often succeeded when cinchona is useless and injurious.'

"Another important circumstance is that the *Chuquiraga* can be safely administered, even when the stomach is deranged—an advantage not possessed by the cinchona, which must be prescribed when the functions of the stomach and bowels have been restored to their natural condition.

"With regard to the influence of this medicine in the cure of fever, I may be allowed to state that in the warm country, where intermittent and remittent types are epidemic, the *Chuquiraga* appears to act with much energy. In Babahoyo I had occasion to attend upwards of fifty patients affected with fever, who, solely by the use of this medicine, were speedily restored to health and radically cured.

"In the convalescence from continued fever, during which the countenance is pale and discoloured, together with a want of appetite and slow digestion—in short, where there is a general torpid condition of the animal functions —the moderate use of the *Chuquiraga* causes a progressive and favourable change.

"In the remittent fever of children, cases of which fre-

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quently occur in this country, followed by a lengthened convalescence and attended by indigestion, partial or general swellings, coldness of the extremities, and a pale countenance—symptoms which indicate a disordered condition of the organic nervous system—I am in the habit of prescribing the *Chuquiraga* with much benefit.

"As the *sequelæ* of measles and scarlet fever are of nearly a similar character to those of the maladies just mentioned, I have used the *Chuquiraga* in all such cases with beneficial results.

"Of the class of diseases strictly denominated *nervous*, I may mention hooping-cough, which almost every year occurs epidemically. In this disease I have also administered the *Chuquiraga* with benefit. The preparation I employ is a simple infusion, made by pouring a pint of boiling water on six or eight grammes of the plant, taking daily two or three tea-cupfuls; the quantity ordered to be given to young children being proportionally diminished. The extract may be employed, but I prefer the infusion.

"I cannot conclude this brief and imperfect sketch without suggesting to you, when time and circumstances allow, to analyse this important plant, inasmuch as the operation made by me is not altogether satisfactory, owing to the insuperable difficulties of obtaining, in this city, the requisite chemical preparations for the performance of an analysis. Notwithstanding, the following is the result of my observations:—1st, A bitter extractive matter; 2d, Chlorides of calcium and magnesium; 3d, A crystallised body, apparently oxalic acid; 4th, On adding lime water to the decoction, a copious precipitate, the composition of which requires further examination."

III. *Obituary Notice of Professor John Goodsir.* By Professor BALFOUR.

I have this evening to record the death of one of our members, John Goodsir, the distinguished Professor of Anatomy in this University. The melancholy event took place on the 6th March, at South Cottage, Wardie. Professor Goodsir was born at Anstruther in 1814, where both

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his father and his grandfather had been medical practitioners. His early studies were carried on at the University of St Andrews. He was afterwards apprenticed to Mr Nasmyth, the eminent dentist of this city. He prosecuted his medical studies here, and he showed a remarkable zeal for anatomical pursuits while attending the lectures of Dr Robert Knox, in whose rooms he made the acquaintance of Edward Forbes. He studied natural history under Professor Jameson, and veterinary anatomy under Professor Dick, for whom he continued during life to entertain a high regard. Goodsir and Edward Forbes were associated together for many years. They lodged together at 21 Lothian Street, and carried on those anatomical and zoological researches which have rendered their names famous in science. Many a pleasant hour have I spent with them in their lodgings at the time when they were rising into fame. The habits and structure of animals had been a favourite object of study with Goodsir from his earliest years. During his apprenticeship with Mr Nasmyth he drew up a paper on the structure and development of the teeth, which showed his powers as an anatomical observer, and at once placed him in a high position as a physiological anatomist. The paper was published in the Edinburgh Medical and Surgical Journal for 1839. He passed as surgeon in Edinburgh, and afterwards began practice with his father in Anstruther. He did not, however, continue long in practice, in consequence of having been (chiefly through Professor Syme's influence) appointed Conservator of the Museum of the Royal College of Surgeons of Edinburgh.

In this situation he had ample scope for anatomical researches, and he added many valuable specimens to the Museum. He also made some excellent casts and models, which displayed great artistic powers as well as anatomical knowledge. In the outer hall of the Royal College of Surgeons there is a remarkable model made by Goodsir. He made also a series of observations on the changes which take place in pathological tissues. These he communicated to the profession in a series of lectures, delivered at the College of Surgeons in 1842–43. These lectures were afterwards published. The views which he then advocated regarding the origin of various morbid products, from changes

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in the pre-existing elements of the textures of the body, have since been amplified by Professor Virchow, and constitute the basis of modern pathology. Virchow dedicated his work on Cellular Pathology to Goodsir, as one of the earliest and most acute observers of cell-life. He prosecuted also comparative anatomy with great enthusiasm, and he became one of the great authorities in that department of science. The specimens afterwards added to the University Museum amply testify his ability and zeal as a comparative anatomist.

He became a member of the Wernerian Society on 29th March 1840, having been proposed by Professor Jameson and Dr Neill. Along with his brother Harry (who perished in the Franklin expedition) and Edward Forbes, he read many valuable papers to the Society. The following may be enumerated:—

1. On certain Peculiarities in the Structure of the Short Sunfish (*Orthagoriscus Mola*), as observed in a large specimen captured in the Firth of Forth, near Alloa (12th December 1840).

2. An Account of the Anatomical Structure of the Ascidiæ, showing that even the rough covering of these animals is highly vascular; illustrated by specimens (9th January 1841).

3. On the Natural History of the *Echinus* and *Thalassema*, two genera of Echinodermata, by Messrs Goodsir and Forbes (23d January 1841).

4. On a new species of *Gymnorhynchus* found on the Short Sunfish (26th January 1841).

5. On two anomalous Marine Animals from the neighbourhood of the Isle of May, in the Firth of Forth, by Messrs Goodsir and Forbes (30th March 1841).

6. Account of some new species of *Pycnogonidæ*, and on *Pelonaia*, a new genus of Tunicated Molluscs, by Messrs Goodsir and Forbes (7th April 1841).

7. On the Metamorphoses of *Cancer Mænas* and *Cancer Bernhardus*, with descriptions of some species of Caprella, by the Messrs Goodsir (16th April 1842).

8. On the Natural Features of the Dornoch Firth (10th December 1842).

9. On the vast Accumulation of minute Marine Ani-

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mals which precede the appearance of a Herring Shoal off the Isle of May; and on a new species of *Cœtochilus*, by the Messrs Goodsir (23d February 1843).

10. On a new Crustaceous Animal, *Erineus splendens;* and on the Larvæ of *Balanus tintinnabulum*, by the Messrs Goodsir (8th April 1843).

11. Description of *Neuronoia Monroii*, a species of Entozoon infecting the nervous system of the Gadidæ (8th February 1845).

12. On the Organs of Circulation in the Echinodermata, with specimens (7th March 1846).

13. On the Characters and Anatomical Structure of the *Hyperoodon Dalei*, taken from a specimen stranded during last autumn near Alloa, with preparations (28th March 1846).

14. Exhibition of living Larvæ of *Medusa aurita*, from the coast of Fife, and a living group of Coryne (19th December 1846).

15. On the Morphological Constitution of the Skeleton in Sponges (20th February 1847).

Botanical anatomy and physiology early engaged Goodsir's attention. He joined the Botanical Society in 1841, having been proposed as a member by Edward Forbes, just before he left for his dredging expedition in the Mediterranean. In the billet of that date Goodsir is designated surgeon, 21 Lothian Street. On 13th January 1842 he communicated to the Society a description of a vegetable found on the gills of the gold fish (*Cyprinus auratus*); and, on 10th July 1842, he gave another paper on the characters of *Sarcinula* (afterwards *Sarcina*) *ventriculi*, a new vegetable infusorial; and, on 12th February 1846, he read a paper on the Potato disease. Brief abstracts of these papers are printed in the Society's Proceedings.

He was elected Secretary of the Society in 1842, and he continued to act in that capacity until 1848, when he was chosen Vice-President. He acted as a member of Council from 1849 to 1851.

When Mr William Mackenzie retired in 1844, Goodsir became anatomical demonstrator to Dr Monro in the University. He was a great favourite with the students, who

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appreciated his talents, and listened with no ordinary attention to his prelections. Like his friend Forbes, he rallied round him a great number of zealous men, who were proud to acknowledge him as their leader.

In 1845, in conjunction with his brother, Harry D. S. Goodsir (who succeeded him as Conservator of the Museum of the Royal College of Surgeons), he published a series of anatomical and physiological observations. The chapters on centres of nutrition, on the structure of the placenta, on the structure of lymphatic glands, on the structure and economy of bone, on the functions which cells perform, on the processes of absorption and secretion, and on the ulceration of cartilage, showed his power of original observation.

He became a Fellow of the Royal Society of Edinburgh in 1842, having previously contributed papers on the mode in which musket bullets and other foreign bodies become enclosed in the ivory of the tusks of the elephant (18th January 1841); and on the anatomy of *Amphioxus lanceolatus*, Yarr. (3d May 1841). He subsequently contributed to the *Transactions* of the Society a paper on the Ultimate Secreting Structure, and on the laws of its function (21st March 1842); and in the *Proceedings* of the Society notices of the following communications occur:—

On the Electrical Organs of the Ray" (6th January 1845.)

Verbal notice respecting the Thyroid, Thymus, and Supra-renal Bodies (16th February 1846).

On the Structure and Economy of Tethea, and on an undescribed species from the Spitzbergen Seas (7th March 1853).

On recent Discoveries on the Adjustment of the Eye to Distinct Vision (7th January 1856).

On the Reproductive Economy of Moths and Bees, being an Account of the Results of Von Siebold's Recent Researches in Parthenogenesis (2d February 1857).

On the Mode in which Light acts on the Ultimate Nervous Structures of the Eye, and on the Relations between Simple and Compound Eyes (6th April 1857).

On the Mechanism of the Knee Joint (18th January 1858).

Along with Edward Forbes, he also gave a paper on new

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Marine Animals, discovered during a cruise among the Hebrides with Robert Macandrew, Esq. of Liverpool, in 1850 (3d February 1851).

In 1846, Dr Monro having resigned the Chair of Anatomy, Goodsir was elected his successor. He was now in a position to carry out his anatomical investigations to their full extent. To his pupils, however, his chief attention was directed, and by his ardent, unwearied devotion to them during a period of twenty years, he maintained the high reputation of the anatomical class, and sent forth a band of medical men well versed in anatomical science, who are now scattered over various quarters of the globe, and who look back with no ordinary feelings of pride and affection to their late much respected teacher.* Goodsir worked for his students. To them he communicated all his important discoveries in anatomy and his physiological views; and many of them have, in after life, given forth, in their printed writings, the lessons of their master; so that, like Linnæus, the *amœnitates academicæ* of his pupils have advanced his fame.

The attendance at the class of Anatomy increased much, and the number of pupils was sometimes so great as between 300 and 400. Besides the ordinary lectures, Goodsir also gave for many years most valuable courses of Comparative Anatomy in summer. He aided for some time his friend and colleague Professor Jameson in the zoological part of the course of Natural History. He gave occasionally special lectures on particular points of anatomy, as on the minute structure of the retina, the lamina spiralis of the cochlea, and on the principle of construction of joints. In 1850 he commenced a periodical, entitled "The Annals of Anatomy and Physiology." Of this journal only three parts were published. About the same time he became a candidate for the office of surgeon in the Royal Infirmary. He did not obtain the office, and soon after he relinquished surgical practice entirely.

* A proposal has been made to found an Anatomical Fellowship in the University, to be called the Goodsir Fellowship; and I have no doubt that the contributions of the friends and pupils of Goodsir will speedily raise the sum required for its foundation, which will do much to commemorate his success as a teacher, and his eminence as an anatomist.

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On June 11, 1846, he was elected a Fellow of the Royal Society of London, having previously contributed to the Transactions of the Society a paper on the Supra-renal, Thymus, and Thyroid Bodies, which was read 22d January 1846 by Professor Owen.

In 1848 he became a member of the Highland and Agricultural Society, and he continued for many years to act as chairman of the Veterinary Department, and assisted at the examination of Professor Dick's pupils in the Clyde Street School. In 1848 he also became a Fellow of the Royal College of Surgeons. During the time that he occupied the Chair of Anatomy, the museum engrossed no small share of his attention, and he was able to prepare a series of specimens which, as regards their beauty and value, are unrivalled.

His naturally robust frame suffered much from his continued and pressing anatomical labours, carried on often to the neglect of the requirements of the body. His health was so impaired in 1853 that he was compelled to give up lecturing for a session. After a continental tour he returned to Edinburgh much invigorated, and able to resume his duties.

In 1855 he published in the "Edinburgh New Philosophical Journal," a brief review of the present state of Organic Electricity; and in 1859 he gave the annual address to the graduates in medicine in the University of Edinburgh. The address was also published in the "Edinburgh New Philosophical Journal." In 1856 he published a series of memoirs on the skeleton, which are highly valuable.

The disease under which he suffered manifested itself in a paralytic condition of the lower extremities, which continued to be aggravated year after year. In spite of his weakness he still carried on his researches, lectured to his class, and conducted the examinations for degrees. During the past year he was preparing another paper for the Royal Society, on the Contour of the Human Body, and he had collected a large amount of materials for the purpose.

He commenced his lectures in November 1866 with a remarkable lecture on the different kingdoms of nature. The exertion of lecturing, however, was too great. On one occasion he fainted towards the conclusion of his lecture, and

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remained in a state of insensibility for some time. On that occasion some of us tried to dissuade him from carrying on the course, but he determined to persevere, until at length he yielded to the earnest solicitations of some of his colleagues, and gave up lecturing, and allowed the course to be carried on by his able and talented assistant, Mr Turner.* His feebleness increased, and he was finally confined entirely to bed.

His mind, however, continued active and vigorous, and he conversed with intelligence on all scientific matters. I visited him several times after he was confined to bed, and had a melancholy pleasure in talking over the scenes of bygone days. He entered on one occasion with great earnestness on the developmental views of man, and condemned strongly the doctrines of Huxley and others. He considered that no true anatomist could adopt these views. He looked at the mental and moral aspect of man's nature as well as the physical. His lectures on man, in which he maintained that his moral and religious constitution ought not to be separated from his anatomical and physiological, will long be remembered by those who heard him. We believe that there are materials extant from which they can be published. Their publication would be an important contribution to science in these sceptical days. Goodsir embraced in his studies a vast range of science. He was, in the first place, a practical anatomist of the highest stamp; then he had an extensive and correct knowledge of natural history, including alike animals and plants; he was an excellent physiologist; he was well versed in physical science; was conversant with all the recent discoveries in electricity and magnetism; he had æsthetic taste of no ordinary kind; his artistic powers were of a high order, and he had a thorough appreciation of high art in sculpture and painting. He was truly an accomplished anatomist, who brought to bear on his science all the discoveries of modern times. He made many valuable discoveries, which were embodied in his lectures, but never published. Many important observations have been lost, owing to their not having been committed to the press. Much anatomical and physiological knowledge will, however, continue to live in

* Now Professor of Anatomy as his successor.

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the minds of his pupils, and, it may be, will come forth in future in their writings.

A writer in the *Pall Mall Gazette* says—"Since the days of John Hunter no greater master of anatomical science, no keener investigator of phenomena, no more comprehensive grasper of generalisations, no clearer or more effective expositor, ever dedicated himself to the great subject of anatomy, human and comparative, than John Goodsir. The only regret is that he has left so few records of his discoveries and conclusions; that in the keenness of his pursuit after scientific truth, he left himself so little time to gather up and embody in a lasting form his numerous incidental felicities of investigation and doctrine. But enough, and more than enough, will always remain to prove the brightness of his intelligence, the justness of his reasoning, and the philosophic comprehensiveness of his generalisations."

By his death science has been deprived of an original thinker, a most zealous and successful worker, and his pupils have lost a warm and devoted friend and teacher. With all his learning he was modest and unassuming, and was always ready to aid others who were labouring in the cause of science. His lectures were not merely descriptive, they brought home to the mind of the hearer philosophic views of anatomy of a highly suggestive nature. They will bear fruit, I doubt not, in after years.

He breathed his last in the same cottage in which Edward Forbes died in November 1854, and his remains were interred next those of his early and loved friend in the Dean Cemetery.

The disease of which he died was atrophy of the spinal cord, with thickening of the arachnoid.

The Senatus Academicus of the University of Edinburgh, at their meeting of 9th March, adopted the following minute:—"The Senatus deeply regret the loss which they have sustained by the death of Professor Goodsir, who for twenty years had ably discharged the duties of Professor of Anatomy. They feel that the University has been deprived of a most distinguished man of science, who, by his knowledge of Human and Comparative Anatomy, had acquired for himself a European reputation, and who, by his prelec-

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tions and writings, had done much to maintain the reputation of the University."

IV. *Report on the State of Open-Air Vegetation in the Royal Botanic Garden.* By Mr M'Nab.

Since the last meeting of the Botanical Society (14th February 1867) the weather has been very variable, and of such a nature as greatly to retard the progress of open-air vegetation. The finest weather experienced was after the middle of February, when several mild sunny days were the means of advancing vegetation considerably, and also had the effect of testing the damage done to *Coniferæ* and several evergreen shrubs from the effects of the frost on the 4th of January.

At the time of my last report the only shrubby plants then recorded as being injured were the *Laurustinus*, certain breeds of hybrid rhododendron, evergreen oaks, and cork trees. Since that period all the plants of *Pinus insignis* have become brown. *Taxodium sempervirens* and *Cryptomeria japonica* are also much injured. Many plants of *Wellingtonia gigantea* have had their points destroyed, particularly those growing on low and somewhat damp situations, while those planted on elevated ground are as yet unhurt, and have every appearance of continuing so. *Garrya elliptica*, which was in a flowering state at the end of December, now shows injury to a considerable extent, many of its branches being totally destroyed. The Japan species of *Euonymus* are so much disfigured that the plants will have to be cut down to the ground. The *Leycesteria formosa* has also suffered severely.

With the exception of the Californian shrub *Nuttalia cerasiformis*, which is now covered with its white racemose flowers and rich green foliage, few other plants show much appearance of growth; even the *Ribes sanguineum*, which has been frequently noticed as flowering early in March, shows but little appearance as yet of bursting its buds. Towards the end of February herbaceous vegetation seemed all ready to advance. The cold and

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backward weather since the beginning of March has kept them in check.

Since the 14th of February the lowest thermometric readings during the remainder of that month were on the mornings of the 15th, 16th, 26th, 27th, and 28th, marking respectively 30°, 34°, 30°, 26°, and 26°; the highest night temperatures being on the 20th, 21st, 22d, 23d, and 24th, marking respectively 42°, 48°, 44°, 43°, and 43°. Since the commencement of March the highest night temperature was on the 9th, when the thermometer indicated 35°, all other mornings up to this date falling below the freezing point, the lowest markings being on the 1st, 2d, 5th, 12th, and 13th, marking respectively 23°, 26°, 28°, 27°, and 26°. This comparatively low temperature has been much against the floral calendar for the past month. The plants noted in bloom, in addition to those recorded at the February meeting, are *Crocus vernus* and *Orobus vernus*, on 15th February; *Scilla bifolia* and *Rhododendron atrovirens*, on the 16th; *Doronicum caucasicum* and *Symplocarpus fœtidus*, on the 18th; *Nuttalia cerasiformis*, on the 20th; *Omphalodes verna*, *Arabis albida*, on the 22d; *Sisyrinchium grandiflorum album*, *Scilla sibirica*, and *Aubretia grandiflora*, on the 23d; *Iris reticulata*, on the 2d of March; *Narcissus pumilus*, on the 4th; *Narcissus minimus*, on the 5th; *Scilla bifolia major*, on the 10th; and *Tussilago Farfara*, on the 13th.

Mr R. T. Mackintosh, of Dean Park Nursery, reported the flowering there of a plant of *Rhododendron Falconerii*. The plant is 4 feet high, with five branches 1 foot 9 inches in length. It has produced five trusses of flowers, each 2 feet 5 inches in circumference, and possessing from twenty to twenty-five flowers, each flower measuring 10½ inches in circumference. Size of leaves, 13 inches long, by 5 inches broad.

Mr I. Anderson-Henry exhibited the fruit of *Solanum caripense* ripened at Jardine Hall. He had first raised this plant from seeds sent home by Professor Jameson from Quito, where it grows on walls (9600 feet above the sea), sending down pendent branches loaded with fruit, which is agreeably acid, and eaten with impunity.

Mr John Sadler reported the discovery of *Buxbaumia*

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indusiata in Ross-shire, by Mrs Captain Clarke, of Meddart. This is the first time that this moss has been met with in Scotland.

11*th April* 1867.—Isaac Anderson-Henry, Esq., President, in the Chair.

The following Gentlemen were duly elected Members:—

As Resident Fellows.

Alexander J. Adie, Esq., Rockville, Linlithgow.
Thomas Stewart Robertson, Esq., 11 Grange Road.

As a Non-Resident Fellow.

George H. Wilson Brown, of the Coedtef, Myfod, Montgomeryshire.

The Secretary laid on the table a letter from Henry H. Calvert, Esq., British Consul at Alexandria, thanking the Society for his election as a Corresponding Member.

Professor Balfour recorded the deaths of the following members of the Society, which had taken place since last meeting:—

John Stewart, F.R.S.E., Esq. of Nateby Hall, Lancashire. He was elected a Fellow of the Society on 9th March 1865, and died at Edinburgh on 17th March last, at the age of forty-six.

Prideaux John Selby, Esq. of Twizel, Northumberland, the well-known author of "British Forest Trees." He was also the author of a work on British Birds, illustrated by coloured folio plates, and he contributed the volume on Pigeons in Sir William Jardine's "Naturalist's Library." He was likewise associated with Jardine in a work entitled "Illustrations of Ornithology." He was a zealous member of the Berwickshire Naturalists' Club. He joined the Society on 9th December 1858, and died at Twizel House on the 27th March last, aged seventy-nine.

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Mr David Tennant, an associate of the Society, died at Pittenweem on 22d March last, in the seventy-eighth year of his age. He was the younger brother of the late Professor Tennant of St Andrews, and was for thirty-seven years schoolmaster at Denino.

The following Donations to the Library were announced:—

Journal of the Linnean Society, Vol. IX. (Botany), No. 39.—From the Society.

Transactions of the Pharmaceutical Society of London for April 1867.—From the Society.

Inhalt eines Gewächshauses im Botanischen Garten zu Breslau.—From Professor Göppert.

The Laboratory: a Weekly Record of Scientific Research, No. 1.—From the Editors.

Icones Carpologicæ, or Figure Descriptions of Fruits and Seeds, by T. S. Ralph, A.L.S.—From Mr B. H. Hossack.

The following Donations to the Herbarium were announced:—

From Mr J. E. Hamilton—West Indian Ferns.
From Mr J. R. Maclaren, per Mr Hossack—Himalayan Ferns.
From Miss Gibson-Craig—Indian Ferns.
From Mr T. G. Kerr—Arctic Plants.

The following Donations to the Museum at the Royal Botanic Garden were noticed:—

From Miss Robertson—Canoe made of birch bark, Burmese Cup, Stigmaria, Petrified Moss, and piece of Wood pierced by insects.

From Dr Duff—Fruit of *Hyphane* sp. and *Brahmia spinosa*, from Natal.

From Mr L. Balfour—Fruit of Bignonia, *Poinciana regia*, &c.

The following Communications were read:—

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I.—*On Silicified Vegetable Structures from the Zambesi.* By Dr John Lowe, Lynn. (Plate II.)

While examining some mud brought from the neighbourhood of the Zambesi Falls, and given to me by Mr Baines, my attention was arrested by some peculiarly-shaped bodies which appeared in great numbers. They presented a variety of well-defined and constant forms, and at first there was considerable difficulty in determining their nature. After long and repeated examination, I was enabled to satisfy myself on this point by finding some of them arranged together in their natural position, their vegetable character becoming at once apparent. The mud had been boiled for a long time in nitric acid and subsequently in liquor potassæ. The bodies in question then appeared as transparent silicious particles mixed with some fine diatomaceæ.

The most regular and noticeable form is that of figs. 1, 2, and its modifications, figs. 6, 7, 11, 18, 19—somewhat resembling in shape a cheese-cutter without the handle, and in its modified forms approaching in outline to that of a leg of mutton. In the former there appears to be, as it were, a hilum at the apex of the cell, and a circular dot at the base of the groove leading to the hilum. This occurs in different positions in some of the other forms, but is of so frequent occurrence that I cannot but regard it as an essential part of the cell structure, and think it is most likely the remains of the nucleus. The margin of the cell is transparent, but evidently raised, and thicker than the body of the cell, in the centre of which is a well-defined space commonly oval or oblong. In many of the cells this space is perfectly diaphanous (figs. 8, 11), but numerous others show that it has been filled with endochrome, since the colouring matter is still present in them (figs. 1, 7, 12). Detached oval pieces of colouring matter are also frequently met with (fig. 16*a*).

In figs. 5, 9, 17, we have more peculiar but somewhat less frequent forms, bearing, however, the same general characters of cell-wall, nucleus, and endochrome.

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In figs. 12, 15, these structures are seen united together in their natural positions. I have lately obtained several specimens showing this arrangement, the parenchyma being composed of three layers—the first consisting of the cells above described, containing endochrome; the intermediate layer having square-shaped cells, some of which also contain endochrome; the superior layer or membrane formed of cylindrical cells without endochrome.

In addition to the structures just described, there are others of an equally remarkable character, though evidently parts of a different kind of texture. Fig. 22 exhibits a very tolerably constant form of elongated cell, having a wavy cell-wall.

In fig. 20 these are seen *in situ*, and between the ends of the cells is a small oval space, in some instances containing colouring matter, and bearing a strong resemblance to some forms of stomata. The whole structure has the appearance of a portion of the epidermis of a leaf.

There are also other forms of structure which are more clearly tegumentary even than this, the stomata being well defined and numerous (figs. 21–23), in one case oval, and in the other circular, with radiating lines from the centre. These are unmistakably epidermis in a silicified state. The cell-walls are more irregular and wavy than the preceding, and the stomatic orifice more distinctly marked.

In attempting to determine the division of the vegetable kingdom to which these belong, one must be guided by the few facts which appear tolerably certain.

The character of the cuticle (figs. 21–23) is indicative of an exogen; that shown in fig. 20 has more the appearance of an endogen—one of the Liliaceæ, for instance.

It appears certain that various plants are mixed up together in this deposit, and thus there is great difficulty in assigning each form to its proper source.

The singular forms figured have not, so far as I am aware, been before described, and there are no exact data upon which to found structural comparisons; but in

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the exceeding abundance of the colouring matter present in the cells we have, I think, a fact of much importance in assigning them to their proper kingdom. This would point very strongly to the exogenæ which are so rich in dyes, and to one of the many African dye-trees I am disposed to think that most of these forms belong.

We may conclude with apparent probability that we have in the Zambesi deposit a mixture of endogenous and exogenous tissues, which have become silicified; that the predominating forms are cuticle and parenchymatous cells of the leaves; and that there is a large amount of endochrome, which renders it probable that the leaves are derived from some species of dye-tree.

I shall be glad to send a supply of material to any one who may be desirous of further investigating the subject.

II. *On the Progress of Cinchona Cultivation in India.* By an Indian Correspondent. Communicated by Professor Balfour.

This valuable quinine-yielding plant may now be considered to be as much naturalised in India as the coffee and tea shrubs. A voluminous Parliamentary blue-book has lately been published "relating to the introduction of the cinchona plant into India, and to proceedings connected with its cultivation from April 1863 to April 1866." A large portion of this paper is devoted to the cultivation in the Neilgherry Hills. The successive reports of Mr M'Ivor are given, with Mr Howard's analysis of the bark of the different species. There is also the correspondence relating to the establishment of a quinine manufactory upon the Neilgherry Hills, which has terminated in the selection of Dr Broughton, who has been seven years assistant to Dr Frankland, at the Royal Institution, and is said to be an excellent analytical chemist. This gentleman is expected immediately at Madras, and has been allowed funds for the necessary apparatus. We have also in this volume Mr Markham's interesting narrative of his visit in 1866,

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accompanied by Dr Cleghorn, to the various plantations on the Wynaad Plateau, or the Pulney range, and along the Coorg and Travancore Ghats. There are also notices of the progress of this new culture on the Mahabaleshwur Hills, upon an extensive scale in British Sikkim, and, the most northern point of all, in the Kangra Valley.

By the latest accounts received from Madras there were growing at the Neilgherry Hills alone 1,690,000 plants, distributed over four plantations, which at present consist of 1200 acres cultivated and 100 in reserve. Of this vast number of plants the botanical species most cultivated are—

	No.
Cinchona succirubra, red bark, .	739,545
„ Calisaya, yellow bark, .	40,421
„ uritusinga, crown bark,	87,509
„ Condaminea, loxa bark, .	787,903

The cultivation of cinchona appears to be passing through the same phases as that of coffee in South and tea in North India. The Secretary of State is gratified at the readiness with which planters, both European and native, undertake the growth of cinchona in many cases in connection with coffee plantations. The skill and energy of Mr M'Ivor are acknowledged by all as having conduced to this result. The object of the Madras Government in undertaking these extensive plantations is likely to be realised. Up to the end of October last (1866) the total number of plants distributed was 125,747. These were sold at a trifling charge, lately reduced to one anna (1½d.) a plant.

Not only India, but all the tropical colonies of the East and West Indies, Australia, and even Algeria, are being covered with the plant. Regarding the total cost of the cinchona plantations upon the Neilgherry Hills, nothing can be clearly made out from the blue-book; but the budget charges of the last two years are given, which may be considered approximate:—

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		1865–66.	1866–67.
Charges,	. . .	Rs. 91,500	81,500
Receipts,	. . .	„ 11,200	20,000
		80,300	61,500

This does not seem to be an excessive outlay, considering the great annual saving, estimated at L.30,000, expected to accrue from the supply of quinine to the Indian army alone. There has not yet been a merchantable consignment of bark, but the results of the experimental cultivation up to date are very satisfactory, and a vast field is opened out for private enterprise. At Hakgalle, in Ceylon, the expenditure is limited to L.500 a-year, which, under the management of Mr Thwaites, Director of the Botanical Garden at Peradenia, secures the minor object of issuing young plants to the settlers.

At Darjeeling the cinchona experiment is under the superintendence of Dr T. Anderson, Superintendent of the Botanical Gardens, and the cultivation is conducted by a gardener who resides upon the spot. The culture commenced in the Himalaya in June 1862. The Government plantations at Rungbee are five in number. The elevation above the sea and the temperature in October at the different plantations are—

Plantations.	Elevation.	Mean maximum.	Mean minimum.	Mean temp.
1st Plantation, . .	5321	58·3	50·1	54·2
2d do. . .	5000	72·0	54·6	63·3
3d do. . .	4410	74·4	57·9	66·15
4th do. . .	3332	69·4	61·2	65·3
5th do. . .	2556	82·4	63·6	73·5

The area under cultivation is much smaller than on the Neilgherries, but the progress of the trees planted out appears to be most satisfactory, and bark is now being despatched for analysis. The number of plants, cuttings, and seedlings on 1st December last (1866) was 593,808. The species most largely propagated are the same in both places. From Dr Anderson's latest report we take the following:—

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"The largest plant of *Cinchona succirubra* was 10 feet in height on the 15th of October, two years after the date of planting. It was between 6 and 8 inches high when planted. This growth of 10 feet in two years in the open ground is not an extraordinary and exceptional case, as there are many other trees of *Cinchona succirubra*, planted on the 15th October 1864, which are now 8 feet high. In the 5th plantation two plants of *C. succirubra* have produced flower buds abundantly, and panicles of flowers are also appearing on the largest plant of *C. officinalis* in the 4th plantation. These flowers were first observed in October. Rain fell plentifully during the month; the amount was 17·8 inches, while the amount in the corresponding month of the previous year was 1·5 inches."

It is impossible to calculate the benefit which will be bestowed upon the masses of India by providing, at a cheap cost, the febrifuge alkaloids, which, from their high price, have hitherto been accessible only to the richer classes.

III. *Notice of Cinchona Planting in the Kangra Valley.* By WILLIAM COLDSTREAM, Esq., B.A.

The Kangra Valley is situated at the foot of the lofty Chumba Hills, whose peaks rise, within four or five miles of this, to the height of 14,000 or 16,000 feet. The first experiment at cinchona was begun some two years ago in a sheltered ravine about 5000 feet above the sea, in the midst of a forest of "chîl." There they grew luxuriantly; but last winter a heavy fall of snow covered the plants, which had grown several feet high, and killed them all. In the beginning of this year (1866) ground was bought some six miles lower down the slope of the valley, at an elevation of about 4000 feet, where the snow never lies. Ten acres have been planted, and a large number of the plants are looking most vigorous.

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IV.—*On New Zealand* "*Carrageen.*" By W. Lauder Lindsay, M.D., F.R.S.E., F.L.S.

In a memorandum appended to a paper on Otago *Algæ*, presented to this Society last session,* I expressed the opinion that the sea-weed variously designated by New Zealand settlers "Carrageen," "Irish moss," "Edible sea-weed," and "*Chondrus crispus*," would probably prove (for I had not then, nor have I yet, myself seen specimens of the *Alga* in question), to be a species of *Gigartina*. The following note, subsequently received from my friend Mr Cooke, of the India Museum, London, confirms that opinion, and renders it probable that all the various designations above given apply to the same New Zealand species—*Gigartina livida*, J. Ag., which I found in abundance on the Greenisland coast of Otago:—†

"In illustration of a memorandum by you in the Transactions of the Botanical Society of Edinburgh, on New Zealand *Carrageen*, I believe that the same thing was exhibited in London in 1851" [at the International Exhibition, I presume]. "I sent a specimen of this, which I obtained, to the late Professor Harvey of Dublin, and he identified it with *Gigartina livida*, J. Ag. This will bear out your remarks."‡

Such designations as "Carrageen" furnish a good example of the confusion, if not error, arising from the application to New Zealand plants, by New Zealand settlers, of the vernacular names of *British* plants, to which the New Zealand plants in question are supposed to possess some resemblance, either as regards their uses or appearance. A similar marked instance among *Cryptogams* is to be found in the term "*Orchella weed*," applied to a Lichen shown in the New Zealand Exhibition of 1865 (at Dunedin), and which, as I have elsewhere pointed out, was probably not a *Roccella*, a genus not yet found in New Zealand, but a *Ramalina*.§

Among *Phænogams*, however, illustrations of this mal-

* Trans., vol. viii. p. 426. † *Ibid.* p. 424. ‡ Letter of Dec. 12, 1866.

§ Observations on New Zealand Lichens, Transactions of Linnean Society, vol. xxv. p. 523.

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appropriation of terms are much more numerous and striking—so much so, indeed, that it is evidently futile in the student to expect aid in the determination of the species or genera of New Zealand plants from their vernacular or colonial names.

Perhaps the majority of settlers' names of New Zealand plants are conferred in virtue of some supposed—rarely if ever real—affinity or resemblance (not of a botanical or scientific kind), to favourite or familiar *home plants.* For instance, the so-called "New Zealand," or "native," or "wild"

Thyme, is one or more species of the genus		*Samolus*, Nat. Ord. *Primulaceæ.*
Broom,	...	*Carmichælia*, N. O. *Leguminosæ.*
Hawthorn or Thorn,	...	*Discaria*, N. O. *Rhamnaceæ.*
Heather or Heath,	...	*Leucopogon* and *Dracophyllum*, N. O. *Ericaceæ.*
Daisy,	...	*Lagenophora*, N. O. *Compositæ.*
Birch,	...	*Fagus*, N. O. *Cupuliferæ.*
Pine,	...	*Podocarpus* and *Dacrydium*, N.O. *Coniferæ.*
Blue Bell,	...	*Wahlenbergia*, N. O. *Campanulaceæ.*
Holly,	...	*Olearia*, N. O. *Compositæ.*
Willow,	...	*Veronica*, N. O. *Scrophulariaceæ.*
Burr,	...	*Acæna*, N. O. *Rosaceæ.*
Spinach,	...	*Tetragonia*, N. O. *Ficoideæ.*
Laburnum,	...	*Sophora*, N. O. *Leguminosæ.*
Cypress or Arborvitæ,	...	*Libocedrus*, N. O. *Coniferæ;* and *Leptospermum* pr. p., N. O. *Myrtaceæ.*

Sometimes they are bestowed in allusion to physical or external characters or resemblances—real or supposed;—or to the nature of some of their products, *e. g.*—

Cotton Grass, or Plant, is one or more species of the genus		*Astelia*, N. O. *Liliaceæ.*
Leather Plant,	...	Do.
Spear Grass,	...	*Aciphylla*, N. O. *Umbelliferæ.*
Bush Rope or Supple-jack,*	...	*Rhipogonum*, N. O. *Liliaceæ.*
...	...	*Parsonsia*, N. O. *Apocyneæ.*
...	...	*Rubus*, N. O. *Rosaceæ.*

* Climbers on forest trees; strong and shrubby, with flexile, but narrow woody stems.

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Bush Rope or Supplejack is one or more species of the genus		*Metrosideros*, N. O. *Myrtaceæ*.
...	...	*Plagianthus*, N. O. *Malvaceæ*.
...	...	*Clematis*, N. O. *Ranunculaceæ*.
Ironwood,	...	*Metrosideros*, N. O. *Myrtaceæ*.
Ivy tree,	...	*Panax*, N. O. *Araliaceæ*.
Sarsaparilla,	...	*Rhipogonum*, N. O. *Liliaceæ*.
Tussock Grass,	...	*Carex*, N. O. *Cyperaceæ*.
Tea Tree,	...	*Leptospermum*, N. O. *Myrtaceæ*; and *Cassinia*, N. O. *Compositæ*.
Pepper Tree,	...	*Drimys*, N. O. *Magnoliaceæ*.
Milk Tree,	...	*Epicarpurus*, N. O. *Urticaceæ*.
Ribbonwood,	...	*Plagianthus*, N. O. *Malvaceæ*.
Iceplant,	...	*Mesembryanthemum* and *Tetragonia*, N. O. *Ficoideæ*.
Broad Leaf,	...	*Griselinia*, N. O. *Cornaceæ*.
Orange Leaf,	...	*Coprosma*, N. O. *Rubiaceæ*.
Aster,	...	*Mesembryanthemum*, N. O. *Ficoideæ*.
...	...	*Olearia* and *Celmisia*, N. O. *Compositæ*.

In other cases the designations appear altogether, or in great measure, fanciful and capricious, *e.g.*—

Wild or Bloody Spaniard, is one or more species of the genus		*Aciphylla*, N. O. *Umbelliferæ*.
Wild Irishman,	...	*Rubus*, N. O. *Rosaceæ*; and *Discaria*, N. O. *Rhamnaceæ*.
Bush Lawyer,	...	(Synonymous with Bush Rope and Supplejack).
Grass Tree,	...	*Carex*, N. O. *Cyperaceæ*.
Spear Tree,	...	*Panax* (in young state), N. O. *Araliaceæ*.
Cabbage Tree,	...	*Cordyline*, N. O. *Liliaceæ*.

On the other hand, it must be conceded that settlers' names are occasionally by no means inappropriate or incorrect, though this is certainly the exception and not the rule, *e.g.*—

Mistletoe is one or more species of the genus		*Viscum*—partly at least.*
Dandelion,	...	*Taraxacum*—the British species.
Sow Thistle,	...	*Sonchus*—the British species.
Bulrush,	...	*Typha*—one of the British species.
Maori Cabbage,	...	*Brassica*—one of the British species.

* Partly also of *Tupeia* and *Loranthus*.

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However useless or mischievous colonial or vernacular designations may be to the home botanist, they are of undoubted interest and importance to the settler. More important to both are the Maori or native names of New Zealand plants. But further reference to this subject here is obviously out of place, and it is one, moreover, that requires treatment at some length. Hence I propose devoting a separate communication to the subject on some future occasion, when I will exhibit a complete catalogue of all Maori and settlers' names of *Otago* plants, and make certain practical commentaries thereon.

V. *On the Botany of the "Jardin" of Mont Blanc.* By Dr Buchanan White.

In this communication the author gave an account of an excursion which he made to the "Jardin" on Mont Blanc, in September 1866. He remarked, "To reach the garden from Chamouni it is first necessary to proceed to the Montan Vert, to which a footpath leads through the firwoods. We then descend on to the Mer de Glace, and, ascending that grand glacier for about three hours, turn to the left, and, climbing up a steep moraine or bank of rocks brought down by the glacier (a proceeding which took nearly an hour to accomplish), we again get upon the snow-covered ice, and in half an hour reach the garden. The Jardin or Courtil is a sloping triangular plot of ground of about seven acres in extent, and forming a kind of island in the ice. It consists of a group of polished and striated protogine rocks, among the *debris* of which a number of plants have established themselves. The height above the sea is between 9000 and 10,000 feet. A flock of ptarmigan seem to be the only feathered colonists of the place; while a few insects, including, among others, the common tortoiseshell butterfly (*Vanessa Urticæ*), one or two species of the genus *Erebia*, and the larva of an Argynnis, completed the zoological list. The flora has been several times investigated, and, among others, by Mr Percy, who recorded the plants he found at a meeting of this Society. In a paper by Professor Martins in the Memoires for 1865 of the Academy of Sciences of Montpelier, the Phanerogamia are stated to be 87 in number; Musci, 16; Hepaticæ, 2; Lichens, 23—making a total of 128 plants. In my visit I found in flower 45 of the species given in Professor Martin's list, and 4 species not mentioned therein; 1 fern, *Allosorus crispus* (not mentioned by him) and one species of *Agaricus.* The mosses include 23 species, and the Hepaticæ 3." The paper was illustrated by specimens of the plants collected, and photographs of the "Jardin."

List of Mosses gathered in the Jardin on Mont Blanc.

Andreæa rupestris (*Rothii Bryol. Brit.*)
alpestris.
Dicranum albicans.
Blytti?
Weissia crispula?
Desmatodon latifolius.
Grimmia mollis.
incurva.
Racomitrium fastigiatum.
Bryum Ludwigii?
polymorphum?
Bartramia fontana, β alpina.
Bartramia ithyphylla.
Conostomum boreale.
Polytrichum piliferum.
sexangulare.
Pogonatum alpinum.
Aulacomnion palustre, β intricatum.
Leskea rostrata?
Heterocladium dimorphum.
Pterogonium filiforme.
Brachythecium glaciale.
Hypnum uncinatum.

List of Phanerogamous Plants gathered in the Jardin on Mont Blanc, Sept. 1866.

Ranunculus montanus.
Cardamine bellidifolia.
resedifolia.
Sisymbrium pinnatifidum.
5. Silene acaulis.
rupestris.
Cherleria sedoides.
Stellaria cerastoides.
Cerastium alpinum.
10. Sibbaldia procumbens.
Geum montanum.
Potentilla aurea.
Alchemilla pentaphylla.
Sempervivum montanum.
15. Saxifraga stellaris.
aspera.
Meum Mutellina.
Tussilago alpina.
Erigeron uniflorus.
20. Pyrethrum alpinum.
Gnaphalium dioicum.
alpinum.
Senecio incanus.
Leontodon squamosum.
25. Taraxacum lævigatum.
Hieracium glanduliferum.
Phyteuma hemisphæricum.
Primula viscosa.
Gentiana purpurea.
30. excisa.
Veronica alpina.
Euphrasia minima.

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Plantago alpina.
Salix herbacea.
35. Juncus trifidus.
Luzula lutea.
Carex curvula.
fœtida.
sempervirens.
40. Phleum alpinum.
Agrostis rupestris.
Avena versicolor.
Poa laxa.
alpina.
45. Festuca Halleri.
Nardus stricta.
Allosorus crispus.

VI. *Notes on* Grimmia subsquarrosa *of Wilson's MS.* By Dr Buchanan White. Plate III. Fig. 1.

Dr White gave a description and exhibited specimens and drawings of a moss which he had recently found growing abundantly on trap rocks near Perth. He had transmitted specimens of it to Mr Wilson, who had decided it to be a species of *Grimmia* new to science, and proposed that it should be called *G. subsquarrosa*. The following are the characters:—

Grimmia subsquarrosa, Wilson's MS.

Dioicous, tufted; leaves lanceolate, tapering into long diaphanous points. Margin recurved.

Hab. On trap rocks near Perth, 1865. F. B. W.—Arthur's Seat, Edinburgh, 1867. F. B. W. and Mr Sadler.—Blackford Hill, near Edinburgh, 1867. Mr Howie.

Grows in dark green tufts. Dr Schimper remarks (*in literis*) that this species approaches *G. montana*, but without losing its identity. Cells subquadrate, enlarged at the base.

Reference to Plate III. Fig. 1.

f. l. front of leaf; *b. l.* back of leaf; *ba. l.* base of leaf; *a. l.* apex of leaf: *s. l.* section of leaf.

VII. *Note on the Occurrence of* Buxbaumia indusiata *in Aberdeenshire.* By Professor Dickie.

A notice of the discovery of *Buxbaumia indusiata* in Ross-shire, given at a late meeting of the Edinburgh Botanical Society, prompted me to re-examine the genus as represented in my own herbarium. Nearly twenty years have elapsed since my friend, Mr A. Cruickshank, of Aberdeen,

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gave me a specimen, which he named *B. aphylla.* With but a very slight examination at the time I received it as such, and placed it in my collection. Mr Cruickshank, in July 1847, found two specimens of *Buxbaumia* among mosses in a dense fir wood at Pannanich, near Ballater, Aberdeenshire. No special search for others was made at the time. One of these he retained, giving me the other. The *habitat* struck me as different from that where *B. aphylla* usually grows. On careful re-examination of my specimen, I find it differs in general appearance from specimens of the true *B. aphylla* fastened on the same sheet, and from three different parts of Scotland. It agrees with Professor Schimper's description in "Synopsis Muscorum Europæorum." Mr Wilson kindly complied with my request for an authentic specimen, and I have now no hesitation in stating that *B. indusiata* was found in this country in 1847. Mr Cruickshank, the discoverer, has undertaken to make a thorough search in the same place this season; and as there are many other suitable *habitats* in this district, I fully expect that other examples will be found.

VIII. *Extracts from Botanical Correspondence.* By Mr John Sadler.

Mr Sadler read extracts from various letters which he had lately received from botanical correspondents. 1. Mr John Dawson, reporting the discovery of *Gagea lutea* on the banks of the Tay, near Perth. 2. Mr Charles Howie, Largo, noticing the disappearance of *Bryum Maratti* from the Tents Muir, and the occurrence of *Campylopus alpinus* abundantly on Ben Wyvis. 3. Mr James Hardy, recording the discovery lately of several mosses new to the Berwickshire flora, such as *Pottia crinita*, *Anacalypta lanceolata*, *Buxbaumia aphylla*, *Orthotrichum phyllanthum*, &c. 4. Dr Dickie, sending specimens of *Pottia crinita*, collected on the coast near Aberdeen.

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IX. *Report on the State of the Open-Air Vegetation in the Royal Botanic Garden.* By Mr M'Nab.

At the last meeting of the Botanical Society (14th March 1867) I gave a detailed account of the state of vegetation up to that period. It was particularly noticed that the thermometer readings, from the 1st of March up to the date of the meeting, was only on one morning marked as being above the freezing point, and which has been the means of keeping back vegetation. The same low temperatures continued till the 24th, the lowest being on the morning of the 17th, when the minimum reading was 18°. With the exception of the morning of the 28th, when the thermometer fell to 29°, on all other mornings up to the present date a favourable improvement to the better has taken place, the early morning readings of the thermometer ranging between 35° and 46°, except on the 2d of April, when it indicated 49°. The cold frosty winds of March have proved very detrimental to the foliage of many of the evergreen shrubs, as well as to the points of numerous coniferous trees, by causing them to become much browned. It will be observed, from the floral calendar appended, that April has effected an improvement. The list given does not include all the species now in flower, but those only which I am in the habit of annually marking. Although vegetation at the present time is considerably behind the average of years, still it approximates very near the floral records given last spring:—

March 21. *Gagea lutea.* March 22. *Scilla bifolia alba.* March 25. *Scilla bifolia rubra; Erythronium dens canis.* March 26. *Corydalis cava; Corydalis tuberosa rubra.* March 28. *Puschkinia scilloides.* March 31. *Hyoscyamus scopolia.* April 1. *Knappia agrostidea; Corydalis solida.* April 2. *Draba azoides.* April 3. *Ribes sanguineum; Rhododendron Nobleanum; Narcissus moschatus.* April 4. *Adonis vernalis; Hyoscyamus orientalis.* April 5. *Narcissus pseudo-narcissus; Primula ciliata purpurata.* April 6. *Fritillaria imperialis; Primula nivalis; Muscari botryoides.* April 7. *Muscari botryoides alba.* April 8. *Hyoscyamus physaloides.* April 9. *Mandragora vernalis.* April 10. *Ornithogalum montanum.*

Mr Isaac Anderson-Henry, Hay Lodge, exhibited a grow-

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ing plant of *Draba violacea*, which he had raised from seeds transmitted to him by Dr Jameson, of Quito.

Mr R. M. Stark exhibited growing specimens of the following American plants in flower:—*Calypso borealis*, from Canada West; *Viola delphinifolia*, from Illinois; *V. rostrata*, and *Corydalis aurea speciosa*.

Mr P. S. Robertson made some remarks regarding experiments he had tried in the crossing of the different varieties of "Greens" and "Kale."

Mr Stark called attention to a work about to be published by Mrs Fitzgibbon, entitled "Wild Flowers of Canada."

Dr Thomas Anderson, Calcutta, sent a memorandum of the number and distribution of Cinchona plants in the Government plantations at Rungbee on 1st December 1866.

9th May 1867.—William Gorrie, Esq., Vice-President, in the Chair.

The following Gentlemen were duly elected Members:—

As Resident Fellows.

Sir Thomas Buchan Hepburn, Bart., Smeaton, Prestonkirk.
Wellwood H. Maxwell, Esq. of Munches.
James Gowans, Esq., Gowanbank.
John Russel, Esq. of Mayfield, Falkirk.
Thomas Alexander Hog, Esq. of Newliston, Linlithgow.
Thomas Greig, Esq. of Glencarse, Perthshire.

As Non-Resident Fellows.

W. S. Turnbull, Esq., Huntingtower, Perth.
William Traill, of Woodwick, M.D., St Andrews.
Alexander Paterson, M.D., Fernfield, Bridge of Allan.

Professor Balfour noticed the death of John Gray, Esq., who had been for many years a member of the Society. He died at Braeside, Helensburgh, on 28th April last, in the seventieth year of his age.

The following Communications were read:—

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I. *On Submarine Forests and other Remains of Indigenous Wood in Orkney.* By Dr William Traill, St Andrews.

It has long been known that submarine forests exist in different parts of the English coast. There is one between Liverpool and Holyhead, where various bronze and iron articles have been from time to time picked up, which are referred to a period prior to the Roman occupation. Several such forests have also been found in Scotland, two of which are in the county of Fife—one situated at the entrance of the Tay, and another at Largo, in the Firth of Forth; and I see that at a late meeting of the Field Naturalists' Society there, specimens of wood from the submerged forest of Largo Bay were exhibited.

Geologists and other scientific men have propounded different theories to account for the existence of submarine forests. By some they have been ascribed to the agency of rivers or tides, carrying along in their eddies fallen trees and other estuary detritus, and massing them together, just as sand banks or gravel banks are formed; others believe that they are occasioned by the sea encroaching upon low flat land, breaking through the coast barrier, and thus permanently ingulfing the forest. Some view this encroachment as a gradual process going on at the present day in certain places; others refer these phenomena to the drift or glacial period.

These theories being somewhat conflicting and unsatisfactory, I was lately induced to give the subject some attention when in Orkney, surrounded by ample materials for investigation; and although it may not be easy to account for the presence of trees in such unusual situations, there seems good reason to assign a very remote antiquity to those found in Orkney.

Our inquiry is both narrowed and simplified at the outset by the fact, that (with the exception of the island of Hoy, where bushes of mountain ash, birch, and aspen poplar, are found in some sheltered nooks) no natural wood now grows in Orkney, nor is there any reliable account of trees having existed there in former times.

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Barry, a modern writer, mentions a vague tradition that the harbour of Otterswick, in the island of Sanday, was once a forest, which was destroyed by an inundation; but I am inclined to think that the tradition, if such it be, has arisen from the fact that remains of trees have often been found in the bay. Any temporary inundation would, after a time, subside naturally, and leave the land exposed and dry as before, unless the level in the interior was below high-water mark, in which case, from the swampy nature of the ground, it would be a most unlikely place in which to find trees. Otterswick harbour is a bay with a wide entrance, having a surface of five or six square miles, and a depth of water sufficient for vessels of considerable tonnage; it seems, therefore, more reasonable to explain the unnatural position of these trees by assuming a general subsidence of the land, due possibly to some geological change, such as we know has long been in operation, and is still observable, in the islands of the Pacific and in other places.

I do not venture to assert that these depressions of surface were the result of plutonic agency in some remote era of the past, but I confess that I see no other feasible way of accounting for them.

If we look back into history we find that Einar, one of the first Scandinavian Earls of Orkney, who lived about the end of the ninth century, was named Torf Einar, from his having taught the inhabitants the use of peat as fuel; this would seem to indicate a scarcity of trees, if, indeed, any then remained, which is very doubtful. Solinus, who wrote A.D. 240, states that the Orkney islands were "only three in number, uninhabited, *destitute of woods*, partly rough with rushes, and partly covered with rocks and with sand." This statement obviously must be received with caution. Tacitus, a much earlier writer, says that these islands were subjugated by Agricola; we may therefore conclude that they were then inhabited; but on this point many different opinions have been expressed. Some suppose that, prior to the time of the Norse invasion, the islands were merely the temporary abode of pirates, while other accounts state that the aborigines were exterminated by the Norsemen. A feeble ray of light has been thrown upon this "vexed question," by the recent discovery of Maeshowe, a building un-

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doubtedly constructed by that ancient race. There are Runic inscriptions on its walls. Some of them referred to the ninth century, one translation of which informs us that it was a sacred edifice which had been broken into by the Scandinavians amidst the lamentations of the *wild men.* It seems probable that the natives were not actually put to death, as has been asserted, but that they gradually receded before a superior and more enterprising race, and thus eventually died out, perhaps contemporaneously with the woods and tho wild animals that frequented them. Be this as it may, if we take the whole subsequent period of Scandinavian rule, from about 890 A.D. until the Scottish annexation in 1471, as narrated by the Danish historian Torfaeus, we find no mention of trees. Where hunting is alluded to, otters are generally specified; and there is reason to believe that at that time they also captured seals and other marine animals. But to return to the aborigines and the forests. Where history is uncertain, we are fortunately in possession of other silent records of the past, which enable us to affirm that at some period anterior to the Norse invasion these islands were inhabited by a rude race of men, who appeared to have obtained a part of their subsistence by hunting deer and other wild animals in the forests. This is clearly proved by numerous remains of human habitations constructed of stone, found on nearly all the islands, which generally contain horns and bones of the red deer, and of a species of ox, *Bos longifrons*, along with bones of the hog and other smaller quadrupeds and birds, including the *Alca impennis*, or great auk, which has become extinct in Orkney only during the present century.

The specimens of antlers and bones of red deer now before you (for the use of which I am indebted to Mr Watt of Skaill) are interesting, not only as relics of a fauna locally extinct, but they are also valuable as enabling us to connect the period at which these forests grew with undoubted marks of the presence of human inhabitants; or, in other words, that before the epoch of the forests and their fauna had terminated, that of the human inhabitants had commenced. The dark-coloured antlers, two of which are very large and perfect, were found in a peat moss, which appears to have contributed to their preservation, though it has

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deepened their colour. The other horns and bones were taken out of some of these ancient buildings, where they are often found mixed with the bones of other animals, but those of deer are most numerous. In the largest tumulus opened by Mr Watt, he collected nearly enough to fill three barrels. The light colour of these bones, and the crumbling condition of many of them, contrast strongly with the more perfect state of those found in peat.

It is observable that the antlers found in these old houses are generally in a fragmentary or truncated condition, the snags or points being broken off. In all probability, these smaller pieces served as substitutes for skewers or forks, or were perhaps applied to a greater variety of miscellaneous uses than we, in these days of cheap cutlery, can easily imagine. I have here a spur of deer's horn, found by my son last summer in the foundation-wall of a brough or round tower near Kirkwall, which has evidently been sharpened by art, and for an inch or two back from the point it is glazed or polished, as though it had been used for boring holes in skins, or for some such purpose; the thick end of it has been slightly rounded off, which would prevent it from injuring the hand, if used in the manner I have suggested.

The larger pieces of horn, from which the points or spurs are removed, appear to have been used as clubs or mallets; one piece, in particular, presents a glaze on its surface suggestive of very frequent handling. A great variety of bone and stone implements of rude construction have been found in these dwellings; but they are now so diligently sought after by collectors that they are not easily procurable.

In nearly all the localities where trees are dug up—in peat mosses, in marl pits, or beneath the bed of the ocean—there also bones and horns of red deer are found, and in some places entire skeletons of deer have been discovered. Most of the principal islands of Orkney show remains of trees in their peat mosses. During last summer I visited the island of Hoy, and on passing by a farm where extensive draining was going on, I observed that the surface of the ground on each side of the trench was literally lined with fragments of decayed trees that had been thrown out in

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the process of digging. In the island of Rousay, where I spent a few days in the summer of 1865, there were many traces of ancient forests, not only in the peat mosses towards the centre of the island, but also in two places on the coast much below high-water mark. I was fortunate in having a friend with a turn for antiquities, who was kind enough to accompany me in my rambles. We first turned our attention to the interior of the island, which is hilly, and much covered with peat, some of which is 8 or 10 feet deep. Beneath that there is generally clay or slaty rock of the Old Red Sandstone formation, with its upper stratum a good deal disintegrated. The trees, for the most part, lay deep in the peat, within a few inches of the clay or rock. Some were prostrate, but the stumps of others appeared quite undisturbed, their root fibres being traceable in all directions through the ground. Many of the smaller branches were flattened by pressure. None of the stems that we saw exceeded 6 or 8 inches in diameter, though we were told that larger pieces are often found by the peat-cutters, who dry them in summer, and add them to their winter stock of fuel. It was not easy to determine the different kinds of trees with any certainty. Birch could be distinguished by the peculiar appearance of its silvery bark ; other trees had rough thick bark not unlike pine ; that hazel was one species is evident from the extraordinary abundance of the nuts ; leaves also of different shapes are occasionally found wonderfully well preserved. Some of the sites of these trees are curious enough. There is a fresh-water lake in the island of Hoy, where trunks and branches of trees are found in abundance *under water*. I have not myself seen the place, but while exploring with my friend among the hills of Rousay, we came upon trees in a somewhat similar place—viz., in a mill-dam of 2 or 3 acres in extent, which, owing to the unusual heat of the summer, was perfectly dry, and its black surface was deeply fissured all over. On raising some of the cracked masses of peat, we found that the entire area was full of dead branches and roots of trees, and when we examined the sides of the dam or reservoir we saw many stems and branches of trees projecting horizontally from the peat. Most of them were about the thickness of a man's leg, but some were a good deal larger ; they were

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all much decayed, and in some instances were so macerated by the water that they were reduced to a pulpy mass of fibres.

A few days after this we resolved to examine some parts of the coast in quest of buried trees. Accordingly, we visited a bay on the west side of the island at low tide, when there might be from 10 to 15 acres of sand exposed. We at once set to work, and at the first thrust of the spade we struck on a tree of considerable size, which we traced under the sand for a distance of 14 or 15 feet; but it was too soft to lift except in sections. This tree had coarse rugged bark, and there was lying across it a well-marked specimen of birch. Wherever we dug into the sand, we met with peat containing trees, except where interrupted by a ledge of rocks across the mouth of the bay.

I may remark, that the layer of sand covering the ligneous peat was from half-a-foot to a foot deep. The peat itself was about a foot thick, and lay at a depth of 7 or 8 feet below the ordinary high-water mark. Under the peat was a layer of blue clay, specimens of which are on the table, along with samples of the wood and hazel nuts.

As I have already observed, the wood, when fresh taken up, was extremely soft; sections of it made by the spade were nearly the colour of beetroot, and the clear water oozing through the sand during our operations was quickly stained with purple—a remarkable proof of the conservative power of peat that this colouring matter should be retained for such a length of time under salt water. On the following day one of our party dug up several pieces of wood with the bark on, from an open exposed part of the coast, about half-a-mile to the eastward of the bay. The trees in both places were found, not piled in heaps or wave-worn like drift wood, but firmly embedded in a stratum of peat, as though a tract of land had subsided to a lower level, carrying with it the trees and the soil in which they grew.

As I left Orkney without having an opportunity of exploring Otterswick Bay, the site of the most extensive submarine forest in Orkney, I wrote to a friend who used to live in that neighbourhood, inquiring what traces of indigenous wood he had seen there; and as his letter in reply contains interesting information, I take the liberty of quoting

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from it as follows:—" In the winter of 1838 there was a long-continued gale of north-east wind, which entirely cleared away the shell sand from about 50 acres of the flat surface usually left dry at low water (our rise and fall of tide is 12 feet, and sometimes as much as 15 feet). Going down one day at low tide, I was astonished to see, instead of the white sand, what appeared a wide stretch of black moss covered with fallen trees, lying with their roots sticking up, exactly as I saw trees afterwards in Canada laid prostrate by a hurricane. I went down to the moss, stepped from trunk to trunk of the trees, and found their substance, when cut into by a spade, quite the same as that of the moss in which they lay, just that of our blackest coal peat. The largest of the trees seemed not more than 2 feet in diameter, and all were lying in the same direction, from S.W. to N.E. I secured several specimens with the bark on, but they soon dried and fell into dust. On taking to a boat, I found the same moss surface, mostly denuded of sand, showing itself under the deep clear water, with trees lying along its surface, quite across the bay to Tuftsness, four miles off, where a rupture of the peat had taken place—as all over that *ness*, under 9 or 10 feet of blowing shifting sand, the same peat moss and tree remains are to be found as under the waters of the bay, although raised above high-water mark some 10 or 12 feet. The rupture of the moss may be seen at most parts of the beach. In digging in the moss at Otterswick I did not find any deer's horns or other animal remains; but I am told that at Skaill Bay several deer's horns were found, and are still in the possession of Mr Watt of Skaill. They are occasionally dug up in all our mosses, and are also found in all the old Pict's houses or barrows that we opened." Here my quotation ends.

The present state of Orkney as regards arboriculture may be briefly described. The original woods, doubtless, supplied fuel to the inhabitants, and would thus slowly but surely disappear; and it is a well-known fact, that a country or district entirely denuded of trees is with difficulty restored to its former condition: young plantations are best protected by other trees, and no walls or fences can adequately supply their place. The earlier attempts at planting seem to have failed partly from the places selected for

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trial being too exposed, but chiefly from the trees not having been planted in sufficient numbers to shelter each other. Recent experiments, in favourable situations, and where a sufficient breadth has been planted, show a more encouraging result, the trees being at present from 20 to 25 feet high; and from their healthy appearance there is every reason to expect that they will continue to increase in size.

In the town of Kirkwall and its neighbourhood, where houses afford shelter, trees readily attain a height of 35 and 40 feet, and by their numbers add not a little to the picturesque appearance of the place; so much so, that, not very long ago, the Prince of Orange, who had been on a visit to Iceland or the Faroe Islands, and on his return touched at Kirkwall, remarked, much to the surprise and gratification of his hearers, that it was delightful to get back to *a well-wooded country* once more. The species of trees that seem to thrive best are the sycamore or Scotch plane, the elm, the ash, the mountain ash, and the white poplar. Larch may succeed tolerably well in sheltered spots, but evergreen firs and pines in general do not appear suitable. A remarkable exception to this is the *Araucaria imbricata* or Chilian pine, which, so far as it has yet been tried, seems likely to stand the climate, as it is there exempt from the severe frosts that are so apt to injure it here and in England. Evergreen shrubs, as a rule, are grown with difficulty, and, from a strange anomaly in the climate, those kinds commonly esteemed hardy are often the most difficult to rear, and *vice versa.* Thus, while the laurel refuses to grow, rhododendrons are more tractable; common box can hardly be kept alive, yet the box myrtle or *Veronica decussata*, which is here treated as a greenhouse plant, grows out of doors there in great luxuriance, retaining its vivid green throughout the winter, and in spring producing a profusion of fragrant white blossoms. This beautiful shrub, which in Orkney grows to the height of 5 or 6 feet, is a native of the Falkland Islands, coast of South America, and there is little doubt that other plants from that locality might be introduced into these islands with a fair chance of success.

The remarkable mildness of winter in so high a latitude as 59° north is chiefly attributable to the influence of the

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Gulf-stream, which perceptibly raises the temperature of the sea, and frequently casts upon these northern shores palm leaves, pieces of bamboo, masses of caoutchouc or gum elastic, and seeds of various tropical plants, as *Stizolobium urens* or cowhage, and *Mimosa scandens*, &c. Various specimens of these foreign products are on the table, including two pieces of gum elastic, one of which bears evidence of its long sea voyage by having attached to it several minute pedunculated shells, allied to the barnacle, which infests ships' timbers.

II. *On the Lichen-Flora of Druidical Stones* in Scotland.* By W. Lauder Lindsay, M.D., F.R.S.E., F.L.S.

The prehistoric remains, generally known as "Druidical Stones" or "Circles," have long been the source of the greatest interest to the historian and archæologist, especially in regard to the question of their probable *age* and former *uses*. They have been the subject of numerous learned speculations and discussions;† and they have been variously designated, according to the views adopted by writers as to their uses in by-gone ages—according to the imaginative or matter-of-fact character of the minds and habits of study of these writers. "The amount of research, the meditation, and the versatile mental labour wasted on these stones, resolve themselves into an interesting psychological phenomenon. They are in themselves a monument of how hard it is to convince a man that anything is a dead secret to him."‡

They have usually been associated in tradition with the *Druids;* but there is no proof of the existence of any such persons. They have been designated *fanes*, *temples*, and

* I use the designation "*Druidical Stones*" simply as that by which certain prehistoric erections are most generally known in literature in this country. I am not to be understood thereby as announcing any belief that such priests or people as Druids ever existed; nor am I called upon here to express any opinion as to the *uses* or *objects* of the erections in question. My sole concern with them at present is as *stones artificially erected, and of proved antiquity.*

† The reader will find the most recent as well as most liberal or unbiassed discussion on the whole subject of *Druids* and *Druidical Stones* in Burton's History of Scotland, Edin., 1867, vol. i. chap. iv. *et seq.*

‡ Burton's History of Scotland, vol. i. p. 145.

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altars; but this involves a theory of their former *uses*—a theory without any satisfactory foundation. The same remark applies in some measure to the appellation *sepulchral*, though the fact that human remains are, as a rule, found about their bases, and generally in considerable quantity, renders it evident that they have been, in one sense at least, cemeteries.* They have been called "*cromlechs;*" and the "Druidical circles" of Scotland are considered the equivalents of the "cromlechs" or "stone circles" of Brittany. But the term "cromlech" is very variously applied; and it is one that may involve erroneous or foundationless theories,† as to the object for which the circular groups of stones in question were originally erected, or for which they were subsequently employed. They are generally spoken of as "*circles*," and this is undoubtedly the usual arrangement of the stones. But there are prominent exceptions, *e.g.*, in the *cross*-shaped grouping of those of Callernish, in the Lews. To the Scottish peasantry they have been long known as "*Stannin' Stanes*" (*e.g.*, Stennis, in Orkney, which are arranged *circularly*, and are hence also locally familiar as the "*Ring* of Brogar"); or "*Grey Stanes*," *e.g.*, those of Callernish. These designations are simply descriptive—implying no theories: hence they are unobjectionable and most graphic; and they are much more truthful and characteristic than many of the designations of modern science or art. Some of the latter designations are, however, also truthfully descriptive, and thus unobjectionable, *e.g.*, cyclopean, monoliths, megaliths, columns, pillars—all of which apply more or less graphically to the huge, narrow oblong, flattened, unhewn blocks, perched on end, which compose the "Stannin' Stanes" in question.

There seems to exist a greater degree of unanimity regarding their *age* than regarding their use. They are generally spoken of as *prehistoric*, *prechristian*, *primitive*, being assigned to early and heathen ages. John Hill Burton, the historian of Scotland, whose characteristic as a historian is his scrupulous separation of fact from fiction or hypothesis—of tradition from history proper—speaks of the Callernish Cross as bearing "the almost certain evidences

* The term *monument* is open to similar objections.

† *Vide* Forbes-Leslie, "Early Races of Scotland," p. 186–7.

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of an antiquity far beyond the conversion of the people of the district, or even the Christian era itself."* While Forbes-Leslie remarks, somewhat more sceptically, "Not only is there an absence of any *direct* information, but no data that would assist in fixing, even approximately, the period when any of the primitive remains, the unhewn columnar temples or stone altars, were erected in Britain."† . . . . "By *primitive stone monuments* I mean those of rude construction and *apparent antiquity*, of the origin of which in any country there is no authentic record nor rational tradition."‡

This question of *age* is one that partly affects the *geologist*. "If naturalists," says Burton, "can see their way to the ascertainment of the rate of growth of peat-moss, they can tell us something about the age of the great circle" ["*cross*" it should be] "of Callernish."§ In the Lews some of the Druid stones are completely embedded in peat and covered over with heather; while others, both there and on the mainland, only exhibit their apices above the level of the surrounding moors. The annual operation of digging peats for winter fuel by the peasantry has in many cases exposed considerable sections of true peat-deposits around these "Standing Stones." In one case, in the Lews, 15 feet of peat were excavated without reaching the base of any of the stones;|| while in others their bases were embedded in 8 feet of peat, or 4 or 5 feet of clay. The determination of the age of a deposit of peat must be guided by circumstances of the most varying kind, *e.g.*, the nature of its constituents, the latitude, climate, elevation, and exposure of its position; so that n deductions from its rate of increase in one locality can be safely applied to it in another, where the conditions of growth may be different. I do not believe it is possible to determine the age of the Lews peat, unless in a general and

* History of Scotland (1867), vol. i. p. 141.

† "The Early Races of Scotland and their Monuments," by Lieut.-Col. Forbes-Leslie; Edin., 1866, p. 185.

‡ *Ibid.* p. 183.

§ History of Scotland (1867), vol. i. p. 144.

|| "Prehistoric Annals of Scotland," Prof. Daniel Wilson, pp. 115, 116, 150. "Description of Callernish" (which is spoken of as a "*circular* columnar Fane)," by H. Callender; "Proceedings of Society of Antiquaries of Scotland," vol. ii. part iii. p. 382.

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approximative way. The testimony of geologists, however, leads apparently to the conclusion, that a bed of peat upwards of 15 feet deep, and so consolidated as that of the Lews, must be the growth of centuries—of a much greater period of time than that represented by Scottish history. But archæologists and historians have arrived, in their own way, at the similar conclusion, that the "Standing Stones" of Lewis are prehistoric; so that the one conclusion merely confirms and assists the other in a vague and general way.

The question of *age* is one that also affects the *botanist;* for the character of the vegetation, which coats the "Standing Stones," has been uniformly *assumed*, and most improperly and erroneously so, to be one of the *proofs of their great antiquity.* For instance, the Earl of Aberdeen, writing of the Newton Stone of Aberdeenshire, speaks of the letters composing the inscription as "being encrusted with the hard gray lichen of precisely the same colour as the stone itself,"* and so scarcely distinguishable or legible. But he hazards further the rash assertion, that "the existence of this lichen is an *indisputable proof of the antiquity* of the inscription."† Burton, writing of the ancient sculptured stones of Scotland, Ireland, and the Isle of Man, remarks more cautiously, "If adepts in the cryptogamic department of botany shall succeed in finding a *test of the precise age* of these lichens, which they believe to be the *growth of centuries,* a key of the most valuable kind will be obtained for describing the age of stone monuments."‡ I do not know on what ground the writer ascribes to cryptogamic botanists a belief that the lichenose vegetation of sculptured and other classes of "Standing Stones" is the "growth of centuries!" I am prepared to prove that a similar vegetation may be the result of a very few years' growth. But I do not propose at present to adduce the proofs; my object now being to establish a basis for future comparison in an inquiry on the *development and growth of lichens in relation*

* Dr Moore also observes that the lichen is very hard, is closely attached to the stone, and appears in most of the letters. It is probably one of the crustaceous *Lecanoræ* or *Lecideæ* (e.g., *Lecanora cinerea, subfusca,* or *atra;* or *Lecidea contigua*), which I found on the "Standing Stones" of Lewis and Orkney.

† "Ancient Pillar Stones of Scotland," by Dr Geo. Moore; Edin., 1865 p. viii.

‡ "The Book-Hunter," by John Hill Burton; Edin., 1862, p. 379.

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*to the age of the structures on which they occur.** As a *point de départ*, I aim at present at establishing the two facts.—that the "Druidical Stones" of Scotland are of great antiquity—are of an age represented by at least several centuries—a fact we must, I think, hold fully proven by combined archæological and geological evidence; and that a certain lichen-flora characterises these stones wherever they occur duly exposed to air and light.

"Druidical Stones" are scattered over the moorland districts of Scotland, especially in its Highlands and Islands. In the latter they are familiar in the Long Island or Outer Hebrides, and in Orkney,—where the finest specimens in Scotland, as regards completeness or preservation, size or extent, are to be found,—in the *cross*-shaped group of Callernish, on the west coast of Lewis, and the better known *circular* group of Stennis, near Stromness, in Orkney. But they are to be found also in Arran, Bute, and Skye. They invariably consist of the rock of the district. Thus at Callernish they are blocks of hornblendic [Laurentian] gneiss, and at Stennis of the middle old red sandstone, or Caithness flagstone. The sculptured stones are similar as to their petrological origin; for instance, the Newton stone is of close-grained quartzose gneiss belonging to the district [Garioch]. According to Professor Nicol of Aberdeen, such "Standing Stones" in Aberdeenshire are glacier-boulders; and the same may be the case with those of the Western and Northern Islands, which, so far as I observed, were, however, certainly not water-worn.

A visit to Lewis and Orkney last summer (May and June 1866) gave me an opportunity of carefully inspecting the cross of Callernish and the circle of Stennis, and of giving special attention to the lichens, which coat the "Standing Stones," of which the cross and circle in question are composed. My object was the determination of the predominant forms of lichen-growth; these I studied on the spot, and the results are represented in the list of genera and species to follow. I had too much veneration for these stones, as prehistoric monuments, to regard them simply as the habitats of so many lichens; which do not differ, moreover, from those that are to be found in abun-

* *Vide* a paper entitled "Is Lichen-Growth any Criterion of the Age of Prehistoric Structures?" read before Section D of the British Association, 1867.

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dance on the rocks and boulders of the same material in the neighbourhood. I did not, therefore, subject them to mutilation by the hammer, even for scientific purposes; hence I did not collect, and could not examine with the microscope, those more minute species, whose name and place in classification cannot otherwise be determined. This category includes a *Lecanora* with the facies of *L. erysibe*, Ach.; a *Lecidea* with that of *L. intumescens*, Flk.; a *Verrucaria* with that of *V. rupestris*, Schrad., and an *Opegrapha* with that of *O. Chevallieri*, Leight., besides other obscure *Lecanoræ* and *Lecideæ*. I will enumerate these, as they occur on neighbouring rocks and boulders, in a separate communication on the "Lichen-Flora of the Western and Northern Islands of Scotland," which will contain a determination of all the rarer lichens that occur on their "Standing Stones," as well observations on the *variations* of the commoner forms with which they are coated.

I had further the opportunity of examining several less complete groups—sometimes isolated specimens—of similar "Standing Stones" in the Lews (*e.g.*, about Garrynahine, near Callernish, where they are arranged *circularly*); in Orkney, and in different parts of the mainland of Scotland (*e.g.*, on the Perthshire moorlands and lowlands).

In all these cases the vegetation, which covers them, though sometimes partly consisting of *Mosses*, *Hepaticæ*, *Chlorospermous Algæ*, or *Protophyta*, was mostly lichenose. As regards the *Lichens*, with which only we have at present to do, there was necessarily some, though slight, variation in the genera and species, according to the situation of the stones, especially as regards proximity and exposure to the sea; but otherwise there is a general resemblance of the Lichen-Flora in the whole group of "Standing Stones." For instance, I found the lichens of Callernish and Stennis nearly the same, notwithstanding the differences, petrological and otherwise, in the character of their habitat. The usual characteristics of that flora may, therefore, be held to be adequately represented by the following

List of the commoner Lichens growing on the "Standing Stones" of Callernish and Stennis.

I. Collemaceæ.

Ephebe pubescens, Fr. Callernish.

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II. Sphærophoraceæ.

Sphærophoron coralloides, Pers. Garrynahine.

III. Cladoniaceæ.

Cladonia cornucopioides, L. Smaller forms. Callernish.
Stereocaulon paschale, Laur. Callernish.

IV. Ramalinaceæ.

Alectoria jubata, L. Garrynahine.
Ramalina scopulorum, Ach. Callernish; Garrynahine; Stennis.
Platysma sæpincolum, Hffm. Sterile. Garrynahine.
P. triste, Web. Garrynahine.

V. Parmeliaceæ.

Parmelia saxatilis, Ach. Stennis. Var. *omphalodes*, L. Garrynahine.
P. physodes, L. Garrynahine.
P. conspersa, Ach. In fruit. Garrynahine.
P. olivacea, L. Furfuraceous form. Garrynahine.
Physcia parietina, L.
P. aquila, Ach. Stennis.
Umbilicaria polyrrhiza, L. Sterile. Callernish.

VI. Lecanoraceæ.

Placodium murorum, Hffm; var. *miniatum*, Hffm. Stennis.
Lecanora atra, Ach. Callernish; Garrynahine; Stennis.
L. cinerea, L. Garrynahine; Stennis.
L. subfusca, Ach. Stennis.
L. parella, Ach. Do.
L. tartarea, L. Garrynahine.
L. badia, Ach. Do.
L. ventosa, Ach. In fruit. Callernish.
L. vitellina, Ach. Garrynahine.
L. ferruginea, Huds. Stennis.
L. varia, Ach.; var. *polytropa*, Ehrh. Garrynahine; Stennis.
L. aurantiaca, Lightf.; var. *erythrella*, Ach. Garrynahine; Stennis.
L. sulphurea, Ach. Garrynahine; Stennis.
L. hæmatomma, Ach. Do. do.
L. fuscata, Schrad.; var. *smaragdula*, Whlnb. Garrynahine.

VII. Lecideaceæ.

Lecidea contigua, Fr. Garrynahine; Stennis.
L. petræa, Flot. Garrynahine.
L. rivulosa, Ach. Do.
L. geographica, L. Do.

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VIII. Verrucariaceæ.

Verrucaria maura, Whlnb. Stennis.

Of these, by far the most prominent and abundant—the most important in every sense—is the *Ramalina scopulorum*, which gives to the "Standing Stones" their "hoary" or "aged" aspect. It is, no doubt, to it that Hugh Miller refers in the following passage, descriptive of the "Standing Stones" of Stennis. "They are covered," he says, "by an extraordinary profusion of a flowing, beard-like lichen of unequal length, in which they look like an assemblage of ancient *Druids*, mysteriously stern and invincibly silent, and shaggy as the bard of Gray, when

> "Loose his beard and hoary hair
> Streamed like a meteor on the troubled air."*

This, however, is a piece of purely poetical or imaginative writing; and, like the bulk of such writing, when applied to matters of science and history, it contains more than one conspicuous absurdity or error. The prostrate stones at Stennis have no *Ramalinæ*, but are coated with *Lecanora parella*, and other *Lecanoræ* or *Lecideæ*.

Several of the lichens in the foregoing list occur in more than one form, *e.g.*, *Ramalina scopulorum*, *Stereocaulon paschale*, *Lecanora subfusca* and *cinerea*, and *Lecidea contigua*. Sometimes the common form is that which is presented, *e.g.*, *Parmelia saxatilis*, *Ephebe pubescens*, *Physcia aquila;* while in other cases it is rather the alpine or subalpine, or other less common, condition, *e.g.*, *Platysma triste*, *Umbilicaria polyrrhiza*, *Parmelia saxatilis*, var. *omphalodes*. Frequently they are sterile; and in some cases also isidioid, *e.g.*, *Lecanora tartarea*, *parella* and *sulphurea*, *Lecidea contigua*. Both Callernish and Stennis are in immediate proximity to the sea,—the former with a westerly, the latter with a southerly exposure. It is not, therefore, matter of surprise that a large proportion of the lichens growing on their "Standing Stones" consists of species common on *maritime* rocks in all parts of Scotland, *e.g.*, *Verrucaria maura*, *Ramalina scopulorum*, *Lecanora cinerea* and *atra*,

* "Cruise of the Betsy;" Edin. 1858, p. 451.

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Physcia aquila and *parietina*, *Placodium murorum*, var. *miniatum*. Of the others, many abound on moorlands of upland districts throughout Scotland, *e.g.*, *Lecidea rivulosa*, *geographica*, and *contigua; Lecanora tartarea*, *parella*, *sulphurea*, *varia* var. *polytropa*, *badia; Stereocaulon paschale; Sphærophoron coralloides; Ephebe pubescens; Platysma triste; Umbilicaria polyrrhiza.*

III. *Botanical Intelligence.* By Professor Balfour.

Dr Balfour communicated a report from Dr Cleghorn on the progress of the forests in Bengal during 1865–66; also a report from Dr Thomas Anderson on the introduction of the mahogany tree into Bengal. This tree was originally introduced from the West Indies in 1795 into the Botanic Garden at Calcutta, from which time its growth had been very satisfactory. In 1864 there were 69 trees of large size growing in the garden, besides numerous small ones, averaging upwards of one foot in diameter. Many of the former were blown down by the cyclone of 1864, and when they were examined the roots of the majority of them were found to be more or less decayed, owing, in all probability, to the richness and dampness of the alluvial soil in which they were planted. The dimensions of the largest tree now in the garden are as follow:—

	Ft.	In.
Circumference at 4 feet above ground, .	14	3½
" 5 " .	14	2
" 6 " .	14	2
Length of bole, ...	13	0
Extreme height of tree, . . .	150	0
Spread of branches, ...	102	0

And the following are the dimensions of a log at present lying in the gardens, cut from one of the trees blown down in the cyclone:—

	Ft.	In.
Length, ...	13	9
Mean breadth, ...	4	3
Mean depth, ...	2	10
Cubic contents, ...	169	2

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To contrast with the above the following are the measurements of the largest log cut in the Honduras up to the year 1830:—

	Ft.	In.
Length, ...	17	0
Breadth, ...	4	9
Depth, ...	5	4
Cubic contents, ...	430	8

IV. *Notice of some rare British Mosses recently collected near Edinburgh.* By Mr John Sadler.

The author gave an account of a muscological excursion which he had recently made in company with Dr White, Mr Charles Howie, and Mr J. Brown, to the Queen's Park, Duddingston, and Craiglockhart, and recorded the rarer species met with. They included *Tortula aloides*, *T. intermedia* (new to the Edinburgh flora), *Grimmia subsquarrosa* (new to the Edinburgh flora), *G. orbicularis* var. *oblonga*, *G. leucophea*, *Schistidium confertum*, and *Orthotrichum anomalum* (*verum*), in the Queen's Park; *Orthotrichum diaphanum*, *Pottia cavifolia*, *P. gracilis*, and *Tortula rigida*, on walls at Duddingston; and *Tortula Mullerii*, *T. intermedia*, *T. papillosa*, *T. rigida*, *T. revoluta*, *Hypnum piliferum* var., *Pottia cavifolia*, and *Dicranum scoparium*, var. *curvatum*, at Craiglockhart. The paper was illustrated by specimens of the different species and varieties referred to.

V. *Notes of an Excursion to the Forest of Fontainbleau.* By Mr George V. R. Hay.

In the beginning of last month (April 1867) the author accompanied a party of Parisian botanists in a botanical excursion to the Forest of Fontainbleau. The party left Paris in the evening, and proceeded to a large cave in the centre of the forest, where they remained for the night. Next day they botanised in the surrounding neighbourhood, and returned to Paris. The author was fortunate in collecting *Hymenophyllum Tunbridgense* in a deep cleft. This fern had not been previously met with in that part of

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France, it being confined in that country to the extreme north-west, as at Brest and near Cherbourg. The party also collected *Asplenium lanceolatum*, which is only found in one place within 40 leagues of Paris. The author concluded by giving a list of the plants collected during the excursion.

Mr A. Craig-Christie exhibited a model of an apparatus for pressing plants, which was so constructed as to form a sort of box for holding drying paper during travelling, and capable of being afterwards converted into a series of boards for pressing plants.

M. Vilmorin, Paris, sent for the Museum specimens of the cones of *Pinus Massoniana*, *P. Koraiensis*, *P. canariensis*, *P. sylvestris* var. *argentea*, *Abies bicolor*, *A. polita*, *A. orientalis*, *A. obovata*, *Sequoia sempervirens*, *S. gigantea.*

Dr Post, Beyrout, sent a collection of 450 dried plants from Palestine.

Sir Walter C. Trevelyan presented a large collection of British, continental, and Australian dried plants.

Mr William Craig presented fresh specimens of *Botrychium Lunaria* which he had recently collected in Lanarkshire. The plants were of large size.

Mr M'Nab placed on the table a collection of interesting growing plants, including a white-flowered sweet-scented *Ixora* from Java; a large flowered *Primula* from Japan; some curious Australian *Rubi;* a flowering specimen of *Neotinia intacta* from Ireland, &c.

Mr M'Nab laid before the meeting a tuft of the Californian bunch grass, raised from seed sent home during 1865 by Mr Robert Brown, the collector to the British Columbia Botanical Association. This grass was planted out during the spring of 1866; it now averages 3 feet 9 inches in height, surpassing from the beginning of tho season all other grasses in cultivation. While this grass is tender it will prove a great acquisition for spring feeding. It is perfectly hardy, and suitable for any climate. Owing to the tendency to form large compact hassocks, it should be grown alone. It seeds freely, and is easily increased by division of the roots.

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13*th June* 1867.—WILLIAM GORRIE, Esq., Vice-President, in the Chair.

The following Gentlemen were elected as Fellows of the Society:—

As a Non-Resident Fellow.

JAMES LILBURNE, M.D., R.N., Sheerness.

As Foreign and Corresponding Members.

M. RENÉ DU PARQUET, Paris.
M. WILHELM PHILIPP SCHIMPER, Strasbourg.

The following Donations to the Library were laid on the table:—

Proceedings of the Alloa Society of Natural Science and Archæology for 1866. 8vo.—From the Society.

Transactions of the Pharmaceutical Society, London, Nos. 95, 96. 8vo.—From the Society.

Verhandlungen des Naturhistorischen Vereines der Preussischen Rheinlande und Westphalens. Hälfte 1, 2, 1866. 8vo.—From Dr Martius.

Bericht uber die Thatigkeit der bayerischen Gartenbaugesellschaft, 1865-66.—From Dr Martius.

Mémoires de la Société Impériale des Sciences Naturelles de Cherbourg. Tom. 11–12.—From the Society.

The Secretary read a letter from the Botanical Society of France, announcing an International Botanical Congress in Paris from 16th to 23d August 1867, and inviting the members of the Society to be present. Various important matters are to be brought before the notice of this Congress; among others, the effect of the constitution of the soil on the distribution of vegetable species, and of the necessity of establishing a botanical code, having for its object to regulate the different disputed questions of nomenclature, synonymy, and priority. The meetings are to be held in the rooms of the Botanical Society (Rue de Grenelle, Saint Germain 84, Paris.)

The following Communications were read:—

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I. *On the Arctic Cladoniæ.* By W. Lauder Lindsay, M.D., F.R.S.E., F.L.S.

The term *Arctic* applies strictly to those portions of the great continents of Europe, Asia, and America, and to those islands, which are situated within or northwards of the *Arctic Circle*. Such are—

I. In *Europe.*—Norway: The greater part of Nordland, Finmark, the Lofoden and other islands. Sweden: Tornea, Lulea, and other northern districts (North Bothnia). Russia: Lapland, part of the Samoyed country. The Spitzbergen and Nova Zembla groups of islands.

II. In *Asia.*—Siberia—its northern extremes, including the eastern portion of the Samoyed country. The New Siberia group of islands.

III. In *America.*—Greenland, whose character as a *peninsula* or *island* has yet to be determined. The northern extremes of the Russian and British territories. All the Arctic or Polar Islands proper.

These regions include—especially in Northern Russia, both European and Asiatic—vast level, generally treeless, barren tracts of country, variously described by travellers as "deserts," "wastes," "steppes," "tundras," or "terræ damnatæ," whose vegetation is frequently exclusively lichenose—sometimes, indeed, consisting of a single species—the cosmopolitan *Cladonia rangiferina.**

But a climate, vegetation, and soil which are at least sub-arctic, are to be met with in certain portions of each of the three great northern continents considerably to the south of the arctic circle, generally as far south as the parallel of latitude 60° N., and occasionally even below 50° N. Between the arctic circle and 60° N. we find in America, the southern portions of Greenland, the northern portions of the Hudson's Bay territories and the bulk of the Russian American possessions; in Europe—Iceland, Faroe, Central Norway and Sweden, Finland, and a great portion of Northern Russia are included; while in Asia we find Southern Siberia. Between 60° and 50° N., in America, occur Labrador,

* Much of these so-called deserts—which can scarcely truthfully be described as *sterile* so long as they bear the useful "Reindeer moss"—is uninhabited; while other portions are frequented only by wandering hordes of Samoyedes. They hunt the reindeer that browse on the pastures of *C. rangiferina*, of which the arctic Siberian and Russian "tundras" so frequently consist.

Compare description of the "Flechten-tundras" of Lapland in my "Contributions to the Lichen-Flora of Northern Europe." Journal of Linn. Soc., Botany, vol. ix. p. 403.

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Rupert's Land, and a portion of the Russian territory; while south of 50° are to be found Newfoundland and New Brunswick, and other outlying peninsulas or islands of the British possessions. Within the same parallels in Asia occur the Kamschatka peninsula, and the Aleutian Islands.

Inasmuch, then, as arctic and sub-arctic lichens occur far to the south of the arctic circle in certain parts of the continents of America, Europe, and Asia, I have included in the following examination, along with the *Arctic Cladoniæ* proper, those which occur in such countries or islands as Iceland, Faroe, central or alpine Norway, the Hudson's Bay and Russian territories, Greenland, Labrador, and Newfoundland.

My enumeration is based on—

I. The contents of the Hookerian Herbarium, Kew, which contains suites of the lichens collected during the exploring expeditions of Parry, Beechey, Ross, Richardson, and other arctic travellers.

II. The contents of other public herbaria, *e.g.*, those of the British Museum; of Linnæus in the Linnean Society's Rooms, London; and of the University of Edinburgh, which includes Menzies' collection.

III. The contents of my own herbarium, which includes the lichens collected by myself in Iceland, Faroe, and Norway, as well as some of the lichens of Arctic America, collected by Sir John Richardson.

IV. Certain recent works or papers on Arctic or Scandinavian lichens, or on the Arctic and sub-arctic floras, or on the European *Cladoniæ;* * more especially the works of Th. M. Fries,† and Nylander,‡ which embody the earlier lists of Linnæus, Wahlenberg, Sommerfelt, Vahl, and other travellers in northern regions; Leighton's § and Mitten's ‖ lists of arctic lichens; those given in the works of travel published by Parry,¶ Scoresby, Seemann,** and other arctic explorers,

* "Re-arrangement of the *Cladoniei*, as tested by Hydrate of Potash," by the Rev. W. A. Leighton. Ann. Nat. Hist. Nov. 1866.

† "Lichenes Arctoi." Upsal, 1860.

‡ "Lichenes Scandinaviæ." Helsingfors, 1861.

§ Lichens of Arctic America, collected by Sir John Richardson. Journ. Linn. Soc., Botany, vol. ix. p. 187.

‖ Lichens of Greenland and Arctic America, collected by Dr Walker. Journ. Linn. Soc., Botany, vol. v. p. 87.

¶ Narrative of 1st voyage of Sir Edward Parry, 1819–20; 2d voyage, 1821–3; 3d voyage, 1824–5; 4th voyage, 1827. (List of *Lichens*, by Sir Wm. Hooker, in appendix.)

** "Botany of the voyage of H.M.S. Herald during 1845-51," by Dr Berthold Seemann. London, 1852. *Lichens*, by Professor Churchill Babington, p. 47.

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and my own publications on the Lichen-Flora of northern Europe.*

The majority of the *Cladoniæ* enumerated below are *terricolous*, growing on level, generally treeless wastes—on a soil which is desert and stony, *e.g*, that of the Russian "tundras;" or peaty, turfy, or mossy, *e.g.*, that of heaths or moorlands. Where forests clothe the country, as in sub-arctic America, and in the Scandinavian peninsula, the *Cladoniæ* are both *terricolous*—sometimes exclusively covering the soil, and *corticolous*—usually, or most frequently attaching themselves to dead and rotten tree-trunks. One species, *C. rangiferina*, is pre-eminently social, covering exclusively vast tracts of country; while others grow more generally intermixed with mosses and various arctic phænogams.

Enumeration of the Arctic Cladoniæ.

I.—*Section* Cladina (Nyl.)†

1. *C. rangiferina*, Hffm. Spitzbergen (Ross); Davis' Straits; Greenland (Walker and Mitten); Disco (Lyall, 1854); Walden Island, abundant; Little Table Island (Sir Edward Parry); Hecla Cove; Hammerfest (Parry); Kotzebue Sound (Beechey, Seemann); Norton Sound (Seemann); Franklin's first expedition, in Herb. Kew;‡ Great Slave Lake and Great Bear Lake (Richardson and Leighton); Sitka (Barclay); Kamschatka (Beechey); N-W. America (Dr Scouler); Fort Vancouver (Garry, 1826); Labrador; Newfoundland (Miss Brenton); New Brunswick; Iceland; "found in the greatest profusion and luxuriance in the plains," says Sir Wm. Hooker, in Sir George Mackenzie's "Iceland;" Faroe (Trevelyan); very abundant, especially in Vaagoe (Landt); Thorshavn (J. Stewart, 1855, in Herb. Univ. Edin.); Norway, Jerkin (W. L. L.).

Form *gigantea*, Ach. Great Slave Lake and Great Bear Lake, intermixed with the type (Richardson and Leighton). —Form *cymosa*, Ach. Great Slave Lake and Great Bear Lake, intermixed with the type (Richardson and Leighton). —Form *grandis*, Flk. Norway, Dovrefjeld, abundant; Christiansand (W. L. L.).

In general terms, this species may be said to abound through-

* 1. "List of *Cladoniæ* collected in Iceland, Faroe, and Norway."—Linn. Soc. Journ., Botany, vol. ix. p. 419. 2. "Contributions to the Lichen-Flora of Northern Europe."—*Ibid.* p. 365. 3. "Flora of Iceland."—Edinburgh New Philosophical Journal, July 1861; or Trans. Bot. Society, Edinburgh, vol. vii. p. 114.

† On *Cladonia* and *Cladina*:—"Notulæ Lichenologicæ," by Leighton: Ann. Nat. Hist., Aug. 1866.

‡ Franklin's Narrative, 4to ed., 1823; Botanical Appendix by Sir Wm. Hooker: *Lichens* collected by Sir John Richardson near Fort Enterprise in 1822–3.

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out arctic and sub-arctic countries equally on the heights and plains; terricolous and saxicolous. There would appear, however, to be occasional peculiarities in its distribution. Arctic travellers, for instance, have pointed out that it does not occur on Melville Island, while it is found in the higher latitude of Spitzbergen. Probably no other lichen exhibits the same richness in individuals in an equal area; certainly none other covers with its social masses—excluding all other vegetation, whether cryptogamic or phænogamic—the same extents of country. Fortunately, moreover, for mankind, it luxuriates where and when other nutritious vegetation fails; while it is in the inhospitable arctic regions that it attains its maximum development. In more respects than one, as we shall hereafter see, this lichen takes the place of the grasses of more southern plains and downs; than which it is even of greater economical and political importance. Its forms are numerous and variable; but their characters are much too inconstant and trivial to entitle them to separate nomenclature or definition. A similar remark applies to all the great types into which I have hereafter divided the Arctic Cladoniæ. Hitherto authors have associated *C. rangiferina* with its forms, and *C. sylvatica* with its forms—and most properly, I think—under a single type—*C. rangiferina;* and all the remarks made in this paper in regard to the economical value or applications of the one must be held to include and apply to the other.

2. *C. sylvatica*, Hffm. Kotzebue and Norton Sounds (Seemann); Great Slave Lake and Great Bear Lake (Richardson and Leighton); Iceland, very sparingly about Reykjavik (W. L. L.); Norway, Dovrefjeld, in fruit; Haalangenfjeld; Christiansand (W. L. L.); Sweden, Upsal.

   Form *alpestris*, Ach. Great Slave Lake and Great Bear Lake (Richardson and Leighton); Norway, Dovrefjeld, common; Christiansand (W. L. L.), associated with type. This form is ranked as a separate species in Rabenhorst's "Cladoniæ Europeæ."—Form *pumila*, Ach. Great Slave Lake and Great Bear Lake (Richardson and Leighton).

The distribution of this species, or, as I regard it, form of *C. rangiferina*, is probably co-extensive with that of the latter; but the records of its geographical range are meagre, because it has not hitherto been distinguished or dissociated from *C. rangiferina*. Of the latter, including all the forms referred to it, or to *C. sylvatica*, the Hookerian Herbarium contains a very valuable and complete suite of specimens from all parts of the known world.

3. *C. uncialis*, Hffm. Kotzebue Sound (Beechey—in abundant fruit; Seemann, 1848); Observation Inlet (Scouler); N. W. America (Scouler); Fort Vancouver (Garry, 1826); Franklin's first expedition, in Herb. Kew; Labrador; Newfoundland

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(Miss Brenton); New Brunswick; East Lapland (Fellman); Sweden, Upsal; Iceland, about Reykjavik (W. L. L.); Faroe, (Landt, Trevelyan); Norway, Jerkin, 4595 feet (W. L. L.)

Form *dilacerata*, Leight. Great Slave Lake and Great Bear Lake (Richardson and Leighton).—Form *adunca*, Ach. Norway, Dovrefjeld—common, occasionally spermogoniferous; Haalangenfjeld (W. L. L.); Faroe, about Thorshavn (W. L. L.).—Form *obtusata*, Ach. (*C. turgida*, pr. p. Auct.); Iceland, about Reykjavik; with the type more abundant here than *C. rangiferina.*—Form *turgescens*, Fr. Norway, Dovrefjeld; common, especially spermogoniferous (W. L. L.).

Where it occurs, *C. uncialis* is generally associated with *C. rangiferina* or *C. sylvatica;* than which it has a much less wide distribution, not extending northwards beyond the continents of Europe and America. Usually sterile; terricolous and saxicolous throughout Northern Europe.

4. *C. amaurocræa*, Flk. Great Slave Lake and Great Bear Lake (Richardson and Leighton, Nos. 36–46); Lapland, abundant; Sweden, Upsal (Fries); Scandinavian alps, plentiful, and in fruit; common also in the woods.

Form *dicræa*, Ach. Norway, Jerkin (W. L. L.).

C. amaurocræa is referred to *C. uncialis* as a variety by Nylander, and most justly, I think.

II.—*Section* Cladonia (Nyl.)

1. *C. pyxidata*, L. Ross' Island (latitude 82° N.); "North Pole," in Herb. Kew; Walden Island (Parry); Little Table Island; Hammerfest; Cape Osborne (Walker and Mitten); Greenland (Fries); Observation Inlet (Scouler); Franklin's first expedition, in Herb. Kew; Fort Vancouver (Garry, 1826); throughout Arctic North America (Richardson, Mühlenbeck); Newfoundland (Cormack); Great Bear Lake (Richardson and Leighton); Siberia-Soongarica (Karelin and Kiriloff, 1840); Sweden (Fries); Iceland, about Reykjavik—deformed, sterile, and very rare (W. L. L.); Faroe, about Thorshavn—rarely fertile, usually deformed (W. L. L.); Norway, Christiansand (W. L. L.).

Form *chlorophæa*, Flk. Norway; Dovrefjeld, and Haalangenfjeld (W. L. L.); Nordland and Central Lapland (Fries).*—Form *cornuta*, Ach. Norway, Dovrefjeld (W. L. L.)—Form *pocillum*, Ach. Spitzbergen; King's Bay and Mitre Cape (Scoresby).†—Form *leptophylla*, Flk.

* Considered a separate species in Rabenhorst's "Cladoniæ Europeæ."

† Rabenhorst apparently elevates this to a separate species, *C. neglecta* (Clad. Europ., p. 8).

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East Lapland (Fellman).—Form *staphylea*, Ach. Great Bear Lake (Richardson and Leighton).

Nearly as widely distributed as *C. rangiferina;* occurring in a much greater variety of forms or conditions, which are mostly quite as undeserving separate nomenclature; never, however, exhibiting the same social aggregations of individuals. Terricolous and corticolous. Equally common in the woods and on the open plains.

2. *C. fimbriata*, Hffm. Franklin's first expedition, in Herb. Kew; Great Bear Lake (Richardson and Leighton); Labrador; Eastern Lapland (Fellman); Sweden, Upsal (Fries).

   Form *conista*, Ach. Occurs associated with type in some of the foregoing localities.

Leighton refers *C. fimbriata*, and very properly, I think, as a variety, to *C. pyxidata.*

3. *C. pityrea*, Ach. Great Bear Lake (Richardson and Leighton). Leighton refers this, and properly, I think, as a form, to *C. pyxidata.*

4. *C. degenerans*, Flk. Great Bear Lake (Richardson and Leighton); Lapland and adjoining regions, abundant; Sweden, Upsal (Fries). Throughout Scandinavia, mostly sub alpine.

   Form *euphorea*, Ach. Great Bear Lake (Richardson and Leighton); Norway; Dovrefjeld, common, spermogoniferous (W. L. L.)—Form *haplotea*, Ach.; *pleolepis*, Ach.; *anomæa*, Ach.; *cladophora*, Leight. Great Bear Lake (Richardson and Leighton).—Form *phyllophora*, Ehrh. Norway, Haalangenfjeld (W. L. L.)

The forms of this variable and puzzling species are terricolous and saxicolous, and mostly occur in woods in Scandinavia.

5. *C. lepidota*, Ach. On twigs, York Factory (Richardson and Leighton); East Lapland (Fellman).

Hitherto regarded, and properly, I think, a mere form or variety of *C. degenerans*, if the latter is entitled to rank as a species.

6. *C. cariosa*, Ach. Great Slave Lake and Great Bear Lake; Fort Franklin (Richardson and Leighton); East Lapland (Fellman); Sweden, Upsal (Fries).

7. *C. botrytes*, Hffm. Lapland; Nordland; Finmark; Onega; Sweden, Upsal (Rabenhorst); Norway, abundant about Christiania (Blytt). Terricolous and corticolous (especially on Coniferæ); common in Scandinavia.

8 *C. gracilis*, Hffm. Spitzbergen; Ross' Island; Walden Island; Low Island; Little Table Island; Greenland, Leively (Walker and Mitten); Franklin's first expedition, in Herb. Kew; Lapland; Kotzebue Sound (Seemann); Lakes Winnipeg and Huron;

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Great Slave Lake and Great Bear Lake (Richardson and Leighton); Upsal (Fries); Faroe, about Thorshavn, abundant (W. L. L.); Norway, Dovrefjeld, to top of Sneehätten; common, both fertile and spermogoniferous (W. L. L.); Hammerfest.

Form *hybrida*, Ach. Kotzebue Sound, fertile (Seemann); Norway, Dovrefjeld, sterile (W. L. L.); widely diffused over cold and temperate northern regions; frequently associated with *C. rangiferina.*—Form *chordalis*, Flk. Norway, Dovrefjeld, to top of Sneehätten; common both in fruit and spermogoniferous (W. L. L.)—Form *macroceras*, Flk. Norway, Haalangenfjeld; common, both fertile and sterile (W. L. L.)

In some of its many and variable forms, *C. gracilis* is nearly as widely distributed as *C. rangiferina* and *C. pyxidata* in arctic and sub-arctic Europe and America. Terricolous, saxicolous, and corticolous; frequently intermixed with moss; apparently prefers the woods.

9. *C. verticillata*, Flk. Greenland; Lapland; Nordland, abundant; Iceland (Fries); common in North America; associated generally, where it occurs, with the preceding, to which it has been hitherto commonly referred as a variety; rarer than *C. gracilis.*

10. *C. cornuta*, L. Great Bear Lake (Richardson and Leighton). Throughout Lapland and the sub-alpine parts of Scandinavia, on barren ground; rarely fertile. Sweden, Upsal (Fries); Norway, Sneehätten, Jerkin (W. L. L.)

Leighton refers this, and probably with justice, to *C. gracilis* as a *variety*—a rank to which, however, I do not think the cornute sterile forms or conditions of this or other Cladoniæ entitled.

11. *C. cervicornis*, Ach. Franklin's first expedition, in Herb. Kew; Greenland; Lapland; Nordland; Iceland (Steenstrup); Faroe, about Thorshavn the most-plentiful form of Cladonia (W. L. L.); Norway, Christiansand (W. L. L.); Christiania in Herb. Leighton; Göteborg, Sweden, in Herb. Leighton. Common in Northern Europe and America (rare in Scandinavia, according to Nylander); more alpine than *C. verticillata.*

12. *C. furcata*, Hffm. Spitzbergen, King's Bay and Mitre Cape (Scoresby); Greenland; Great Bear Lake (Richardson and Leighton); Franklin's first expedition, in Herb. Kew; Faroe, about Thorshavn (W. L. L.); Norway, Christiansand (W. L. L.); Sweden, Upsal.

Form *racemosa*, Flk. N-W. America (Scouler and Douglas); Faroe, about Thorshavn (W. L. L.); Norway, Haalangenfjeld (W. L. L.); in the sylvan districts of Southern

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Scandinavia.—Form *recurva*, Hffm. Great Bear Lake (Richardson and Leighton).—Form *cymosa*, Flk. Faroe, about Thorshavn (W. L. L.)—Form *subulata*, L. In open barren parts of Northern Scandinavia.

In some of its numerous forms, *C. furcata* occurs throughout Northern Europe; but it gradually disappears as we proceed towards the more arctic regions, where it is comparatively rare. Terricolous; generally occurs in woods or on heaths.

13. *C. crispata*, Ach. Great Slave and Great Bear Lakes (Richardson and Leighton); East Lapland (Fellman).

A variety of the preceding, according to Leighton, with whom in this respect I quite agree.

14. *C. squamosa*, Hffm. Spitzbergen (Parry), N-W; America (Scouler, sub nom. *Scyphophorus sparassus*, Ach.); Fort Vancouver (Garry); Russian America (1837); Finland; Upsal.

15. *C. cornucopioides*, L. (including *Lichen cocciferus*, L. E. Bot. 2C51) Spitzbergen (Parry); "North Polar Regions" (Parry); arctic coast between Cape Barrow and the Mackenzie River (Capt. Pullen, Aug. 1849); Franklin's first expedition, in Herb. Kew; Fort Vancouver (Garry); Kotzebue Sound, very fine and fertile (Seemann); N-W. America (Scouler); Davis' Straits; Chamisso Island (Seemann, 1849); Hammerfest; Lapland; Labrador (Breutel); Newfoundland (Miss Brenton); Great Bear Lake (Richardson and Leighton); Sweden, Upsal; Norway, Christiansand, Haalengenfjeld, Dovrefjeld (W. L. L.); Faroe, about Thorshavn (W. L. L.); Iceland, about Reykjavik (W. L. L.)

Form *extensa*, Hffm. Iceland, about Reykjavik; Faroe, about Thorshavn; Norway, Dovrefjeld and Haalangenfjeld (W. L. L.) Of this form Rabenhorst makes a separate species in his "Cladoniæ Europeæ."—Form *asotea*, Flk. Occurs occasionally with the type or with form *extensa* in some of the foregoing localities.

A thoroughly arctic species; of wide distribution, moreover, in northern countries. Terricolous and saxicolous; occurring equally in woods and on the alps.

16. *C. bellidiflora*, Ach. Greenland, Frederikshaab (Walker and Mitten); Lapland, abundant; Hammerfest (Parry); Newfoundland (Miss Brenton); Norway, Sneehätten—top—7620 feet (W. L. L.)

Less widely distributed and less variable than *C. cornucopioides*; common in the colder parts of Scandinavia; terricolous and saxicolous. An old author cites this as "an instance, among many others, of the greater beauty and vigour of this tribe of plants,

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whether species or individuals, in proportion to the cold and severity of the climate to which they are exposed." Such statements are frequent among the earlier lichenologists. But they are not altogether true; for as regards the *Cladoniæ*, *C. bellidiflora* appears to be surpassed, in beauty at least, by a Brazilian (though montane) species, *C. sanguinea*, which is characterised by Nylander as "*Decus insigne vegetationis lichenosæ*" (Synopsis, p. 219).

17. *C. deformis*, L. Spitzbergen; Greenland, Port Kennedy (Walker and Mitten); Great Bear Lake (Richardson and Leighton); Kotzebue Sound, on rotten wood, in abundant fruit (Seemann); Franklin's first expedition, in Herb. Kew; Kamschatka (Beechey); Davis' Straits; Labrador; Lapland; Newfoundland (Cormack, Miss Brenton); Norway, Christiansand, Sneehätten (top), Dovrefjeld, and Haalangenfjeld, common (W. L. L.)

Nearly as arctic and as widely distributed in northern regions as *C. cornucopioides*; rarely in fruit; terricolous.

18. *C. digitata*, L. Kotzebue Sound, in Herb. Leighton; Hammerfest (Parry); Murray Bay, North America (Shepherd, 1829); Franklin's first expedition, in Herb. Kew; Eastern Lapland (Fellman); Sweden, Upsal.

19. *C. macilenta*, Ehrh. Central Lapland; Nordland. Common in Northern Europe; but mostly dwarf, abortive, or degenerate; terricolous, saxicolous, and corticolous.

Form *polydactyla*, Flk. Norway, Jerkin (W. L. L.). This form Leighton refers to *C. digitata;* and it is probably partly referable also to *C. Flörkeana;* while Rabenhorst, in his "Cladoniæ Europeæ," gives it rank as a separate species. But the assignation of so trivial a condition is wholly unimportant, when *C. digitata*, *C. macilenta*, and *C. Flörkeana* themselves have, I think, no good title to be ranked as autonomous.

20. *C. Flörkeana*, Fr. (*C. macilenta*, Auct. pr. p.) Nordland and Lapland; sub-alpine; not abundant.

Much most unnecessary criticism has been bestowed on the supposed distinction between this and the preceding; whereas both of them ought properly to be referred to a more comprehensive type.

21. *C. alcicornis*, Lightf. Walden Island and Little Table Island (Parry).

22. *C. endiviæfolia*, Fr. Observation Inlet (Scouler).

23. *C. ecmocyna*, Ach. Greenland; Siberia; Eastern Lapland (Fellman).

24. *C. decorticata*, Fr. Finland, Dagerö (Coemans); Sweden, Upsal.

25. *C. cenotea*, Ach. Norway, (W. L. L.); Sweden, Upsal.

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26. *C. carneola*, Fr. Onega Lake, Russia (Kullhem); Sweden, Upsal (Fries).
27. *C. turgida*, Ehrh. Eastern Lapland (Fellman).
28. *C. delicata*, Flk. Smôland, Femsjô (Fries).
29. *C. pleurota*, Flk. Norway, Dovrefjeld, (W. L. L.)

The remaining species are Scandinavian and Northern (mostly Swedish); but scarcely Arctic in their distribution.

30. *C. pungens*, Ach., which has been, for the most part, hitherto referred to *C. furcata*, as a variety.
31. *C. cyanipes*, Smft., which is a variety of *C. carneola*, according to Leighton.
32. *C. carneo-pallida*, Ach.
33. *C. cæspiticia*, Flk.
34. *C. straminea*, Smft.
35. *C. coralloidea*, Ach.

III.—*Section* PYCNOTHELIA.

1. *P. Papillaria*, Ehrh. Smôland, Femsjô (Fries).

IV.—*Genus* THAMNOLIA.

1. *T. vermicularis*, Ach. Melville Island (Parry); Spitzbergen; Greenland; Beechy Island (Lyall, 1854); Low Island (Parry); Franklin's first expedition, in Herb. Kew; Mackenzie River; Great Bear Lake (Richardson and Leighton); Iceland (Vahl). Alps throughout Scandinavia.
   Form *taurica*, Ach. "British North America," in Herb. Kew; Mackenzie River; Great Bear Lake (Richardson and Leighton).

A thoroughly arctic and alpine lichen of very wide distribution. Terricolous, generally growing on mossy or lichen-covered ground; frequently intermixed with such *Cladoniæ* as *C. amaurocræa* and *gracilis*, as well as with species of *Cetraria* (*C. islandica*), *Platysma* (*P. nivale*), or *Alectoria* (*A. divergens*).

In many respects the genus *Thamnolia* differs from *Cladonia*; but its habit and distribution are those of the arctic and alpine *Cladoniæ*, and it is associated with the genus *Cladonia* by authors so recent and so competent as Th. Fries (p. 161), and Mudd (p. 34).

According to the view adopted of the distinction between *species* and *varieties*, these arctic Cladoniæ (genera *Cladina* and *Cladonia*) may be classified as either thirty-nine, or seven, species.* My own opinion is that the majority, at least, may be with propriety arranged

* My views on the relation of varieties and species in the genus Cladonia are partly expounded in my "Memoir on the Spermogones of the Higher Lichens," Trans. Royal Soc. Edin., vol. xxii. p. 154; and "Observations on New Zealand Lichens," Trans. Linn. Soc., vol. xxv. p. 531.

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under the seven following largely or widely distributed and variable types :—

1. *C. pyxidata*, which is by far the most comprehensive, including such pseudo-species as *degenerans*, *coralloidea*, *cariosa*, *pityrea*, *cenotea*, *carneola*, *carneo-pallida*, *cyanipes*, *cornuta*, *fimbriata*, *botrytes*.
2. *C. cornucopioides*—which is second in comprehensiveness and extent of distribution only to *C. pyxidata*—includes *pleurota*, *Flörkeana*, *macilenta*, *digitata*, *deformis*, *bellidiflora*.

The only distinction between the groups respectively represented by *pyxidata* and *cornucopioides* is the different colour of the apothecia,—a character which is not permanent,—inasmuch as the erythrocarpous apothecia become phæocarpous under a variety of circumstances, natural or artificial.* The distinction, though thus not a sound scientific one, is undoubtedly, however, convenient as subdividing a group of variable plants, otherwise of undue size.

3. *C. gracilis* includes *ecmocyna*, *verticillata*, *cornuta* pr. p., *cervicornis*, pr. p.
4. *C. furcata* includes *crispata*, *pungens*.

But this species appears to pass, on the one hand, into *gracilis*, and, on the other, into *rangiferina*.†

5. *C. rangiferina* includes *sylvatica*, which I cannot consider separable from the type, notwithstanding the recent and strong opinions of Nylander and Leighton to the contrary.
6. *C. uncialis* includes *amaurocræa*.
7. *C. squamosa* includes *cæspiticia* and *delicata*.

I believe it to be much more convenient for the student, as well as more consonant with the principles of philosophical classification, to arrange or group the dubious and difficult species of which the arctic *Cladoniæ* are composed under or around specific *types*,—*aggregate*, or *collective*, or *representative*, *species* (or by whatever name it may ultimately prove desirable to designate such aggregates). Under such an arrangement there is, doubtless, sometimes great difficulty in finding a suitable place for such Cladoniæ as *endiviæfolia*, *alcicornis*, or *cervicornis;* but there is at least equal difficulty in considering them separate species. If they cannot be satisfactorily referred to any of the foregoing or other comprehensive specific types, it is better to arrange them provisionally

* In my "Popular History of British Lichens" (1856), p. 268, I pointed this out in regard to *C. bellidiflora*, in which simple steeping in water, or excess of moisture, effects the transformation.

† *C. rangiferina*, in Linnæus' Herbarium in the Linnean Society's Library, is, I found, partly *C. furcata*.

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as anomalous in position than, as at present, to give them equal rank with *C. pyxidata*, *C. rangiferina*, and other more distinct forms. Many of the Cladoniæ develope, under certain circumstances, their horizontal foliose thallus rather than their podetia; and I am inclined to look on such Cladoniæ as *endiviæfolia*, *alcicornis*, and *cervicornis* as mere conditions of this kind, referable not uniformly to the same, but sometimes to different, types. More particularly and frequently is this the case with *cervicornis*, which I believe to be a condition sometimes of forms of the *pyxidata*, sometimes of the *gracilis*, group.

In the foregoing enumeration I have, however, preferred to give the nomenclature and arrangement of Mudd, Nylander, and Leighton, simply as being the most recent and most familiar in this country. I am not, however, to be held thereby as endorsing or approving it; on the contrary, I protest against both the principles and practice of classification and nomenclature, which characterise the modern school of lichenographers, whether as represented in this country or in its birthplace—the Continent, and whether as applied to the Cladoniæ in particular, or Lichen-groups or genera in general. Leighton characterises the Cladoniæ as "the crux of lichenologists;" and the earlier lichenologist and long recognised authority on this group, Flörke, in his "De Cladoniis *difficillimo Lichenum genere* commentatio nova,"* assigns to them an epithet, to which all lichenographers will agree they are fairly entitled. That they are most difficult of study cannot be questioned; † and there can be equally little doubt that this difficulty results from their infinite variability. Nevertheless, they are extremely common in all parts of Europe; and they admit of examination and determination without the necessity for elaborate microscopic investigation, for their spores and spermatia are essentially the same throughout the genus. Hence they have attracted great attention from lichenographers in all parts of Europe, and have been made the subject of several elaborate monographs. The principal and most recent are those of Leighton,‡ Mudd,§ Coemans,|| Anzi,¶ and Rabenhorst; ** while the earlier include

* Rostoc, 1828.

† Sir Jas. Ed. Smith remarks—"To determine the *species* among the cup-bearing lichens, is one of the most difficult problems in botany." Engl. Bot., 2d ed., 1844, vol. xi. p. 95.

‡ "Re-arrangement of the Cladoniei, as tested by Hydrate of Potash." Ann. Nat. Hist., Nov. 1866.

§ "Monograph of British Cladoniæ;" Cambridge, 1865.

|| "Cladoniæ Belgicæ;" and "Cladoniæ Acharianæ," by the Abbé Eugène Coemans; the latter being an examination of the Cladoniæ of Acharius contained in the Museum of the University of Helsingfors: Ann. Nat. Hist., Oct. 1866, p. 306 (in "Notulæ Lichenologicæ," by Leighton).

¶ "Cladoniæ Cisalpinæ."

** "Cladoniæ Europeæ;" Dresden, 1860.

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those of Hampe,* Flörke, and Dufour.† It is only in certain senses, I believe, that these monographs—some of which exhibit immense research, and are monuments of the industry, critical acumen, and power of minute analysis of their respective authors ‡—can be considered as of advantage to the student—as simplifying to him the knowledge of a most difficult group of plants. I believe their chief value to be their presenting, in a form easily examined, a contribution to our materials for judging of the variations of species. In certain other senses, however, I am forced to regard them as not only useless, but obstructive. What Quinctilian says of style may with some truth be applied to modern "systems" of lichenology—to the current classification and nomenclature of the *Cladoniæ*. "Obstat quicquid non adjuvat." So far from assisting the student, they present to him a formidable accumulation of synonyms, attempts to unravel and harmonise, to correlate or co-ordinate, which only render "confusion worse confounded;" there is an endless multiplication of Latin and Greek terms for mere conditions—for distinctions of character, which are either minute and obscure, or inconstant, and which are thus more or less trivial. Such classifications err, and err greatly, I think, in the direction of excessive, unnecessary, and even mischievous elaborateness, in the extreme multiplicity of names and divisions, which cannot fail to perplex and repel the student. The essence or foundation of the error appears to be the futile endeavour to define variations that are infinite and indefinable—to outdo or improve upon nature by creating limits and distinctions, where she establishes none! In this sense I hold that such classifications are the reverse of improvements upon the older arrangements of those fathers of lichenology, Hoffmann, Acharius, Fries the elder, and Schærer. I leave, however, this subject for the present, as I propose devoting a separate essay to a criticism on the "Modern Classification and Nomenclature of British Lichens," in which will necessarily fall to be discussed, *ad longum*, the value of the "characters" on which the definitions of species and their subdivisions are founded.

I have found it necessary, for the sake of uniformity, and in order to avoid the inextricable confusion to which an opposite procedure would have led, to record all the subdivisions of species as mere *forms*. No two authors agree as to the distinc-

* Section on Cladoniæ in the "Prodromus Floræ Hercyniæ," by E. Hampe of Blankenburg, apothecary. On the Hartz Cladoniæ (Review), Ann. des Sciences Naturelles (Paris), vol. ix. p. 243. "Ueber die Cladonien der Flora Hercyniæ" (Review) in "Linnæa," vol. ii. 1837.

† "Révision des genres *Cladonia*," &c.; Brussels, 1818.

‡ The recent monographs of Leighton and Mudd, including Leighton's nomenclature of the Cladoniæ of Arctic America, may be held to exhibit the acmé of critical determination and minute elaboration.

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tions between *varieties*, *subvarieties*, and *forms*, *states*, or *conditions;* what is the variety of one becomes the subvariety or form of another, and *vice versa.** The "characters" on which they are founded are inconstant and trivial for the most part; and the distinctions are thus, I think, generally unnecessary. Considering them as mere incumbrances to study, as useless exhibitions of hypercritical research, I would retain few, if any, of the distinctions in question; nor would I deem it necessary, where I did preserve them, to adhibit separate Latin or Greek designations. Especially useless are the subdivisions or designations known as *vulgaris*, *simplex*, *cornuta*, *turgescens*, *fimbriata*, *polydactyla*, *polycephala*, *syncephala*, *monstrosa*, *subulata*, *tubæformis*, *phyllocephala*, *foliosa*, *polyphylla*, *spadicea*, *abortiva*, *epiphylla*, *infuscata*, *varia*, *isidiosa*, *radiata*, *tortuosa*, *denticulata*, *megaphyllina*, *myriocarpa*, *prolifera*, *ramosa*, *crassiuscula*, *polycarpa*, *scyphifera*, *squamulosa*, *major*, *tenuis*, or others which refer to conditions obviously inconstant and unimportant.†

Whether the Arctic Cladoniæ are to be regarded as consisting of thirty-nine, or seven, species, it is quite certain that their importance to man cannot be estimated by their mere numerical relations. One species at least, *C. rangiferina*, is not only superior in economical and even political importance to the better known "Orchella weed," but it is in this respect quite on a footing with the valuable grain-stuffs, timber-trees, and other phænogams of more favoured regions. The economical value and applications of the Arctic Cladoniæ may be appropriately considered under the following heads :—

I. As Fodder or Forage to Animals—domesticated or wild, *e.g.*, the reindeer and caribou of the European, Asiatic, and American continents; cattle and swine, &c.

II. As an Ingredient of Man's Food.

III. As Medicines, or ingredients thereof, in virtue of their starchy or bitter principles, *e.g.*, demulcents; tonics; astringents; febrifuges; emetics.

IV. In the Arts, *e.g.*, perfumery; dyeing.

I. Incomparably the most important of all the Arctic Cladoniæ is the "reindeer moss,"‡ *C. rangiferina*, in relation especially to its use as winter forage for the reindeer. In the arctic parts of Scandinavia and Russia, the reindeer are in great measure dependent—at least during winter—on this lichen, which is luxuriant when and where other nutritious vegetation fails. On these

* The confusion of species, varieties, and forms by the most eminent authorities is well illustrated in the Kew Herbarium; and to a correspondingly minor extent in other public Lichen-Herbaria.

† These include, *e.g.*, large and small, tall and dwarfed, forms; laxly and sparingly branched states, or the reverse; normal or deformed conditions; plants bearing apothecia alone, or spermogones alone, or neither; cornute, fimbriate, turgid, lacerate, or squamulose, forms, and so forth—practically *ad infinitum.*

‡ Known also as the "Cow Moss," "White Moss," "Caribou Moss."

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reindeer depend for subsistence in great measure the nomadic inhabitants, who follow these animals in their seasonal migrations in search of "fresh fields and pastures new." Were it not for the presence of reindeer, much of the arctic region of Europe and Asia could scarcely be inhabited; and were it not for the abundance of "reindeer moss," this useful animal could scarcely exist in these latitudes. So that it is no great stretch of imagination to regard the *C. rangiferina* as the cause of much of at least Arctic Europe and Asia being inhabited—and as supplying to its inhabitants the place very much of the potato in Ireland, or the grain crops of temperate Europe.

It would appear that the arctic parts of *Russia*, its northern "steppes" or "tundras," are more fertile in "reindeer moss" than the corresponding parts of *Scandinavia*. The instinct or the exigencies of the Scandinavian reindeer lead them from time to time to transgress the political boundary line between Scandinavia and Russia, and to invade the lichen-pastures of the latter country. The poor inhabitants naturally follow the migrations of the animals on which they virtually depend for subsistence. But the lichen-tundras, the reindeer-moss-pastures, are quite as important to the Lapland (Russian) reindeer and to the Russian Laps; whence it follows that there is a frequent collision between the reindeer herds and their possessors belonging to and representing the two great northern nationalities. This transgression of the political boundary has formed a frequent subject of keen diplomatic discussion between these northern rival powers; and restrictions or prohibitions have been over and over again framed, and as often withdrawn on retaliation being threatened. The subject has promised more than once to become a *casus belli;* but actual war has happily been averted—apparently, however, only because it happens that if *Russia* can offer the best lichen-pastures to the Scandinavian reindeer, Bothnia (*Sweden*) offers the best fishing ground to the Lap fisherman. "Vix alius tanti momenti lichen adest in toto terrarum orbe!" exclaims the distinguished Swedish lichenographer, Fries the younger,* and with justice.

C. rangiferina is a perfect cosmopolite—flourishing in all climates and countries. In arctic regions, however, most fortunately, it attains its maximum size—frequently 1 foot high—while in England it rarely exceeds 6 inches. Fortunately, also, it is social or gregarious, and covers vast tracts of open or forest†

* "Lichenes Arctoi;" Upsal, 1860, p. 159. Compare also Mitford's "Norway," 1842, p. 8; or Murray's "Handbook for Northern Europe" (Scandinavia), 1849, p. 205 (in reference to the habits of the Laps on the Namsen River, Norway).

† "I notice," says Forester, of Norway, "that the forests of Scotch fir have the surface of the soil uniformly clothed with the yellow moss, which is the same apparently with the 'reindeer moss,' but which is here called the 'cow moss;' and they gather it for winter fodder." "Norway in 1848–9," by Thos. Forester: London, 1850, p. 392.

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land with its dense masses, which exclude all other vegetation, giving the appearance at a distance of snow-fields. In more senses than one, these are pastures or meadows—quite comparable to the grass prairies or pastures of more southerly and temperate regions. On the destruction of arctic forests* by fire, this is the only plant that replaces the pine or fir; in such localities in a few years it attains its maximum size and beauty.† In all countries *C. rangiferina* affects a soil, which is sterile in higher forms of vegetation; so invariably so, indeed, that in this country it has been considered by keen observers diagnostic of poor soils unfit for tillage.‡

Reindeer browse on *C. rangiferina* apparently only in default of higher vegetation (grasses); but this occurs more or less every winter. The permanent snow covering of the lichen is no barrier to the animal, which readily gets access to its fodder by means of its feet or horns. They browse also on nine or ten other lichens —such as *Alectoria jubata*,§ *ochroleuca*, *divergens*, *Usnea barbata*, *Platysma nivale*, *cucullatum*, and *triste*, *Cetraria islandica*, *Stereocaulon paschale*, and *Ramalina calicaris;* especially in Arctic Scandinavia and Russia, on the first named species. In these countries, *C. rangiferina* appears to be preferred by the reindeer—probably because it is much more abundant—more prolific in individuals—than any of the others, some of which, *e.g.*, *Cetraria islandica*, are probably more nutritious or amyliferous. The use of *C. rangiferina* as fodder has the reputation in Lapland and Iceland of causing the reindeer to become fat, and to yield good milk and butter; but I have met with no mention, in the many works I have consulted on this subject, of the comparative value, in this respect, of the other lichens above enumerated.

The habits of the "Caribou" of Arctic America appear to resemble those of its representative in Europe and Asia, in so far as regards its use of *C. rangiferina* and other lichens as fodder.

* There is a considerable amount of forest-clad land within the Arctic Circle, and reaching to the shores of the Arctic Ocean, *e.g.*, in Finland (European Russia). Mr Campbell, H.M. Consul at Helsingfors, reports (in 1867) to our Government that the *pine* forests, which supply first-class material for ship and house building, extend to 68° N. The tree, however, becomes short, conical, and unfit for building purposes as it approaches the arctic coast. The time required for a tree to attain maturity in these regions is from 250 to 300 years. The *fir* occurs in latitudes 67° N., where, however, it is weak and thin, and scarcely suitable for house building.

† Linnæus, "Flora Lapponica," p. 332.

‡ The late Archibald Gorrie of Annat; Editor of the *North British Agriculturist;* in a paper on "Waste Lands judged by their Vegetation." Of the plant as it occurs in Norway, Williams remarks—"Its habit is to grow on the dry, well-drained spots; while peat moss occupies the swampy localities" (p. 51).

§ Linnæus tells us the Laplanders cut down the trees on which this lichen grows, in order that it may be made accessible to the animal.

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Professor Hind of Toronto writes:—"The most remarkable forms which vegetable life assumes on the Moisie are those of mosses and lichens. Among the latter the 'caribou moss,' as it is termed (*C. rangiferina*), is the most widely distributed, and is probably the most important, as constituting the chief food of the reindeer or 'caribou.' It is, however, remarkable that this lichen was more frequently observed on the gneiss of the Laurentian series than on Labradorite rocks."* A still more recent traveller, Major Ross King,† speaks of *C. rangiferina* as well known to the Canadian settler as "white moss," and as the favourite food of the caribou. It is also fond of a kind of pendent lichen,‡ which grows on the trunks of forest trees, says he—probably *Alectoria jubata*, *Usnea barbata*, or *Ramalina calicaris*; and only when neither *C. rangiferina* nor the corticolous lichen in question can be obtained does it devour grass, leaves, buds, young twigs, or bark. Sir John Richardson§ thus describes the habits, in regard to food, of the "barren-ground caribou" of Hearne, and other writers—the "North American reindeer," the *Tarandus rangifer* of Gray—an animal familiar in the Hudson's Bay territories:—"The 'barren-ground caribou,' which resort to the coast of the Arctic Sea in summer, retire in winter to the woods lying between the 63d and 66th degree of latitude, where they feed on the *Usneæ*, *Alectoriæ*, and other lichens, which hang from the trees, and on the long *grass* of the swamps. About the end of April, when the partial melting of the snow has softened the *Cetrariæ*, *Cornicularia*, and *Cenomyces*, which clothe the barren ground like a carpet, they make short excursions from the woods, but return to them when the weather is frosty. . . . This journey takes place after the snow has fallen, and they scrape it away with their *feet* to procure the lichens, which are then tender and pulpy, being preserved moist and unfrozen by the heat still remaining in the earth. . . . The lichens, on which the caribou principally feed whilst on the barren grounds, are the *Cornicularia tristis*, *divergens*, and *ochroleuca*; the *Cetraria nivalis*, *cucullata*, and *islandica*; and the *Cenomyce rangiferina*."

In reference to the dentition of the young deer, my friend Andrew Murray, F.L.S., remarks, "Instead of being worn flat on the crown or somewhat inwards, as is the case with other ruminant animals, the front of the central teeth are worn down obliquely outwards. This arises most certainly, not from nipping *Usneas* hanging from the trees or from cropping grass like a sheep, but

* "An exploration of the Moisie River, Labrador:" Journal of the Royal Geographical Society, vol. xxxiv. (1864), p. 85.

† "The Sportsman and Naturalist in Canada;" London, 1866, p. 83.

‡ He describes the "red deer" of Canada (*Cervus virginianus*) as also feeding partly on this pendent tree-lichen, p. 90.

§ "Fauna Boreali-Americana," pp. 242–3.

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from grubbing up the *Cenomyces* and other lichens growing flat on the surface of the ground—an additional argument in favour of these being their principal food.*

Several wild animals, *e.g.*, stags, deer, and roebuck, in Northern Scandinavia and Russia eat *C rangiferina* with avidity in winter. When hay is scarce, and as a substitute therefor, it is in the same countries diligently collected and stored like hay as winter provender for cattle, goats, sheep, and pigs, which are said to fatten on it and to yield more and richer dung. In West Bothnia (Sweden) the peasants scrape it after rain into heaps with iron rakes; in Carniola there is a similar practice. It is variously preserved for winter use, soaked in or sprinkled with water—cold or hot—mixed or not with salt and minced straw—stowed in casks or otherwise heaped or piled up.

Reindeer moss is one of the few lichens that have been found in a fossil or semi or pseudo-fossil state, and under circumstances leading to the inference that its uses in prehistoric times were similar to its economical applications at the present day. Masses of "reindeer moss" have been found at Schussenried, near the Lake of Constance, Switzerland—associated variously with flint knives on the one hand, and with large numbers of reindeer horns, and with bones of bears, wolves, horse, ox, and other animals on the other—overlaid by beds of loam, tufa (calcareous), and peat.†

II. The Laplanders boil it in broth or milk for their own use, In some parts of Scandinavia (Hessel), and in Iceland (Hjaltalin), the peasants mix it powdered with wheat flour in order to economise the latter in bread-making in times of dearness or scarcity of provisions. Its flour or powder is said to be capable of being fermented with yeast and made into true bread—a statement which certainly requires confirmation. That it forms an occasional ingredient in bread, under certain circumstances, in arctic countries there is every reason to believe. In the Kew Museum of Economic Botany there is exhibited by H. Woodfall Crowe a specimen of bread—in dark brown, flat, round, thick cakes resembling the "black bread" (rye bread) of Germany, or some forms of gingerbread—which is used in Finland (Uleaborg district, Russia) in famine times, and which is said to consist of pine bark and "moss." The moss in question is most probably *C. rangiferina.*‡

* "Contributions to the Natural History of the Hudson Bay Company's Territories." "Edinburgh New Phil. Journal," April 1858, p. 206.

† According to Dr Ferd. Keller, of Zurich.—"Athenæum," Oct. 20, 1866, p. 500.

‡ Several other lichens have been, or are occasionally—generally under exceptional circumstances, such as famines from the failure of grain crops—used in the manufacture of a very coarse, comparatively innutritious form of bread. Such are *Lecanora esculenta* and *L. affinis*, *Cetraria islandica*, *Evernia prunastri*, and *E. furfuracea*. *Vide* my "Popular History of British Lichens," under the heads of these genera and species.

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III. Several of the arctic *Cladoniæ* were at one time much used in *medicine.* In some affections they were supposed to possess the virtues of specifics. They were generally prescribed, however, in such vehicles or media as sugar, syrup, or milk; and it is at least doubtful whether the good effects—where they really existed —were not attributable to these important media. Among the properties or qualities attributed to the *Cladoniæ* were those of—

1. Nutrients—demulcents—diluents; depending, if they existed at all, probably on their lichenine (starch).
2. Tonics—astringents—febrifuges; depending, apparently, on a bitter principle, which in some form pervades all the edible or nutrient lichens (*e.g.*, the "Tripe de Roche" group and the "Iceland moss.")
3. Antilithic—depending, perhaps, on the presence of a considerable amount of potash.

I am not aware of any competent chemical analysis of the *Cladoniæ*, which might lead to the determination whether and to what extent they really do possess starchy or bitter principles or alkalies. Some of the writers on lichens during last century—especially Amoreux, Willemet, and Hoffmann*—made crude qualitative analyses, but their results are, unfortunately, of a kind that renders them of little or no value. The species chiefly experimented on were *C. pyxidata*, *C. coccifera*, and *C. rangiferina.* The aqueous extract is described variously as mucilaginous or resinous—as brownish or greenish—as having an acrid or bitter taste,† resembling that of *Polygonum Hydropiper*—as slightly acrid and astringent, and as having sometimes a heavy disagreeable odour. *C. pyxidata* dried, reduced to powder, and distilled in a glass retort, was said to yield an acid yellow liquid, which effervesced with alkalies; and an empyreumatic oil. Combustion and lixiviation yielded a varying amount of potash, which was supposed to be absent in the case of *C. rangiferina.* The latter lichen, if compressed into pill-shaped masses, and thrown into a furnace, was said to exhibit in combustion a strong colour, though the shade or kind of colour is not added.

Of all the northern *Cladoniæ* used in medicine, the ubiquitous *C. pyxidata* was the most and longest celebrated. It was at one time famed as a sort of specific‡ in pertussis—both sporadic

* Amoreux—"Recherches et Expériences sur les di ers Lichens dont on peut faire usage en Médecine et dans les Arts." Willemet "Lichénographie économique." Hoffmann—"Commentatio de vario Lichenum usu." All apparently prize essays published by the Academy of Sciences at Lyons in 1786.

† *C. rangiferina* has been described as nearly free from this bitterness.

‡ As such it was compared with cinchona bark in agues, and mercury in syphilis; and its properties were said to be essentially those of *Cetraria islandica.*

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and epidemic. Its reputation would appear to have reached this country, where it was at one time occasionally used by the peasantry in the cure of hooping-cough. Dr Willis was the first to recommend it for this affection. He gave it either in the form of powder, in ʒj doses; as decoction or infusion, in teacupfuls; or in syrups. Van Wensel is said to have cured by its means an epidemic of hooping-cough at St Petersburg. C. Bauhinus and Ray first employed it boiled in beer in syphilis; and they were followed by others who commended its antisyphilitic virtues. These and other authors, including J. Dillenius Moguntinus, who devoted a special treatise to its virtues,* lauded its efficacy as a demulcent, tonic, and febrifuge in a variety of other diseases—especially pulmonary † (*e.g.*, phthisis; all forms of catarrhs, including the catarrh of sheep; ‡ hæmoptysis; hysteria). Its infusion was said to be generally emetic.§

C. coccifera appears to have had similar uses. Willemet gave its decoction, sweetened with various syrups, in one or two ounce doses several times a-day in the pertussis of infants—with the result that a cure was effected in twelve to fourteen days. In adults, in doses of three ounces he removed cough in a fortnight. A decoction of extra strength was recommended in *hysteric* cough! Cullen gave it in combination with other remedies in gravel and calculus. Willemet reports *C. fimbriata* as also probably possessing the properties of *pyxidata;* while a form of *C. furcata* (*Lichen spinosus* of Hudson, Lightfoot, and Necker) was reputed to possess similar demulcent and bitter principles to *Cetraria islandica*, for which it was consequently commended as a substitute.

IV. The northern *Cladoniæ* have also been used as *dye stuffs;* but in this respect their value is even more problematical than as medicines. They appear to contain usnic (or usneic) || acid, which with alkalies, such as potash, gives a lemon (greenish-yellow) colour. Though very vivid and beautiful in some species and under certain circumstances, this colour is in no case of such a character as to be valuable as a dye—even had it only to compete with the colours producible from other lichens nearly equally common. The apothecia of the erythrocarpous species yield to alkalies and

* "Dissertatio de *Lichene pyxidato*," Moguntia (Mentz), 1785.

† In Iceland *C. rangiferina* had at one time a reputation in pulmonary diseases (Hjaltalin).

‡ The sheep are simply fed on the lichen.

§ "It is still" (says Berkeley in the "Treasury of Botany, 1866," p. 759), "kept by the herbalists, as a remedy for hooping-cough, though its virtues are probably quite imaginary."

|| Which occurs also in the genera *Usnea* and *Ramalina*.

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even to alcohol or water—boiling or cold—their own beautiful crimson colour, or some modification thereof. But this is not comparable either in quality, durability, or amount, with the crimsons producible by ammoniacal maceration or otherwise from other genera. Amoreux, Willemet, and Hoffmann, made a series of experiments with decoctions and infusions—using a variety of re-agents, such as alum, salts of iron and tin, quicklime, sal-ammoniac, and various alkaline leys—which are not specified as being ammonia, potash, or soda, but were probably sometimes the one, and sometimes the other. The colours producible were very much alike in all the species experimented on, which included *C. rangiferina*, *C. uncialis*, *C. gracilis*, *C. pyxidata*, and *C. coccifera*. Tinctures, decoctions, and infusions, were generally some shade of straw-yellow or greenish-grey. With salts of iron they became, on standing for various periods, shades of ochre—a result probably due simply to the decomposition of the iron salt. In some northern countries (*e.g.*, Iceland) certain species (*e.g.*, *C. rangiferina*, *C. pyxidata*, and *C. coccifera*) were at one time used, according to Hjaltalin, to die yarns various shades of green, yellow, and purple. In these cases the crude fashion of maceration in stale urine—a practice once familiar in Scotland—was resorted to; or simple boiling in water, with or without the addition of mordants, was the process employed. From *C. coccifera* a purple, black, or green dye was obtained, according as the apothecia alone,* or the podetia without the apothecia, or the whole plant, were used, and according to the process of preparation. *C. pyxidata* gave yellow, green, or black; and *C. rangiferina* yellow colours.†

In some other arts one or two of the northern *Cladoniæ* have also been employed. *C. rangiferina*, powdered, formed an ingredient, apparently in virtue simply of its mechanical qualities, of the "Poudre de Chypre,"‡ or "French scent bags," a cosmetic once largely manufactured by perfumers.

The Norwegians stuff the crevices between the logs of their wooden huts with mosses and lichens intermixed—the former con-

* These apothecia, macerated in alkaline ley, were said to yield a permanent purple.

† Of the natural colour of *C. rangiferina* on the Dovrefjeld, Norway, Williams writes, p. 51, "The tints of the reindeer *moss*, or rather *lichen*, which abounds, are in many parts very beautiful, especially where a rounded heap of earth-covered boulders is overgrown with it. . . . . its colours vary from straw colour, through a pale buff, to a bright orange and warm red brown." I have examined and collected the plant on the Dovrefjeld, and have little doubt he is here confounding two or three different genera, *Cladonia*, *Cetraria*, and *Platysma*.

‡ Lindsay's "Popular History of British Lichens" (1856), p. 92. According to the "Treasury of Botany, 1866," this "Poudre" is now a cosmetic wash-powder prepared from the starch of *Arum maculatum*.

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sisting chiefly of *Sphagna*—the latter of *C. rangiferina*, *Usnea barbata*, *Alectoria jubata*, *Evernia prunastri*, and similar abundant filamentous or fruticulose, corticolous or terricolous, species. Among the least questionable of the uses of *C. rangiferina* is its suitability in lieu of heather as a mountain couch to the weary pedestrian. Williams* speaks of it in Norway as "dry and crisp, forming a luxurious mountain couch"—a description which may be considered to be applicable in dry sunny weather or periods of the day; but the plant possesses the attribute of most of the higher lichens, of readily absorbing moisture—so that in wet weather, or during dews, it must be found as spongily damp as the bog *Sphagna*.

It is interesting to notice, in connection with the geographical distribution of the *Cladoniæ*, that, of the arctic or northern forms enumerated in my list, the majority are British; that several are cosmopolite, or of very wide diffusion over the world; and that I collected several of these cosmopolite species in New Zealand.† The non-British species are *C. lepidota*, *botrytes*, *ecmocyna*, *decorticata*, *cenotea*, *carneola*, *turgida*, *cyanipes*, and *straminea*—none of which are types, or aggregate, or representative, species, and none of which have a wide distribution, or are of any economical importance.

II. *Recent Regulations regarding the Forest Department of India.* By Professor Balfour.

Dr Balfour called the attention of the Society to some particulars respecting the selection of candidates for nomination to junior appointments in the Forest Department of India. He stated that the candidates, after passing a preliminary examination in English, arithmetic, algebra, and geometry, were to undergo a regular course of studies and training for three years and a-half in the natural sciences, in the practice and science of forestry, and in those branches of surveying and engineering required for the profession of a forest officer in India. The first, or purely scientific part of this course of training, will take place in Great Britain. For the second part, comprising the in-

* "Through Norway with a Knapsack," by W. Mattieu Williams. London, 1859, p. 51.

† "List of Lichens collected in Otago, N.Z." Trans. Bot. Soc. Edinburgh, vol. viii. p. 351.

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struction in forestry, arrangements are to be made on the Continent in the meantime, until an efficient forest school is established in Great Britain or in India. The studies of candidates during the first or scientific part of their training is to comprise the following subjects:—

1. Mechanical and Natural Philosophy.—The elements of mechanics, hydrostatics, hydraulics, optics, heat, climate, rain-fall, and the first elements of electricity and magnetism.

2. Chemistry.—*Inorganic*—The non-metallic elements and the principal metals. *Organic*—Elements only, with special reference to the chief constituents of the vegetable and animal organism, the chemical principles of the process of nutrition, and of respiration in plants and animals; fermentation, decay, putrefaction, destructive distillation.

3. Botany.—Characters of the principal European natural orders. Ability to describe any common phænogamous plant of ordinary structure systematically and with accuracy from a living specimen. The elementary facts referring to the development and nutrition of plants.

4. Geology.—Elementary portions of descriptive geology.

5. Either the French or the German Language.—Good colloquial knowledge, with the facility to read and translate into English easy passages taken from the works of some classical writer.

Candidates are at liberty to choose the place of study, but they must, before being admitted to the second or practical part of instruction, pass an examination before the Civil Service Commissioners in the branches of science, and in one of the languages enumerated above. Candidates who have taken academical degrees or honours in science and mathematics will, wholly or partially, be excused from the examination of admission, as well as the examination in sciences, and will only be required to furnish proof of a sufficient knowledge of German or French. Candidates who have passed any examination requiring a sufficiently high standard of proficiency will be excused examination in the branches in which they have been previously examined. Her Majesty's Secretary of State for India will determine how far the certificates of candidates may entitle them to exemption, either entire or partial, from examination. It is

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very desirable that candidates should, before proceeding to the Continent for their professional training, devote two months to a practical apprenticeship with an approved wood manager or forester in Scotland. Early spring is the best season of the year for this purpose. A certificate of their having done so will entitle them to a stipend of £20, to be paid in case they pass the science examination. The course of training in forestry abroad will commence on the 1st September 1869, and will be concluded on 1st September 1871, and will be conducted either at Nancy, in France, or at Hanover.

III. *Recent Botanical Intelligence.* By Professor Balfour.

1. *Tendrils of the Cucurbitaceæ.*—Dr Balfour called attention to the various views taken by botanists of the tendrils of the *Cucurbitaceæ*, and particularly noticed the opinions of Chatin, who supposes that these tendrils may be analogous to adventitious or aerial roots.

2. *Sexual Organs of Fungi.*—Dr Balfour referred to a paper which had been recently published by Dr Antoine de Bary, in which the author had clearly demonstrated that, in the lower class of fungi, the sexual organs greatly resemble those of other cryptogamic plants. In the former plants the fertilisation takes place by means of the contents of two different cells coming in contact—the one called *Antheridia*, and the other *Oogonia*, representing the antheridial and archegonial cells in ferns, mosses, &c. Dr Balfour exhibited and explained coloured drawings illustrating the subject.

IV. *On a Supposed New Species of Vellozia, or probably a New Genus in the Order Hæmodoraceæ.* By Professor Balfour.

Dr Balfour stated that he had received from H. Fox Talbot, Esq., Lacock Abbey, Chippenham, the flowers of a plant which he had transmitted to the Royal Botanic Garden last year. It is a native of Natal, and appears to belong to the Nat. Ord. *Hæmodoraceæ.* It has not yet flowered in the Botanic Garden; but the following are some of the characters taken from the plant and from the flowers sent by Mr Talbot:—Stems shortened, triangular, covered with brown scales at the lower part. Leaves with equitant vernation, alternate, distichous, sheathing at the base, lanceolate, about 6 inches long, margins with sharp serratures, apex sometimes split. Flowers solitary, on slender peduncles, about 6 inches long; perianth six-leaved, at first delicate lilac, afterwards becoming greenish-white, dry, and persistent, the green colour appearing particularly in the veins, which become prominent; outer leaves of perianth ovate-oblong, and somewhat acuminated; inner leaves bluntish. Stamens six, with very short filaments; anthers, two-celled, narrow, about five times longer than the filaments, opening longitudinally and laterally. Pistil about the length of the stamens. Ovary inferior (one or three celled), style thick, stigma large, somewhat tongue-shaped, grooved. Ovules oblong, numerous, attached to a central placenta, anatropal.

Vellozias are chiefly natives of Brazil. This plant seems to represent the genus in Africa, and possesses interest on that account. Dr Balfour proposed to call it *Vellozia Talboti*. It may turn out to be a new genus. If so, the name *Talbotia* will be given to it; but the determination of this point must be delayed until the plant flowers at the Botanic Garden.

V. *On the Discovery of Orthotrichum phyllanthum near Edinburgh.* By Mr John Sadler.

Mr Sadler stated that he had recently collected *Orthotrichum phyllanthum* on rocks by the sea at Dalmeny Park, being the first time that this moss had been detected within 30 miles of Edinburgh. In its character it somewhat resembles *O. crispum*. It has not yet been met with bearing fruit in Britain. Specimens of the plant were exhibited.

Mr Alexander Craig Christie exhibited a completed apparatus for drying plants, a model of which he exhibited and explained at the May meeting of the Society.

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Mr P. S. Robertson exhibited specimens of grasses raised from seed sent home by Mr Robert Brown from Vancouver's Island.

Mr Lea Richardson presented specimens of ferns collected in St Helena; and Mr R. F. Johnston presented ferns collected in Australia.

Dr Dickson, Jersey, sent a specimen of the "green rose." Mr F. C. Henderson sent fossil woods from Australia; and Dr Howison presented the fruit of the warted club gourd, &c.

Mr M'Nab placed on the table a collection of interesting herbaceous and other plants, and intimated that two large plants of *Cantua dependens* had been recently presented to the Botanic Garden by Sir A. C. R. Gibson-Maitland of Barnton.

Mr Hanbury presented seeds of *Myroxylon pubescens* from New Grenada.

11th July 1867.—William Gorrie, Esq., Vice-President, in the Chair.

The following Gentlemen were elected Members of the Society:—

Resident Fellows.

John Millar, M.D., F.R.C.S.E.
Robert A. Arnott.

Non-Resident.

Gavin Steel of Carphin.

The following Donations to the Library were laid on the table:—

Transactions of the Pharmaceutical Society, London, Vol. IX., No. 1. 8vo.—From the Society.

Proceedings of the Academy of Natural Science, Philadelphia, for 1866. 8vo.—From the Society.

Zoologische Miscellen, Nos. VIII.–X. Von Georg Ritter von Fraunenfeld. 8vo.—From the Author.

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A Fern Book for Everybody. By M. C. Cooke. 8vo.—From the Author.

The following Donations to the Museum at the Royal Botanic Garden were announced:—

From Dr Aitchison—Dried Pulp of Plums sold in the Punjab bazaars to goldsmiths, to clean and frost silver.

From Mr Samuel Brown per Mr Johnston—Lace Bark, and Fruit and Seeds of Chocolate.

The following Communications were read:—

I. *On the Discovery of* Buxbaumia indusiata *near Aboyne.* By Professor Dickie.

Dr Dickie reported that he, along with Mr John Roy, picked, on 29th June last, ten specimens of this rare moss near Aboyne—being the third time it has been met with in Britain. The plants were growing on rotten timber, on the north slope of the hill of Craigendinnie.

II. *Botanical Intelligence.* By Professor Balfour.

1. *Talbotia elegans.*—Dr Balfour placed on the table a flowering specimen of the plant sent by H. Fox Talbot, Esq., and which was described at last meeting under the name of *Vellozia Talboti.* Dr Balfour thought that, although the plant was very nearly allied to *Vellozia*, yet it possessed certain characters in which it disagreed with that genus. He proposed, therefore, that it should be made a new genus, and in the meantime he would name it in honour of his friend Mr Talbot, and designate it *Talbotia elegans.*

2. *Gases found in Plants.*—Messrs Faivre and Dupré have recently examined the gases found in the mulberry and vine, the parts which contain them, and the changes produced in them by the process of growth and development. They have arrived at the following conclusions:—

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1. The presence of gases in the interior of the root of the stem, and of the branches in the mulberry and vine, is a normal and constant fact. 2. The composition of these gases changes with the epochs of vegetation. 3. During the period of inactivity, carbonic acid is in very small proportion, and is scarcely appreciable. Oxygen is present to the same extent as in atmospheric air. During the phase of activity the contrary takes place, and the changes are more marked in proportion as the vegetation is more energetic; with the progress of vegetation, the proportion of oxygen diminishes. 4. In the roots, during the epoch of vegetation, the quantity of oxygen is not so great, while that of carbonic acid is greater than in the branches examined under the same circumstances. 5. In the branches, as in the roots, there is an inverse relation between the oxygen and the carbonic acid; by adding to the normal oxygen that disengaged under the form of carbonic acid, we obtain a number which is scarcely above the proportion of oxygen in the air. 6. In the mulberry and the vine, injections do not penetrate the pith or the bark, whether in the branches or roots. The ligneous layers are alone permeable to mercury. The more the formation of vessels increases, the easier and more complete are the injections. The injections are fuller in the roots than the branches; they are also more in the branches than in young herbaceous shoots. In the old stems of the mulberry, the central layers cease to be permeable. 7. Microscopic examination proves that the injection specially penetrates the pitted and reticulated vessels, and also the spiral vessels in the young herbaceous shoots. 8. The pitted vessels show distinctly the mercury in the areolæ, as if in so many little pouches formed by thin portions of the wall; the same observations have been made in regard to the reticulated vessels. 9. The contents of the vessels expelled by the mercury are variable. Sometimes gas only is sent out; this is the case in winter and after dry weather. Sometimes the gas is mixed with sap, which is more or less abundant according to the epoch of vegetation and external temperature. These two latter conditions regulate in a certain degree the contents of the vessels. 10. The contents are so variable

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that in plants the root vessels of which contain gases and sap, the stem vessels contain only gases, or inversely. 11. The presence in the vessels of animals of oxygen and carbonic acid mixed with the blood, constitutes one of the best established facts in animal physiology; the presence of the same gases mixed with the sap in the vessels of plants, and the modifications which they there undergo, seem to establish an interesting correspondence between these two kingdoms.

3. *Nature and Structure of the Pod of Cruciferæ.*—In a paper in the "Liverpool Naturalists' Journal," Dr J. Birkbeck Nevins gives what he considers a new explanation of the nature and structure of the pod of the *Cruciferæ*, and attacks botanists for applying the term "spurious" to the replum or dissepiment, which he says is simply saying that it is "a dissepiment which we do not understand." He states that the replum is merely the thin elongated axis of the plant, ending in a point called the stigma, and that the carpels are leaves attached near the apex of the axis, and bending downwards, so as to be fixed slightly to the lower part of this thin axis or replum. In process of time the attachment below gives way, and the leaves separate from below upwards, and finally fall off by an articulation at the upper part of the axis. The view, as regards the axis, is not new. It is that taken by all those who support axile placentation. Some hold that axile placentation occurs in all plants; while others restrict it to certain cases, such as *Primulaceæ*, *Caryophyllaceæ*, &c. Some, who deny axile placentation, believe that in all cases the placenta is formed on the margins of carpels. Those who believe the replum in *Cruciferæ* to be an axile formation, have generally agreed that the leaves arise from the lower part of the replum; but Dr Nevins thinks they arise from the upper part, and are folded downwards. This view is certainly not in accordance with what we see generally in the vegetable kingdom, and we are disposed to doubt its accuracy. At all events, there is nothing new in his statement as to the replum.

As to the use of the term spurious dissepiment, he is perfectly wrong. It does not imply ignorance, as he states. It is a technical term, and simply means that the division is not a true septum, formed by the edges of car-

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pellary leaves, but that it is a phragma formed by the placenta, the folding of carpels, inwards, outwards, or transversely, &c. It is a most correct term as used by botanists. We see a phragma in *Cruciferæ*, in *Datura Stramonium*, where the placenta elongates and forms two additional loculaments in the fruit; in *Linum* and *Astragalus*, where the back of the carpel folds in; in *Oxytropis*, where the ventral part of the carpel turns inwards; in *Cathartocarpus Fistula*, where the inner lining of the legume forms transverse divisions; and in the *Acacias*, *Raphanus*, *Ornithopus*, &c., where the whole walls of the carpel fold in transversely. Some explain this last occurrence by supposing that the carpel is composed of a compound pinnate leaf, and that the phragmata or spurious dissepiments indicate the divisions between each pair of leaflets. Dr Nevins does not follow those who consider axile placentation as general, for he says—" Whilst the seeds are generally developed from the edges of the carpellary leaves, they are produced in crucifers from the edges of the stem itself." But what will Dr Nevin say about some legumes, such as *Carmichœlia*, where, as Endlicher says, " A replum remains after the valves have fallen off?" and Lindley, " The valves separate from the sutures, which remain entire, like the replum of *Cruciferæ?*" In *Schrankia*, also, there are four valves, of which the two lateral ones may very well represent the outer edges of the cruciferous replum. Dr Nevins ought to apply his view to such cases as these also, and thus adopt fully the axile view of placentation.

III. *On the Palm Trees of Old Calabar.* Extracted from the MS. Journals of the late Mr William Grant Mylne. By Mr Sadler.

The *Ata ukot*, wine palm or common mimbo, is apparently an undescribed species of *Raphia*. It yields a very pleasant beverage, which is much appreciated by all classes of people who have the fortune, or rather misfortune, to touch the western shores of Africa. It has been cultivated by the natives for ages for its watery fountain. The trees

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are generally seven years old before they are tapped. At this age they are from 30 to 40 feet in height. The natives ascend the trees and pierce a hole to the centre of the stem immediately below the growing point; a small pipe is then inserted into the hole and led into a vessel which is fixed to the tree. In this way it is drained from time to time, which causes the tree to die, and it is then cut down to make room for others. The mimbo thrives best in damp situations, and such localities are generally chosen for its cultivation; at the same time, I have seen avenues of mimbo trees on high sandy places leading to towns. The people employed to tap the mimbo are Ibibio slaves, who are purchased by kings and chiefs at public slave marts. The Calabarians are not a climbing race. The Ibibios are in practice superior in the art of climbing. The liquid, when taken from the tree, has somewhat the colour of cream, and has a pleasant sweetish taste. This only lasts a few hours, when it becomes tartish. The natives have certain barks which they bruise and mix with the liquid, which becomes intoxicating. It is sold in the public markets; and in the Ibibio country there are mimbo public-houses, similar to our beer-shops. It is used by the missionaries' wives for making bread, being subject to fermentation; the bread made with it is excellent. The young leaves of the plant are split up into threads and made into bags and cloths.

The *Iya*, or bamboo palm, is another species of the same genus (*Raphia*). Its petioles are used for house-building at Calabar and all along the coast. These petioles are generally from 20 to 30 feet long. The fruit is used as an article of food, which is not the case with the last-named species. Many of the trees are from 50 to 60 feet high. In the Uwet country the natives do not cultivate the wine palm, consequently they tap the bamboo; but the wine is strong and harsh and unpleasant, and is very intoxicating. I once saw the King of Uwet as tipsy from its effects as any man under the influence of brandy. The inland kings and chiefs indulge themselves to excess in drinking bamboo wine, and consequently are always in a state of stupidity. The tree is tapped in the same way as the mimbo, at the base of the growing point. In the Qua country, at the foot

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of the Qua mountains, as well as in Calabar, they use the wine of the oil palm (*Elais guineensis*), which is inferior to that of the bamboo, being much harsher and stronger. In this case the trees are tapped about two feet from the ground, and also at the top, in the same way as has already been described. I never saw any of the natives intoxicated by this beverage, but I have no doubt that they can supply ingredients to it for this purpose.

Another species is the *Afia okuk ukot*, or the white rod mimbo. The petioles of this palm are white, while that of the *Ata ukot* are red. Its wine is equal in quality to that of the *Ata ukot.* The scales of the fruit are, however, much thicker than those of that species and of the bamboo.

The *Idim ibom* is perhaps the most important palm of all at Calabar. *Idim* signifies water, and *ibom* great. It occurs on the banks of the main branch of the Calabar river, but confined to the district of Ikorofiong. The quantity of wine which this plant produces is astonishing. An ordinary tree will yield a puncheon of a most delicious beverage, which is deservedly a great favourite with the people. In colour it resembles cream, which is sold in large quantities at the mimbo public-houses. When the tree is once tapped it invariably bleeds itself to death. This is not the case with common mimbo; it can be tapped from time to time till the fluid is exhausted, and then it dies. Such is also the case with the *Idim ibom*, the *Iya* or bamboo, the *Afia okuk ukot*, and the oil palm.

The last of this class of palms, belonging to *Raphia*, met with at Calabar, is the *Iya asiakha nditau*, which produces shoots, or sucklings. The base of the fruit is surrounded by numerous scales similar to those produced at the base of bulbiferous plants; these are called by the natives *nditau.* This palm is not common. Another nearly allied species is plentiful upon the south coast; it sends up numerous shoots, similar to the plantain, covering a great space of ground.

On the south coast a species of date is abundant on the sea shore, but not. inland. The fruit is small, and of an oval shape. In taste the pulp is similar to that of the date of commerce. Its foliage also resembles that of the com-

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mon date, and might easily be mistaken for it were it not for the fruit. A fan palm is plentiful at Citia Camma, but I have not seen the plant, never having been so far south. Captain Kirkwood has two plants raised from seed collected at Citia Camma, where he states it is abundant.

IV. *Notice of two Mosses new to Science*—Hypnum rupestre, *Buchanan White's MS.; and* Hypnum Breadalbanense, *Buchanan White's MS.* By F. BUCHANAN WHITE, M.D. (Plate III. figs. 2 and 3.)

Dr White gave descriptions and exhibited drawings of two species of *Hypnum*, which he had collected in 1865 on Ben Lawers, in Perthshire, and which had been ascertained to be as yet undescribed in any work. The one he proposed to call *Hypnum rupestre*, and the other *H. Breadalbanense.*

Hypnum rupestre, Buchanan White's MS.: stem procumbent, covered with very short villi (paraphyllia), irregularly pinnate; leaves falcato-secund, lanceolate acuminate from a wide base; obscurely 2-nerved, margin plane, and scarcely denticulate.

Hab. Ben Lawers, August 1865.—Fruit unknown.*

REFERENCE TO PLATE III. FIG. 2.

st. Stem showing short villi. *f. l.* Front of leaf. *b. l.* Back of leaf. *ba. l.* Base of leaf. *a. l.* Apex of leaf. *s. l.* Sections of leaf.

Hypnum Breadalbanense, Buchanan White's MS.: stem procumbent or suberect, covered with villi (paraphyllia), vaguely pinnate; leaves secund ovate lanceolate, concave; nerve strong, single, reaching about half-way; margin of the base slightly recurved.

Hab. Breadalbane mountains, Ben Lawers, August 1865. —Fruit not yet found.

A slender species, with pale yellowish green leaves. Margin of the leaf subdenticulate; cells at the narrowed base quadrate.

* *H. rupestre* now appears to me to be rather too closely related to *H. callichroum*; but as Dr Schimper considers that it has claims to distinctness, I think it is as well to leave it as it is.

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Dr Schimper remarks (*in lit.*) that the species to which this most nearly approaches is the European *H. fastigiatum.*

REFERENCE TO PLATE III. FIG. 8.

st. Stem with villi. *l.* Leaf. *ba. l.* Base of leaf. *a. l.* Apex of leaf. *s. l.* Section of leaf.

V. *On a supposed Fungoid Disease affecting the Human Hair.* By JOHN BISHOP, Esq.

As the subject of fungoid growths within or upon the human hair is of considerable interest to botany, as well as to medicine, I desire to contribute the following imperfect notice of a case which has recently come under my own observation:—The patient is a young man, about twenty-six. His general health is very good. In the spring of 1865 he noticed that considerable portions of his beard appeared as if the hairs had been "singed." This was especially noticeable on the right side, along the line from the angle of the lower jaw to within an inch or so of the symphysis. By the middle of summer the beard had resumed its normal appearance. About March 1866 the same symptoms recurred. The right side was again the worse. The hairs were harsh, stubbly, and crooked. They broke off short, and the broken ends were curiously twisted, curled, and shrivelled, like hairs which have been partially burnt. The skin was hyper-sensitive along the line of the jaw. If a few hairs were pulled (not plucked up) the sensation was very peculiar—half pleasurable and half painful. There was also slight heat and itching, which tempted the patient to rub or scratch the part. He fancied that he could feel pimples on the skin, but none could be observed. The skin was clean and healthy-looking. There was a bare place on the right side about $1\frac{1}{2} \times \frac{3}{8}$ inch. This was perhaps caused by the rubbing. A lead lotion was applied, and afterwards one of potassic sulphide. The hairs reached their ordinary length, and resumed a healthy appearance in the summer. Towards the end of March this year a few of the diseased hairs were again noticed. In May a potassic sulphide lotion (gr. v. ad. ℥) was applied, but the number of damaged hairs continued to increase until the beginning of July. Since then the progress of the disease appears to

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have been checked by a wash of bicarbonate of potash, followed by a lotion of bichloride of mercury and nitric ether. The skin appears to be perfectly healthy. There is, however, again the hyper-sensitiveness before-mentioned, and the hairs appear to be fewer than usual on the right side. The beard has to be cut once in four weeks, otherwise the difference in length of right and left side would be quite perceptible. The attack this year is not so severe as on the former occasions. This is shown by the fact that now the peculiarity is not observed until attention is called to it, whilst formerly the disease was at once remarked. If one of the diseased hairs be examined before it breaks it will be found to be bent at a sharp angle, and to be evidently ready to break at the angle, and at two or three other points may be noticed small white knots or specks.* Under the microscope the hair presents a remarkably jointed appearance at each of the specks; and if the speck is large the whole substance of the hair is seen to be split into its component fibres, and a mass of something which appears to be fungus is found to protrude from the centre of the hair. This fungus has evidently broken the continuity of the hair, by rupturing it from within outwards, thus giving rise to the fibrous appearance, and also to the bending and fracturing which are so characteristic. If the end of a broken hair be examined, it will be found to have a brush-like appearance, and the fungoid growth will again be visible. The fungus appears to be of a low type, and to consist of an aggregation of cells, with occasionally sporules and *mycelium* branching amongst the broken fibres of the hair. I am at present attempting to investigate the disease further; and if I obtain any results worthy of attention, I shall be most happy to bring them forward on another occasion. The subject appears to demand investigation, as I have heard recently of two or three cases in which the beard has been affected in a similar way to that here related.

[NOTE.—Subsequent careful examinations have failed to confirm the fungoid character of the disease. The cause of the altered nutrition appears to be at present unknown.]

* As many as eight of these specks have been counted on a hair about 1½ inch in length.

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VI. *Addenda** *to the Cryptogamic Flora of New Zealand.* By W. LAUDER LINDSAY, M.D., F.R.S.E., F.L.S.

I. ALGÆ: Marine.

1. *Rhodymenia lanceolata*, Harv. Dr Hooker (Handbook Fl. N.Z. p. 692) found it in my Otago collection. Omitted in my enumeration of Otago Marine *Algæ* (Transactions Botan. Society, Edinb., vol. viii. p 423).

ALGÆ: Freshwater.

2. *Batrachospermum vagum*, Ag. Also British. According to Berkeley, occurs in various parts of New Zealand; the forms there prevalent being indistinguishable from British ones. One of the most beautiful species of its genus or family. Not mentioned either in the "Flora Novæ Zelandiæ," or the Handbook Fl. N.Z.

II. FUNGI.

3. *Hirneola Auriculæ-Judæ*, Berk. Abundant on the "Kauri Pine" (*Dammara australis*, Lambert) and other forest trees; Kapunga Bush, Coromandel, Auckland Province, Feb. 1862 (W. L. L.).
4. *Aseröe Hookeri*, Berk., var. *miniata*, Berk. (as determined by Currey). Nelson (probably Tarndale district); in Herb. Dr Andrew Sinclair, Auckland, 1862. This *variety* is not recorded in the Handbook Fl. N.Z.; while the *type* is given as a *North* Island fungus only.

I am indebted to my friend M. C. Cooke, of the India Museum, for the following Notanda on *Lichenicolous Micro-Fungi*, the result of a careful microscopical examination of my specimens.

5. *Dothidea Otagensis*, Linds. Parasitic on *Sticta fossulata*, Duf. Saddlehill Bush, Otago, N.Z., Oct. 26, 1861 (W. L. L.).

"On this lichen [the *Sticta*] sent to me for examination by Dr Lindsay, I find a parasite which I presume to be the same as he describes in Trans. Roy. Soc. Ed., vol. xxiv. p. 449, as *Celidium dubium*. I have no hesitation in affirming that it is a decided *fungus*, and a good species of *Dothidea*, Fr. The figs. 51 *b* and 52 represent sections of the agglomerated cells, which in this genus are not true perithecia, the fruit being contained in cells. Carefully examining the external appearance of the different

* *Vide* the author's previous papers on New Zealand *Cryptogams* in the Society's Transactions—Algæ, vol. viii. pp. 283 and 420; Fungi, vol. ix. p. 13.

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clusters on the specimen sent, I found one cluster only with an indication of convex cells; this I isolated, and was successful in meeting with the fruit. The asci are cylindrical, and about ·0625 *mm.** long by ·012 *mm.* wide, containing hyaline, uniseptate spores, of the *Dothidea* type, slightly attenuated towards each extremity, and ·018 *mm.* long. When contained in the ascus the sporidia appeared to have an outer hyaline coat, but of this I could not fully satisfy myself. It should be borne in mind that the fruit is generally long in attaining maturity in this genus after the development of the black spots in which the cells are enclosed. In the foliicolous species the fruit is seldom to be found until the leaves have lain through the winter. Hence in lichenicolous *Dothideæ* we should not be disappointed if we do not at once find fruit in the cells. The clusters in this species, when barren, are not sufficiently decided in Dothideoid character for me to have affirmed it a *Dothidea* in the absence of fruit. This is clearly not the *Dothidea hymenicola*, B. and Br., found on the apothecia of a species of *Sticta* from Central America.

"I think that you cannot maintain this as a *Fungo-Lichen* † any longer, and I have transferred the fragment sent me to my herbarium under the name of *Dothidea dubia;* not that I have any doubt of it, but from a desire not to change the specific name."

6. "The parasite on *Peltigera rufescens*, Hoffm., may be a *Dothidea;* but the very small fragment sent contained no fruit."

7. "On *Cladonia degenerans.* I would not pronounce from the specimens examined. I find no asci, and no fruit save stylospores, which may, or may not, belong to some *Sphæria.*"

Mr M'Nab laid before the meeting a specimen of a *Cratægus* which was raised from seed collected during 1828, by the late Mr Thomas Drummond, in the Rocky Mountain district, during the second land expedition under command of the lamented Captain Franklin, late Sir John. The peculiarity of this tree is that it never flowers before July, and generally about the middle of the month, and during moist seasons flowers have been seen as late as the beginning of August. The tree is now about 20 feet high, having a somewhat pendulous head, and bears black fruit. It was many years before it bloomed, but now it flowers annually.

"* I always employ the French method of measuring by millimètres.—(M. C. C.)

"† I do not think that a genuine *Dothidea*, when in fruit, can well be confounded with any lichen.—(M. C. C.)"

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Mr M'Nab also placed on the table flowering plants of *Goodenia amplexans* and *Selliera radicans*, which were sent to the Botanic Garden last year from Australia by Dr Mueller.

Mr Sadler read a letter from Mr Wm. Robson, dated Tukvar, Darjeeling, 29th May 1867, giving a favourable account of the progress of the cinchona plantations under his charge in that part of India.

Mr Baildon, chemist, exhibited a series of beautiful nature-printed ferns by a new process which he had discovered. The process is to be the subject of a patent; and from its cheapness is likely to be of considerable value as a means of illustrating works.

Dr Mueller, Melbourne, presented a series of twenty different kinds of paper manufactured in Australia from different species of native plants.

Professor Balfour recorded the following new localities for rare plants in Scotland:—*Alyssum calycinum*, St Andrews Links (collected by Mr Alex. Stewart), near Loch Leven (Mr Buchan); *Allium Schœnoprasum*, wall at Hiltly, near Linlithgow (Mr Duncanson); *Lysimachia thyrsiflora*, in the canal near Linlithgow (Professor Liston); *Veronica Beccabunga*, var. *limosa*, near Cullen House, Banff (Mr Wm. Brown); *Diplotaxis muralis*, Prestonpans (Dr Aitchison); *Buxbaumia aphylla*, near Kinloch Rannoch (Dr Buchanan White).

Sir Walter Elliot, Wolfelee, presented to the University Herbarium a large collection of dried Indian plants.

Mr F. C. Henderson presented a collection of dried plants, contained in eight volumes. The collection was prepared by the late Rev. Andrew Kemp, formerly minister at Aberlady, and his brother, and were principally collected about the close of last century.

Mr Jenner sent fresh flowering specimens of *Azalea procumbens*, gathered on Ben Lawers, Perthshire.

The Rev. Mr M'Murtrie exhibited living plants of *Woodsia hyperborea*, *Asplenium germanicum*, and *A. septentrionale*, which he had collected last year in Switzerland, all growing in one tuft.

Mr P. Neill Fraser exhibited growing plants of a distinct variety of *Polypodium alpestre*, and of *Polypodium flexile*,

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which he gathered last year in Braemar, Aberdeenshire. The only other station hitherto recorded in Britain for *P. flexile* is in Glen Prosen, Clova. He also exhibited a flowering spike of *Orchis latifolia*, which measured 6½ inches in length and 5 inches in circumference.

Mr Alex. Craig Christie exhibited a large growing tuft of *Asplenium septentrionale*, lately collected on Blackford Hill. The fronds measured from 5 to 7 inches in length.

Professor Balfour laid on the table the first volume of a new work, entitled "Flora Orientalis," by M. Boissier, including an account of the plants found in the East, from Greece and Egypt to the confines of India. The volume embraces the *Thalamifloræ*.

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Rob Brown

TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

VOL. IX.—PART II.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY.
MDCCCLXVIII.

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The Botanical Society of Edinburgh is prepared to make exchanges of plants with Foreign Botanists. Extra-European species, and more particularly Ferns, are desirable.

British or Foreign species will be given in exchange, in accordance with the wish of the Contributor.

Part 3 of Vol. I. of the Transactions has been reprinted, and complete copies of the Transactions, up to Vol. VIII. inclusive, can be had for L.3, 10s., from the Treasurer.

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TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

14*th November* 1867.—ISAAC ANDERSON-HENRY, Esq., President, in the Chair.

The following Donations to the Library were laid on the table:—

Fragmenta Phytographiæ Australiæ, Vol. V. By Ferdinand Mueller.—From the Author.

Transactions of the Connecticut Academy of Arts and Sciences Vol. I. Part 1.—From the Academy.

List of the Coleoptera of North America. By John L. Leconte, M.D.—From the Smithsonian Institution.

Miscellanies; being a Collection of Memoirs and Essays on Scientific and Literary Subjects. By Charles Daubeny, M.D. (2 vols.)—From the Author.

Annual Report of the Board of Regents of the Smithsonian Institution for 1865.—From the Institution.

Annals of the Lyceum of Natural History of New York, Vol. VIII. Nos. 11, 12.—From the Lyceum.

New Species of North American Coleoptera. By John L. Leconte, M.D.—From the Smithsonian Institution.

Pharmaceutical Journal and Transactions, Vol. IX. Nos. 4–6. —From the Pharmaceutical Society, London.

Natural History Transactions of Northumberland and Durham, Vol. I. Part 3.—From the Tyneside Naturalists' Field Club.

Memoirs of the Boston Society of Natural History, Vol. I. Parts 1 and 2.—From the Society.

Report on Epidemic Cholera in the Army of the United States. —From the United States War Office.

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Lunds Universites Ars-Skrift, 1865.—From the University.

Schriften der Königlichen Physicalisch-œkonomischen Gesellschaft zu Königsberg, 1865–66.—From the Society.

Proceedings of the Boston Society of Natural History, Vol. X. —From the Society.

The following additions to the University Herbarium were announced:—

From the Royal Garden, Kew—Plants collected in Africa, by the late Dr Burchell.

From the Royal Garden, Kew—Ceylon Ferns, collected by G. H. K. Thwaites, Esq.

From Miss Goodsir—Collection of Dried Plants from Australia, India, Arctic Regions, &c.; also Specimens illustrating the Varieties of Leaves; which belonged to the late Professor Goodsir.

From the Rev. W. W. Kirkby, Red River Settlement—Collection of Plants from Mackenzie River and Fort Simpson.

From Henry H. Calvert, Esq., Vice-Consul, Alexandria—Collection of Plants from Erzeroum.

The following Donations to the Museum at the Royal Botanic Garden were announced:—

From Major Yule—Whip, Purse, and Pocket-Book, made ot Lace Bark; also Dolichos Pods.

From Mrs Little, Singapore—Skeleton Leaves.

From Professor Archer—Collection of 50 Species of Cones.

From Dr John Foulerton—Cones of Wellingtonia, collected under the trees in the "Mammoth Grove," California.

From Henry H. Calvert, Esq., Alexandria—Mussana Bark.

From Alex. Craig Christie, Esq.—Model of *Saxifraga granulata*, prepared by himself.

From Mr Coughtry—Specimens of Wigan Coal and Fossils.

From Rev. Buchan Wright—Fruit of Luffa, Soap Berries, and other Seeds.

From a Visitor—Large specimen of *Delesseria sanguinea.*

The President delivered the following Opening Address, "On Pure Hybridisation; or, Crossing Distinct Species of Plants:"—

The various papers and publications given to science and the world in recent years, by Darwin and others, have directed the attention of all botanical observers to the changes which have been, and which may be effected on

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the existing species of plants; and those who reflect on the diversity of the vegetable kingdom as displayed in the grandeur of the various forms which compose the primeval forests of the torrid zone, or in the no less diversified but homelier forms of our temperate climes, must be attracted with the statement that, throughout all past time, change —slow but incessant—has passed on everything that now has life; in so much that we see no more the things which were in the things that do appear. So, at least, holds Darwin, whose observations for general accuracy, so far as they are open to scrutiny, stand well the test of investigation, though beyond that limit they diverge, as he himself admits, into speculations which, however logically deduced, all of us are free to adopt or reject as we are or are not convinced by them. I acknowledge that I believe much of the Darwinian theory—more now than I once did—and my grounds for doing so will be afterwards stated. As, however, I have been asked by a high authority (in reference to the paper I read to you in March last), whether I adopted the Lamarckian views, which form the germ, if not the basis, of the Darwinian doctrines, I reply unhesitatingly, No—not in their beginning or their ending—though where the latter is, Mr Darwin is perhaps as much at sea as any one of us. But lop off that beginning and ending—above all, lop it off as regards his views of the animal creation—and there remains in that great work, "The Origin of Species," a body of botanical philosophy, so well sustained by the author's own generally accurate observations and wonderful discoveries, that it constitutes the most valuable contribution ever made to botanical science, and marks an epoch in its annals more brilliant than any yet attained. This is no inflated eulogy. For the last quarter of a century I have myself devoted every spare hour of my professional leisure, and for the last seven years (when free from professional yoke), my leisure almost entirely, to similar pursuits; and, as a humble labourer in the same field during all that time, I have some claim to be recognised as capable of forming an estimate of what has been discovered and achieved by Darwin, and given to the world in that great work, and in his scarcely less wonderful book on the "Fertilisation of Orchids," and his papers read before the Linnean

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Society.* He has not only accomplished great things by himself, but he has aroused attention, and stirred up other admirably qualified observers to extend his researches, and, it may be, has thus led the way to other no less startling discoveries. Among those now in the field I would especially instance Naudin and Wichura, whose published researches in this department have stamped them as physiologists of no mean order, as close and discriminating observers, and generally just and sound in their conclusions. I may perhaps take occasion, in giving some of my own experiences, to point out how far they harmonise or conflict with theirs.

In the paper I read before the Society in March last, which related mainly to that form of hybridising generally known as *muling*, and cognate matters—all akin, no doubt, but for the most part *outside* the proper province of hybridisation—I intimated my intention of afterwards submitting to you another paper limited to the latter branch in its purer and simple form. I have now some things to mention which may sound as a thrice-told tale; but as they have reference to my own experiences, and as I desire to lay them truthfully before you, I trust they will neither overtax your patience, nor be without some value to those who may have already entered to some extent on the important field of observation. Let such as have the taste, and the means and appliances to boot, never be discouraged. Nature has many mysteries to unfold. She has fixed rules—some so plain that he who runs may read; and she has exceptions to these rules. Look at the wonderful provision she has made for the fertilisation of the orchids, and look at the no less marvellous modes she has adopted for the same end in the dimorphic forms of the genus *Primula*, and also in some forms of the genus *Linum*—of all which Darwin was the grand discoverer. I was myself almost a sceptic in the results obtained by him till I tested the statement he enunciated in the former genus by actual experiment, and found it true. I had, before he wrote, been myself at work among the species of the genus *Linum*, and while I found some of them tractable and open to self-fertilisation, I found a disturbing element among others for which I could not

* Journal of Proc. of Linn. Soc., vol. vi. pp. 77, 151; vii. p. 69; viii. p. 169.

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account, till I found it cleared up by Darwin in his *dimorphic* discovery. To a mind like his, ready to follow out by untiring research every perplexing cause which baffles the expected result, one discovery followed and perhaps suggested another, and it may be that the most brilliant of all yet awaits him. Let us follow in his wake; and though few are so constituted or so gifted as to attain to like successes, there is much for all to do. There is romance in the pursuit, and laurels to be gathered by every acute, industrious observer. If he make no grand discovery, he may zealously endeavour, and assuredly he will succeed in improving our common flowers, fruits, and vegetables, and, what is still more important, our cereals and grasses. I never myself sought any high flight; but with an experience co-extensive, perhaps, with any living experimentalist, I had been both blind and stupid not to have obtained some sparks of more light, and a better acquaintance with nature's modes of working; though I did not give, as perhaps I ought to have done, more publicity as I went along to that little knowledge which I acquired. I feel the loss, as many things which I observed might, if noted then, have been useful to me now; and, unfortunately, many things which baffled me and called for solution have passed from my mind. I must, therefore, as respects the past, keep within the record of my written notes, and from these cull only such as may be of use to others.

Holding, as I do, that the first object of all papers on subjects laid before a society like the present is to communicate instruction, I hope the Fellows of the Botanical Society will not consider the present Address unworthy of their attention, but that they will bear with me while I state the rules I observe and the means which I take to ensure success in my experiments.

1*st*, I long held it to be of vital importance to have the separate plants intended for the parents in the cross, even though both were hardy, put under glass, and I still recommend it; for by doing so you heighten the temperature —an important thing—and you can better secure against the interference of winds and insects; and though Darwin holds the former of small account, I have reason for differing from him. But in the height of summer, pollen may

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be taken from an outside plant to cross an inside one, and *vice versa.*

2*d*, I hold it not enough merely to emasculate the intended seed-bearing flower, I take off every petal, for the petals attract the insects, which seem guided more by their optics than any sense of smell. This act of emasculation in some cases I perform long before the expansion of the bloom, for in many plants—as, for instance, in the *Papilionaceæ*, some of the *Rosaceæ*, and *Compositæ*—self-fertilisation may and does often take place in the unopened flower. This is not all. I sometimes put a *gauze* bag over it; if I do not, the mutilated bloom may not escape that most troublesome of all insect pests, the humble bee, which in his unwieldy flight may come across it by pure accident. But for the most part now I make clean work of it, and remove all other expanded flowers on the seed-bearing plant, and allow no kindred one to be near.

3*d*, Do not be in a hurry to effect your cross; wait till you find that the stigma is fully developed. In many plants this is shown by a glutinous exudation on the summit, as in the orders *Ericaceæ*, *Onagraceæ*, &c. In other orders, such as *Geraniaceæ* and *Malvaceæ*, it is indicated by the feathery expansion and recurvature of its separate divisions.

4*th*, The next thing is to obtain properly ripened pollen grains from the male plant. This is done by carefully watching when the anthers burst, otherwise the insects may be before you; and so active are they, especially on such favourite food as the pollen of the *Rubus* tribe, that, to get it at all, I have found it necessary to encase the opening blooms in muslin bags till the pollen was ripe and ready for use. Do not use, as is generally recommended, the camel-hair pencil, which, applied often and indiscriminately, may and often does convey, with the foreign, some insidious grains of native pollen, which, however few, are prepotent, and wholly neutralise the former. Take, where that can be obtained and afforded, the entire bloom of the intended male, and give the slightest brush with all its anthers over the stigma, or all the stigmas, if more than one, of the intended female. I will give my reasons for this by-and-by. You may use for experiment, in some

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cases, the *long*, and in some the *short*, stamens. To those of the proper dimorphic form I have made some allusion already; they occur in the species of *Primula* and in some of the species of *Linum* (as to both of which see Darwin's remarkable papers in the Proceedings of the Linnean Society). Such stamens, at least two long and two short ones, occur in the two orders of the Linnean class *Didynamia*, on which I may have a suggestion to offer hereafter. In cases where the anthers are few—as in the Linnean classes *Diandria*, *Triandria*, &c.—you may use small pincers—a bit of wire so twisted as to form that implement, and easily carried in the pocket, is by far the most convenient. I have used such an instrument all along, and find it better than any other form. In some tribes, the better to secure against invasion by insects, such especially as in some of the *Rosaceæ* having large discs, a muslin bag may be used so as effectually to exclude them. I use it constantly in the *Rubus* tribe immediately after emasculation, taking it off and replacing it after the cross, and keeping it on thereafter till the cross has set.

5th, In some cases it is a matter of some difficulty to procure, and when procured, of no less importance to preserve, pollen. In diœcious plants—such as *Aucuba*—a friend may have the male and you have, as we all have, the female in abundance. You would like to store that pollen till your female plant—generally later—comes into flower. Many hold that pollen cannot be preserved in a vital condition for more than one or two, or perhaps three, weeks. In a recent publication which refers to this matter—namely, Max Wichura's "Observations on Hybridisation" (of which a very lucid abstract, carefully digested and translated from the original German, by the Rev. M. J. Berkeley, is given in the January number of the "Journal of the Royal Horticultural Society"), that eminent author states that "the pollen of willows retains its potency for some time. In some cases pollen ten days old was efficient, while vitality was still further prolonged by steeping it in a solution of honey" (of which I have doubts). "Pollen," he adds, "of *Salix Silesiaca* eight days old seemed almost as potent as ever; in twenty-eight days the traces of vitality were very slight, while that of *Salix cinerea* had become weak in

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sixteen days." Now, I am not aware that there is less vitality in the pollen of willows than in that of any other family; and as many experimentalists hold kindred views to those here enunciated by Wichura, I deem it a matter of some importance to give you one or two instances of my own experience. I have carried in my pocket the pollen of *Rhododendron* again and again from six weeks to two months and upwards, and still found it potent. Of the Japanese forms of the genus *Lilium* I have kept pollen in an effective state in the same manner for equal periods. In fact, generally speaking, I have found the pollen of most plants remain good for similar periods. Having last year got the new and beautiful *Clematis Jackmanii* to flower, and being anxious to preserve its pollen as long as possible, I collected and stored it in its anthers in a simple pill-box. On the 4th of July 1866, I so gathered it and put it into a drawer of a cabinet in my own sitting-room, where it remained completely free from damp. On the 5th of June 1867, having first carefully emasculated a flower of *Clematis candida*, I crossed it with the pollen, then eleven months old, and from this cross I have this autumn gathered and sown eight well-developed seeds. Now, both parents are hybrids, with a large infusion of *alien* blood in them, so that here the vitality was put to its severest test. I notice this result here (somewhat out of place) to suggest the propriety of storing, and, if needful, of importing, pollen, which, if wrapt up in silk paper, might even, enclosed in a letter, reach this country still potent, by the overland route from India, or, after two or three months' voyage, from all parts of South and North America. Let collectors and friends in distant countries be instructed as to this, and we may soon have an improved progeny of the rarest things, even before such novelties from which they are derived have been obtained from their own seeds in this country.

6*th*, There is another matter of much consequence to be attended to in the crossing of distant species. I mean the times and seasons for effecting the cross. I do not find that any of those most experienced in the art, from Darwin downwards, have touched upon this point. It has been forced upon my attention for more than twenty years. I have found that I could, on some few propitious days which

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occur throughout the season, successfully effect crosses which I could not effect with all my care at other times. I adverted to this in the paper which I formerly submitted to you, and I again refer to it. There are some crosses which I have effected at such times, and which I would have tried in vain to accomplish at times less favourable. If you have, say, two plants of *Rhododendron*, one a tiny thing, to cross with a large species, or if you wish to attempt a cross between an Indian Azalea and a Rhododendron, watch for a propitious time. Such times occur, often few and far between, when there is less of sun than of that latent form of heat, which frequently occurs before thunder, from the air being more than ordinarily charged with electricity. Or they may occur in the spring season, when there is much ozone present in the atmosphere. The influence of this I have often found tell most favourably in promoting the germination of long-sown seeds. It was to the presence of ozone, or to some other form of electrical agency, that I attributed the almost simultaneous germination of some New Zealand seeds of a shrub which I got from that country under the name of "Black Maupan," a species of *Pittosporum*, which sprang up together on the morning of the 16th March 1863, after they had lain dormant two years and eight months. Such atmospheric conditions, to whatever cause they may be due, I have found not unfrequently to occur with the east winds of March and April; at which times I have seen many long-sown seeds spring up suddenly and unexpectedly. Seize upon all such seasons for difficult crosses. As to the time of the day, you will operate best from 10 A.M. till 6 P.M.

We shall suppose the cross now performed. Your next anxiety will naturally be to find out whether it has taken. Almost all experimenters have noticed that soon—I would say from six to ten days—an alteration is observed on the stigma and style. You will find the viscid matter on the former dried up while the latter has begun to shrivel. You will naturally conclude that it is all right, and that the fertilising influence of the pollen has now passed down into the ovary, and in some cases you may be right. But these appearances are deceptive, especially if you find the style maintain an erect position. I find, on glancing at the

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"Gardeners' Chronicle" of the 19th October 1867, that this state of matters had been observed last summer by the editor of that publication, and described in his leading article of that day. He there observes:—"We have ourselves, in following some experiments on cross-breeding this season, noticed that the stigma becomes changed—withered almost immediately after contact with the pollen, even if no perfect seeds be produced." That is a correct statement, in my opinion. I did not, however, note the withering effect to be just so immediate as he had observed it, though it might have been so in the *Epilobium* tribe to which his experiments refer. Another effect I particularly noted last summer was, that, in attempting to cross an Indian Azalea with a Rhododendron (which, however, in that instance failed), not only did the stigma and style decay, but the divisions of the calyx took on a purplish tint, and a honeyed secretion continued long to exude from the disk. Another still more misleading condition often arises, as is noticed in the same leading article of the "Chronicle:"—"The ovary will swell, the fruit will set, in some cases without any contact with the pollen at all, though of course no embryo is produced." Wichura has noticed the like result, and the following degrees of failure noted by him have so often occurred in my own experience, that I cannot do better than cite them in his own words, from the Rev. M. J. Berkeley's translation already alluded to, which I only alter according to my own experience:—"*1st*, The organs submitted to hybridisation (the stigma and style) soon wither, but do not in all cases soon fall off. *2d*, The ovaries swell and ripen, but do *not* contain a trace of seed. *3d*, The ovaries may seem filled [I say may seem partially filled], having in some instances the small protuberant swelling outside as if seeds were within, and yet no seed be there. *4th*, Seeds are present, but small, languid, and incapable of germination. *5th*, Seeds apparently perfectly developed, which do not germinate. *6th*, Seeds which germinate, but the young plants are weak, and wither in a short time, dying off oftentimes after developing the seed-leaves. I have had all these conditions and results amply illustrated; and of the second of these results, I had, last summer, mortifying proofs in a muling operation I tried, by

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fertilising a flower of the new *Arabis blepharophylla* with my still newer *Draba violacea.* The cross, to all appearance, had taken; the seed-vessel swelled better than the others where no experiment was made, and while the valves of the silicules of the latter plants opened and showed no trace of seed in them, the siliquas of the former remained closed, showing by outward swellings that two seeds were certainly within. But I found on opening the ripe seed-vessels that there was no perfect seed in the interior, but only an abortive production." While Wichura's statements in the above instances of *failure* are consistent with what I have myself amply experienced, I cannot, from my experience, endorse the views he has propounded on some of his *successful* results. At page 72 of the above article in the "Journal of the Royal Horticultural Society," Mr Berkeley, commenting on Wichura's paper, observes—"Gærtner, indeed, supposes that in genera which are rich in species, there are some which have a *prepotent* influence when hybridising, so that in some hybrids the type either of the male or female prevails. Amongst the various hybrid willows, though the genus is so rich in species and so prone to hybridising, Wichura has never seen a prepotent type, and doubts Gærtner's statement, especially as he makes it in very qualified terms." Mr Berkeley very judiciously remarks that it is not easy to determine "by examination of types, whether a hybrid is more like the mother or father—the perfect distinction is subject in many cases to great difficulties, since very much depends on the subjective view of the observation; for, in consequence of the frequent intermelting of both characters, the one observer finds in a hybrid the maternal type, while another thinks the paternal type prevalent." By which I regard Mr Berkeley as very modestly dissenting from his author. Further on, at page 78 of the same journal, Wichura speaks out still more absolutely. "When both parents," says he, "belong to the same species, we cannot tell what part the male and female parent take respectively in the formation of the progeny. But dissimilar factors are united in hybrids, and an *intermediate* form is the consequence. The products which arise from reciprocal crossing in plants, unlike those which are formed amongst animals, are per-

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fectly alike." I regret to differ from so great an authority as Wichura, and I must venture to demur to the doctrine in more decided terms than Mr Berkeley does. I have had many instances of hybrids taking sometimes to one side and sometimes to another—but most frequently to that of the mother. To those who, like myself, have made experiments with many genera, it would be needless to give instances. The converse is the rarer case—that is, where the paternal type comes out most marked. Yet I remember one eminent instance of a seedling *Veronica* (from the batch of seedlings from which I obtained *V. Andersonii*, *V. salicifolia*, *V. speciosa*), being so like the male parent *V. speciosa*, that I presented it to a friend in the belief it was purely and simply the latter species; but when it bloomed, it showed, by the longer spike and lighter and brighter colour of the flowers, and by their being a bright crimson instead of very deep purple (which is the colour of the flower of the *V. speciosa*), that the blood of the *V. salicifolia* was there. I can well understand that, as respects the family of willows, from their being so attractive to bees, and from their being naturally so prone to intermix (in so much that few can tell what is a species and what is a hybrid), Wichura has not much overstated the fact, and that a distinct intermediate form may generally be reckoned on.

I must dissent still more strongly from what Wichura lays down in continuation of the above passage at page 78, as to reciprocal crossing. "The products," he says, "which arise from reciprocal crossing in plants, unlike those which are formed among animals, *are perfectly alike.* It is of no consequence which is the male and which the female parent. It is, therefore, a mathematical necessity that the pollen-cells must have just the same part in the act of generation as the ovules." He follows up and amplifies this doctrine in a series of aphorisms which, he admits, are to be "considered conjectural, and require to be submitted to proof"—an admission for which he is to be commended, and all the more if he submitted to the like test the dogma on which they mainly rest. It appears to me that his statement had been suggested from his experience among the *Salices*—of all plants the most mongrel

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in a state of nature. Now, in all this Wichura appears to me to imply, that if a distinct intermediate may be formed, and is formed, by crossing A on B, so may an exactly similar intermediate be reciprocated by crossing B on A. And M. Naudin, in his experiments among the *Daturas*, enunciates the same belief, and holds "that there is not a sensible difference between reciprocal hybrids of two species." That distinguished observer, like Wichura, seems to have confined his experiments to herbaceous or soft-wooded plants. But, from a long and large experience among both hard and soft-wooded plants, I demur—1*st*, To the capability of the parents being in *all* cases made subject to such reciprocity; and, 2*d*, To the statement, where such reciprocity does hold, that the progeny are *perfectly alike*, whether A or B supply the pollen.

In my various crossings I have experimented on many hard as well as soft-wooded genera, and among the former I would particularly mention the species of Rhododendron. In these I have again and again been baffled in reciprocating a cross which on one side was comparatively easy to be effected. When the lovely and fragrant *Rhododendron Edgeworthii* first bloomed in this country, all were eager to see its beauty and perfume transfused into dwarfer and hardier forms. Some tried the cross by making *R. Edgeworthii* the female or seed-bearer, others by making it the male. I tried it in both ways, but all my efforts failed where I attempted the cross on the *R. Edgeworthii*. But while it could not be brought to bear hybrid seed, I had no great difficulty in effecting a cross from its pollen on *R. ciliatum*, another of Dr Hooker's beautiful Sikkim species, having all the desirable requisites of hardihood, dwarf habit, and free-flowering tendency; and, singularly, just as I had obtained and sent off blooms of this brood to lay before the Committee of the Horticultural Society of London, Messrs Veitch of Chelsea anticipated me in having a plant of this identical cross first exhibited before that Committee, which is now well-known and generally cultivated under the name of "Rhododendron Princess Alice." Now, neither I nor any one whoever tried it, so far as I know, ever effected the *inverse* cross of *R. ciliatum* on *R. Edgeworthii;* and if they did, the progeny would long ere now have appeared in nur-

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sery catalogues. There is yet another instance I may notice as an illustration of what I am now contending for. In my former paper I noticed, as an exception to a rule I had found almost general—viz., that European had great aversion to cross with Asiatic species—that I had, notwithstanding, effected such a hybrid by crossing *Rhododendron eleagnoides* (another of Dr Hooker's acquisitions, a tiny Sikkim species) on the European *R. hirsutum*, and of having sent the survivor of the two plants which came of it to Kew, which, Dr Hooker writes, dwindled away and died after being a few years in the garden; but by no possible means could I invert that cross, or get that same very interesting tiny yellow-flowered species, *R. eleagnoides* (a form of *R. lepidotum*), to submit to a cross from any species whatever.

I shall now advert to the second point which Wichura lays down as a fact, viz., that the progeny of reciprocal crossing, whether it is A on B, or B on A, are precisely alike. While my past experience goes with what I observed last summer, it may perhaps suffice to give the latest instance. Having, through the kindness of Dr Hooker, obtained seeds of a beautiful new Californian Arabis (*A. blepharophylla*) with large fine rose-tinted flowers, I felt desirous to infuse that colour into some of the other kinds I possessed. After trying it on several, especially on *A. albida*, in vain, I at last effected a cross—a reciprocal cross—between it and *A. Soyeri*, a white-flowered kind, something like the *A. albida*, but with glabrous foliage. Of the cross *A. Soyeri* on *A. blepharophylla* I have raised six plants, the product of two very largely developed seed pods. These plants are alive and healthy, and promise an improved vigour over either parent. That the cross was sure, I had the best proof, from there being no seeds in the normal pods of the seed-bearer. Of the inverse cross from one weakly seed-pod I raised one plant, which, after maintaining a sickly existence for some two months or so, has died off. But while this last cross was equally certain as the others, like it, the plant had more of the mother than the father in it. In fact, I have oftener found the maternal type most marked in hybrid progeny. I have various crosses effected between distinct species of Rhododendron, where, while the male manifests his presence, the female type prevails. I have

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it in *R. Jenkensi* crossed by *R. Edgeworthii*, *R. Caucasicum* by *R. cinnamomeum*, and the hybrid from this latter cross crossed again with *R. Edgeworthii*, and especially the Sikkim species *R. virgatum* crossed with another of my hybrids, *R. ciliatum* by *R. Edgeworthii*—all having more the foliage and the aspect of the mother than the father.

I have another hybrid of the same *R. virgatum*, the female parent crossed, I believe, by *Rhodothamnus Chamæcistus*, a tiny procumbent plant of 3 inches, but all set with flower-buds—not, as in the male parent, at the tips of the shoots, but as in the female, at the axils of the leaves. I have stated my belief that the *Rhodothamnus* is the male parent, but I cannot do so confidently, from the tallies having got into confusion—the specimens being planted out. But as some plants were obtained from that cross, and as this is the smallest, I regard it as likeliest to be the true progeny; and the cross being an extreme one—a mule, in fact—it is open to question. But as I have this season effected still more extreme—certainly more unlikely—crosses in that family, where there could be no miscarriage, you may, I think, take it as true in the meantime. I could overwhelm you with proof. Darwin, at page 333 of the last edition of his "Origin of Species," has observed the above tendency. "When two species," he says, "are crossed, one has sometimes a prepotent power of impressing its likeness on the hybrid; and so I believe it to be with varieties of plants."

Naturalists of the highest note—Gærtner, Kolreuter, Naudin, and Wichura—are far from being at one on the subject of *variability*, as Darwin has shown, especially as relates to crosses—1*st*, between species and species; 2*d*, between species and varieties; and 3*d*, between mongrel offspring. But this is a complex subject; and when such high authorities are not at one, and Darwin admits that he cannot reconcile them, it is manifest that the case is still open to further probation. In dealing with the views of Gærtner (to whose testimony he deservedly accords great value (page 331), Darwin says that Gærtner, whose strong wish "it was to draw a distinct line between species and varieties, could find very few, and, as it seems to me, quite unimportant, differences between the so-called hybrid offspring of species and the so-called mongrel offspring of

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varieties. And, on the other hand, they agree most closely in many important respects. The most important distinction is, that in the first generation mongrels are more variable than hybrids; but Gærtner admits that hybrids from species which have long been cultivated are often variable in the first generation; and I have myself seen striking instances of this fact. Gærtner further admits that hybrids between very closely allied species are more variable than those from very distinct species, and this shows that the difference in the degree of variability graduates away. When mongrels and the more fertile hybrids are propagated for several generations, an extreme amount of variability in their offspring is notorious; but some few cases, both of hybrids and mongrels, long retaining uniformity of character could be given. The variability, however, in the successive generations of mongrels is, perhaps, greater than in hybrids." So reservedly does Darwin deal with a subject on which the opinions of many others could be brought to bear; but as they are not all concurrent, and not unfrequently conflicting (which they may well be from the various subjects experimented on), he has said, with commendable moderation, all that can be said on the subject.

From you, gentlemen, I respectfully claim the same kind indulgence which Darwin has shown to the testimony he has had to deal with, in judging of the views I have offered, and am now to offer, on the experiments which I mean to lay before you. But ere I enter upon them, it is necessary to make some remarks on that form of *dimorphism* which occurs among many plants—in the Linnæan classes from *Pentandria* up to *Decandria*—in having very generally one if not two pairs of stamens shorter than the other stamens in the same flower. And the same dimorphic form often occurs in even a more marked degree in many plants of the class *Tetrandria*. It is also the distinctive character of the two orders of *Didynamia* to have two long and two short stamens.

As observed in my former paper, it is now seventeen years since my attention was drawn to the long and short stamens, but to the latter more particularly in some muling operations there alluded to, where, by using them, I crossed that large species of Rhododendron, *R. cinnamomeum*, on the pigmy *Rhodothamnus Chamæcistus*. I refer to these

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short stamens again, as the means by which I succeeded in effecting some extraordinary crosses which, I confidently believe, but for their use and my improving a propitious time, would have been utterly impracticable. As I have said, I at first worked only with short stamens. These I use in all cases where I wish to cross a large on a small species. I have now found that the converse holds, and use the long stamens where I wish to cross a small on a large species. In all extremes I use the *longest* or *shortest* pair of stamens as the case demands. The short pair is generally well distanced by the others—the longest pair is often not just so much in advance. There is often an intermediate pair of short stamens, which in cases less extreme are exceedingly serviceable, but there are seldom such intermediates among the long ones. My reason for the use of these short, intermediate, and long stamens is intelligible enough. If I wish to cross a large on a small species, the smallest-grained pollen being in the short stamens, I take the pollen of these stamens of the *large* plant as best fitted to send tubes through the stigma and style, to fertilise the ovules of the *smaller* species, and so effect the cross on it; and so, *cæteris paribus*, with respect to the other forms. I shall restrict the instances I am now to cite to the last few years, noticing,

1. *Cases of Crossing with Short Stamens.*

The first cross I shall notice is one I have already alluded to—viz., *Rhododendron virgatum* with my own hybrid rhododendron *B.* (*R. ciliatum* crossed on *R. Edgeworthii*); and as this cross is memorable and instructive in several points of view, it is proper to give its history. On April 20, 1864, I find from my note-book that "I took off all expanded blooms of *R. virgatum*, and removed the stamens from all unopened ones on the plant, there being none left for self-fertilisation; done in fine sunshine—west wind—with three short anthers of *B*"—*i.e.*, the hybrid male, being the identical cross which produced Veitch's rhododendron, Princess Alice. Of this cross I ripened four capsules of seed, which I sowed on January 28, 1865, and, with some failures, got up by December that year seven nice healthy plants, all of which, however, save one, I lost

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by an accident. That one plant is now setting for bloom—not at the axils, as the female parent (*R. virgatum*), generally shows, but at the extremities of the shoots, as in the male (*R. ciliatum*), crossed by (*R. Edgeworthii*). But as I have had occasion to observe already, the type in all else is more that of the *female* than of the *male* parent. By the mother's side this plant is a hybrid, by the father's it is a mongrel, and yet it has a fair share of vigour in it. As in its sexual aspect, so in its height, it is that of the mother. A few *cilia* are noticeable on its leaves, but it has none of the tomentose or dense hairiness of the male parent; and so in this also it partakes most of the glabrous foliage of the mother. Again, this doubly-crossed plant, and the crosses which produced it—all extreme—show how such crossing may hasten on the reproductive or flowering state. Never in all my experience have I seen or heard of rhododendrons offering bloom at two years of age. I have rhododendrons now fifteen years from seed which have never shown the slightest tendency that way, though ten and twelve years I would consider about the mean at which they attain their flowering state. If by such crosses the like precocity can be generally secured, practical florists may turn them to some account in their profession. I am now dealing with *hard-wooded* shrubs, where there is in general more fixedness of structure and habit, than in those on which the physiologists I have cited have chiefly experimented, and which are less liable to be modified by the manifold influences which affect the more pliant and shorter lived herbaceous *genera*.

2d, The next cross in the rhododendron tribe effected by the short stamens to which I would direct attention is very recent, and one with which I took the utmost pains to prevent miscarriage. The beautiful *R. jasminiflorum* of Java, with its delicious perfume and its long tubular five-lobed flowers, of snowy whiteness, so like *Erica Aitonia*, so like, too, in form and fragrance, the sweet-scented jasmine, and so unlike all its own congeners, is the subject of it; and as I regard this cross of some scientific as well as of some practical value, I shall offer no apology for giving you full particulars. I made it the subject of attempted crosses by many of its own tribe—all of which failed except two,

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which, by the way, afford a good illustration of what I alluded to in my former paper of the *sympathies* of plants, and perhaps, too, of natural selection, though whether it be in the mode which Darwin regards as leading to diversity of species I cannot positively assert, yet I think it is worthy of his consideration. While it rejected many of its legitimate brethren of the rhododendron tribe pure and simple, I was somewhat surprised that it took kindly with my hybrid *B* already noticed, *i.e.*, *R. ciliatum* crossed by *R. Edgeworthii*, a hybrid of the first degree, having large flowers of 3 inches diameter, perfumed, and also of snowy whiteness. After the bloom had been long emasculated, on April 17, 1867, I effected the cross with the *short* anthers of the hybrid *B*. The cross took admirably—the seed-pod swelled, and was pulled fully ripe about 12th July last. On the 15th of that month I sowed the seeds. For the purpose of comparison, I sowed a pod of its own plain native seeds, which I had gathered previously, and had, in fact, sown some ten or twelve days before I sowed the cross. These are both now up. While the native seeds have produced a fair show of feeble plants, the crossed seeds have come up in more than double the number of plants, doubly vigorous in growth and habit, and with leaves so much larger than those of the normal form as to remove all doubt about the verity of the cross.

3*d*, The next illustration I have to give you is of a small-foliaged *Indian Azalea*, 18 inches high, which I crossed with the tall and robust shaggy-foliaged *Rhododendron Edgeworthii*. Two things more unlike in every feature from which to effect a union can hardly be imagined. Yet, with the short anthers—and it was with the *very shortest* I could find on *R Edgeworthii* that I effected it—the cross, after careful emasculation, was done on 6th May last. The seed-pod swelled to its due dimensions, and appearing to be ripe, I cut a slice *off* it, and sowed the seeds so early as the 13th, and the residue on 28th September last, and I have now got up one or two plants. If I shall be so lucky as to bring it to maturity, the progeny of this cross (one never before accomplished, perhaps), should be a sweet-scented Azalea, having a rose variegation like the female parent, a novelty in its tribe; for though the *Azalea sinensis* has

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been crossed by rhododendrons, I am not aware of any authentic cross, or cross of any kind, between the rhododendrons and this proper Indian Azalea.

4th, I have still further a cross of the same nature between another Indian Azalea and the *Rhododendron jasminiflorum*, the latter being again the seed-bearer; and I here refer to it mainly as showing another tendency of this rhododendron towards natural selection, or rather perhaps of *sympathy* between it and remote species, if not genera, for the azaleas have till lately been regarded as a separate tribe from the rhododendrons. The cross was effected in August last, when it again rejected its more natural allies, and formed a union with the Indian Azalea, a late rose-coloured spotted variety, a seedling of my own raising. The seed-pod of this cross is now at maturity.

5th, But I have now to call your attention to a cross in this same family bearing on Darwin's doctrine of *natural selection*, or of *sympathy*, in a still more remarkable manner, which I effected last summer between that most gorgeous of all the rhododendron tribe—namely, the lovely white, large-flowering, sweet-scented *R. Aucklandi* of Dr Hooker—and an Indian Azalea, the latter being the seed-bearer. I made the cross on two separate days on two separate blooms, carefully emasculated some time before; and on the same Azalea I tried other crosses with several of the rhododendron tribe—viz., with a fine form of *R. arboreum*, *R. Edgeworthii* pure, and the above hybrid seedling *B* (*R. ciliatum* by *R. Edgeworthii*). But while every one of these failed, the crosses by *R. Aucklandi*, which were effected respectively on 30th April and 1st May, took most kindly. Both pods swelled; and the seed-pods, though green, appeared to be sufficiently ripe when I pulled them. I counted the seeds in one of these pods, and found them to be about 324, all finely formed, but, I fear, too green to vegetate freely, though some which I sowed appear to be coming up. I cannot vouch for this cross being effected with the *shortest stamens*, for the stamens with which I effected it were kindly sent to me from another source, as I did not myself possess the male plant; but as I invariably select the *shortest* for such crosses, my firm belief is that I had so selected these in this instance, and I had a plentiful supply

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of all lengths to choose from. In the above cases of crossing a *small* with a *large* species, I hold firmly by the opinion that but for the use of the *short stamens* I could not have succeeded. I have few recorded instances of having extended my experiments with them far into other families. I certainly tried the *Pelargonium* in a plant I had of the beautiful white-flowered Madame Vaucher. I fertilised a bloom with its *two shortest* stamens, which, however, were very little shorter than the remaining ones; and from the three seeds which germinated I raised two fine plants, far more compact and somewhat dwarfer in habit than the parent, having the flowers equally fine, and elegantly thrown up above the plant. But the short stamens of this section of the *Geraniaceæ* are very little shorter than the others, and I therefore cannot rely much on the results as establishing the hypothesis I contended for in my former paper—namely, that where all other things are equal, a cross or simple fertilisation with the short *stamens* tends to *dwarf* the progeny. I still, however, adhere to my belief in this hypothesis. The instances I have given support this other *hypothesis*, that by the use of the short stamens you may cross a large on a small kindred species—a result which, without them, you might not affect.

2. *Crossing with Long Stamens.*

I have made fewer experiments with the long stamens, but I have one before me now no less remarkable, perhaps, for its far-reaching result than any I have alluded to as done with the short stamens. It is a cross which I effected on the tall *Rhododendron formosum*, fertilised with a scarlet-flowered Indian Azalea, on the 11th June last. The seed-pod is finely developed, but I have taken care in this instance to avoid pulling it too early. And I may here notice, once for all, that to obtain the seeds of a cross—especially if it be *extreme*—sufficiently ripe, you must allow a longer time for it than for the ripening of the normal seeds on the same plant.

In all the above crosses I had, perhaps, less an eye to accomplish a purely scientific experiment than to effect a beneficial result; for, after all, it is the *quid sit utile* which

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those for whom this paper is mainly intended, will have most in view; and, in my estimation, science is best promoted when she is made to minister to some useful end.

The following experiment among the species of *Clematis* illustrates my view of *sympathy* as well as of *antipathy*, and, I would add, of *unnatural selection*:—Having many years ago (long before the Messrs Jackman, who have accomplished such wonderful results) been myself working on the members of this genus, I thought of making another experiment on it, with a view to infuse a richer colour into a new and larger-flowering progeny; and, as I have observed already, I managed successfully to cross with pollen, kept for eleven months, the beautiful four-petaled *Clematis Jackmani* on a thirteen-petaled flower of the fine *C. candida.* But it is of a cross on Messrs Jackman's smaller, but no less beautiful, *C. rubro-violacea* I am now to speak. Though, like its congener *C. Jackmani*, it sometimes shows five or even six petals, it is in its general type a four-petaled flower. With a view to improve it in this feature, I crossed it also with pollen of the large-flowered *Clematis candida*, taken from a bloom having seventeen petals, though this *Clematis*—a French hybrid, I believe, from *C. lanuginosa*—is in its normal state a six or eight petaled flower. Though I crossed two flowers, after careful emasculation, I only gathered three seeds, but these all of unusually large dimensions. After the cross had taken, I left the normal blooms on the crossed plant to their fate; and though visited by insects innumerable, and though the native pollen was abundant, not one native seed, or any, except the three produced by the cross, were ever formed on the plant; and the singular thing was that, with its own native pollen, abortive on itself, I successfully crossed the fine double-white flowered Chinese *C. Fortunei;* and a cross more prolific in the seeds it yielded I have not seen in the tribe before. I know not the parentage from whence this *C. rubro-violacea* was derived, though I believe it to be a mongrel with none of the *Fortunei* blood in it; yet mark how kindly the latter took with it—another instance of remarkable *sympathy*. Although I have no record of it, I think I failed to get *C. rubro-violacea* to reciprocate *this* cross.

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In all these instances of *sympathy* and *antipathy*, and especially in this section of the natural order *Ranunculaceæ*, there is something apparently so inexplicable, that I can only concur with what Darwin has observed in his paper on the existence of two forms in the genus *Linum*, where, in summing up the good gained by the inevitable crossing of the dimorphic flowers, and numerous other analogous facts, he says, that these all lead to the conclusion that some "unknown law of nature is here dimly indicated to us." This law, when discovered, may disclose more mysteries, tending, perhaps, to the wider divergence of species, with constitutions and habits better fitted for the climates and localities in which they may be cast, as well as for subserving the purposes they are intended to fulfil in the economy of nature. In looking at *Ranunculaceæ*, with their innumerable male and female organs (and the same thing occurs in the *Myrtaceæ*, most of the *Rosaceæ*, some of the *Hypericaceæ*, and in many other families and tribes), the idea was long ago suggested to me, that each separate row, from the outer to the inner circle of the stamens, might have some separate function, just as I believe that the long and short stamens have their separate functions; and with the view of testing the matter, I had the last summer begun experiments with these *outer* and *inner* stamens; but other aims and objects interfering, I gave up the experiment after I had begun it on these Clematises.

But to make success certain, it is my custom, as I have already stated, in crossing any of these polyandrous flowers, to take the entire bloom of one kind, and lightly to come over, with all its anthers, the stigmas of the flower to be crossed, and leave nature to make her own selection. In referring to the *Rubus* tribe and its species, I am reminded of an intention I expressed in my former paper of perhaps returning to them afterwards. I again experimented upon them last summer. But though I tried various crosses among them, and reciprocated the cross, I had no success in any, except between the *R. biflorus* and the *R. Idæus*, and that only where I made the latter the seed-bearer. And to make sure of either event—success or failure—I had the *Idæus* early potted and put under glass, emasculating every bloom I meant to cross; and for more security I

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stripped off all other flowers—nay, more, I put the emasculated flowers under fine gauze bags, to ward off the invasion of insects. When ripe for crossing I removed the bag, and on effecting the cross, I replaced it. In this way I succeeded in ripening three berries of the cross *R. Idæus* by *R. biflorus*, of which I sowed the seeds between the 5th and 16th July, though as yet none have vegetated. But *R. biflorus* stubbornly rejected a reciprocal cross. Again I tried both of these on *R. rupestris*, and the latter on them; and though *R. rupestris* showed some sympathy with *R. biflorus*, in a slight tendency to form seeds, these came to nothing. In all these attempts I applied, as I have said, all the anthers of the male flower.

I cannot quit this part of the subject without offering some additional suggestions to those of you who wish to act on any hints I have in my power to give:—

1*st*, If your desire be to *hasten* the flowering condition of plants, I recommend you to cross *violently*. That is to say, where the allies are not too near akin, and, above all, in the case of mongrels; for nature, ere she gives up, always makes a violent effort to reproduce.

2*d*, If you wish to make your hybrid flower more *freely*, as well as *early*, adopt the same advice.

3*d*, By following it, you will find that you have attained a further advantage. Your plant will remain longer in bloom, because most mongrels, especially those among herbaceous or soft-wooded plants, to which these suggestions apply, are impotent to produce seed, or nearly so, and in such cases the blooms remain long upon the plant. I have another idea, not sufficiently tested, however, in reference to the first point among hard-wooded as well as soft wooded plants, that all such as ripen their seeds more quickly than others (some among the rhododendron tribe ripen seed in half the time that others take) will reach more quickly their flowering state.

Lastly, as to *fruits*, on which, however, I have only partially experimented, I entertain the belief that we are on the eve of a revolution. I think that by judicious and persevering crossing we may not only transfer the delicious aroma of one to another, and communicate hardier and more abundant bearing habits to the hybrid progeny, but

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further, especially in stone fruits, such as peaches, plums, apricots, &c., we may, in addition to these advantages, increase the size of the fruits and diminish the size of the stones; and among *vines*, get rid of, or greatly diminish, the number of the seeds. All this I hold to arise from that law of nature by which she not merely strains her efforts to reproduce (to which, however, she has assigned a limit), but extends it when these have failed to make provision for her creature's wants. These views gather strength from what has been already done; and I may especially allude to what Mr Standish of Ascot has achieved among grapes, of whose extraordinary results an interesting account is given at p. 135 of the "Journal of the Royal Horticultural Society" for July 1866.

In conclusion, permit me to observe that, while my aim has been, in all the experiments I have brought before you, rather to achieve something useful and practical than to test the theories which Mr Darwin and others, especially the continental *savants*, have been so much engrossed with, I cannot refrain from making some remark on the results and the conclusions which some of them have come to while prosecuting a series of crossing operations, namely, that such crosses do and must eventuate in sterility. M. Naudin seems, like Wichura, as already observed, to have limited his experiments chiefly to herbaceous or soft-wooded plants. Among such, especially among Calceolarias, I too have often found myself brought to the *terminus* of bitter and hopeless sterility. I remember one instance where I had reached a perfect monster for size in that tribe, but except in that particular it had no other desirable property. Determined, however, to improve it by crossing, I found on trial I could make nothing of it, and on examination I found its stigma was a hollow tube, and that its anthers were hard masses, and contained not one particle of pollen. Man may run into such mistakes, but he cannot thence conclude that unviolated nature does so. Speaking from a general recollection which does not admit of my specifying instances, I have often found among hybrid seedlings some of a vigour which, in that respect, were in advance of either parent. May not such often occur in nature, and, as a naturally selected parent becomes the progenitor of a hardier and

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more vigorous race (which having in it, according to Darwin's views, a tendency to diverge), may it not culminate after the long lapse of time into a distinct species, and even annihilate the weaker one which gave it being? so that, in nature's crossing, may not fertility and vigour take the place of sterility and weakness, into which she so generally dwindles when modified by man's device?

Ere I close, I beg to express, as indicated at the beginning, how far my own ideas harmonise with Mr Darwin's on at least some of those doctrines propounded by him in the "Origin of Species." 1*st*, I am humbly but firmly of opinion that that portion of the creation which we inhabit came from the Creator's hand a completed work. 2*d*, That there were no separate or successive acts of creation apart from, or as a sequence of, those mutations or convulsions through which this globe has passed. But I no less firmly believe, differing from Mr Darwin, that it so came clothed with a vegetation of innumerable types and forms, different, it may be, from those that now appear, but from which these last, much varied, changed, and modified, are nevertheless legitimately descended. 3*d*, That differing again from Mr Darwin's belief, expressed summarily at p. 570 (last edition), "that animals have descended from at most only four or five progenitors, and plants from an equal or lesser number," I nevertheless, as respects the latter (for with the former I have nothing here to do), agree with him that there may, and most likely (through the vast lapse of unknown time which, it must be admitted, is involved in this earth's history) has been a great divergence of species, whether arising from natural selection, or descent with modification, or other causes. We see the laws by which such divergence may arise in operation around us now. I have no sympathy with those who, objecting to one part of his doctrines, wilfully shut their eyes to the grounds and facts on which the broad basis of his theory is laid, the truth and value of which, to my mind, is in no way shaken by all that is hypothetical being swept away. Holding the belief in innumerable vegetable forms simultaneously evoked into being with creation, all the *divergence* of species and *diversity* in character for which Darwin contends may, I think, have arisen from the causes assigned by him. And

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as for their dispersion, this, I humbly think, is reasonably accounted for from the various causes, detailed by him, briefly summed up in the following passage:—"The process of diffusion," he observes (p. 390), "may often be very slow, being dependent on climatal and geographical changes, or on strange accidents, or on the gradual acclimatisation of new species through the various climates through which they have to pass, but in the course of time the dominant forms will generally succeed in spreading."

I had intended to have offered some remarks on the very interesting paper of M. Naudin on hybridism, and had, in fact, written down some views with that intention; but as I have already exceeded all due bounds, I must for the present leave that intention unfulfilled.

I. *Abstract of Observations on New Zealand Plants.** By W. Lauder Lindsay, M.D., F.R.S.E., F.L.S., &c.

These observations refer exclusively to *flowering plants* collected by the author during his excursions in the province of Otago in 1861. The *species* commented on belong to the following Natural Orders and Genera:—

1. Ranunculaceæ
   - †Clematis
   - Ranunculus
2. Cruciferæ
   - Nasturtium
   - Cardamine
   - Lepidium
3. Violarieæ
   - Viola
4. Portulaceæ
   - Claytonia
   - Montia
5. Hypericineæ
   - †Hypericum
6. Lineæ
   - Linum
7. Geraniaceæ
   - Pelargonium
   - Oxalis
8. Rhamneæ
   - Discaria
9. Leguminosæ
   - †Carmichaelia
10. Rosaceæ
    - †Acæna
11. Crassulaceæ
    - Tillæa
12. Droseraceæ
    - Drosera
13. Haloragaceæ
    - Haloragis
    - †Myriophyllum
    - Gunnera
14. Myrtaceæ
    - Myrtus
15. Onagrariæ
    - †Epilobium
16. Ficoideæ
    - Mesembryanthemum
    - †Tetragonia

* The paper itself is reserved for future publication.

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17. Umbelliferæ
    Hydrocotyle
    Ligusticum
    Angelica
    Daucus
18. Loranthaceæ
    Loranthus
    Tupeia
19. Rubiaceæ
    †Galium
    Asperula
    †Coprosma
20. Compositæ
    †Olearia
    †Celmisia
    Microseris
21. Ericeæ
    Cyathodes
    Leucopogon
    †Dracophyllum
22. Primulaceæ
    Samolus
23. Apocyneæ
    †Parsonsia
24. Boragineæ
    Myosotis
25. Convolvulaceæ
    †Convolvulus
26. Solaneæ
    Solanum
27. Scrophularineæ
    †Veronica
28. Chenopodiaceæ
    Salicornia
29. Polygoneæ
    †Polygonum
    Rumex
    †Muhlenbeckia
30. Thymeleæ
    †Pimelea
31. Euphorbiaceæ
    Euphorbia
32. Urticaceæ
    Urtica
    Parietaria
33. Orchideæ
    Corysanthes
    Microtis
    Pterostylis
    Thelymitra
    Prasophyllum
34. Irideæ
    †Libertia
35. Typhaceæ
    Typha
36. Naiadeæ
    †Potamogeton
    Ruppia
37. Liliaceæ
    Rhipogonum
    †Astelia
    Arthropodium
    Anthericum

The observations themselves consist for the most part of *critical notes* on those "*characters*," which form the bases of the artificial groups respectively denominated *genera*, *species*, and *varieties*, with their sub-divisions. They illustrate the *variations* of the *individual* from the characters of the *type*, in relation more particularly to the limitation or definition of the *species*. They discuss in many cases the question of *unity or plurality of species* in a genus. They demonstrate that frequent *continuity of variation*,* whereby variety and species pass into each other

* This subject is further illustrated in the author's "Contributions to New Zealand Botany," London, 1868, 4to (with coloured plates of new species of

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or into higher divisions by gradations so imperceptible that it is impossible, without violence to nature, for the systematist at arbitrary points to make separations, whether varietal, specific, or generic. They show how incomplete is our knowledge of the *range of variation* in New Zealand phænogams.

From the extreme *variability* of most of the species commented on, the author deduces an argument for the *greater comprehensiveness of generic and specific definitions.* He believes the use of *typical or aggregate species* to be preferable to the unnecessarily numerous specific divisions presently in use.

He commends strongly to the attention of *local botanists* the desirability of a *revision* of most genera containing more than one species, and particularly of those marked † in the foregoing list.

His observations include also notes on the following features of the natural history of the species selected for commentary:—

I. Geographical Distribution.
   A. In Otago; the South Island; New Zealand generally; and other parts of the world.
   B. Peculiarities of local distribution.

II. Comparison of *Naturalised* with *Native* Plants.
   A. Immigrant flora.
   B. Influence of colonisation on the disappearance of native vegetation.

III. Influence of *Cultivation* on the alteration of Botanical Characters.

IV. Acclimatisation in Britain.

V. Maori and Settlers' Nomenclature.

VI. Properties and Applications.
   A. In colonial manufactures.
   B. In the domestic arts of settlers and natives.
   C. As food for man and cattle.
   D. As ornamental, shelter, or hedge plants.
   E. As medicines or poisons.

Phænogams), p. 46; and in his papers in this Society's Transactions, vol. ix., p. 35 (Otago Ferns); p. 66 (Otago Glumaceæ); and p. 175 (Arctic Cladoniæ).

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II. *Letter from* Dr Robert O. Cunningham, *H.M.S. "Nassau," Rio de Janeiro, to* Professor Balfour.

H.M.S. "Nassau,"
Rio de Janeiro, *October* 4, 1867.

My Dear Sir,—We left England about the middle of last September, on our voyage to the Strait of Magellan, visiting on our way Madeira, St Vincent in the Cape de Verde group, Rio de Janeiro, Monte Video, and Maldonado. I was delighted with the wondrous beauty of Madeira, and struck with the combination of European and subtropical characters exhibited by its vegetation; but I did not see nearly so much of the island as I would have liked, in consequence of our being placed in quarantine for five days out of the week we remained there. St Vincent, where we spent four or five days, interested me very much indeed,—partly because it constituted my first experience of land in the tropics, partly on account of its intensely volcanic character, and the peculiar, and, to me, novel aspect of its plants. Here I saw shrubby *Euphorbias*, for the first time, in the uncultivated condition, and here also I made practical acquaintance with members of the Orders *Zygophyllaceæ*, *Cucurbitaceæ*, &c. The animals did not less interest me, for I met with *Mollusca*, *Crustacea*, corals, &c., with whose forms I had been long familiar from figures and descriptions. I was interested to find both the *Octopus* and *Aplysia* which Darwin describes in his account of the neighbouring island of St Jago. I made a considerable collection of the plants of the island, but unfortunately lost nearly all of them in the process of drying; for the extreme heat of the weather, for the time, caused my health to suffer so much as quite to unfit me for work of any description, and consequently most of my specimens were destroyed by the damp atmosphere which one encounters at sea in the tropics. I have regretted this very much frequently since then, for I believe the vegetation of the island was much more abundant the season we visited it than is usually the case. We were all delighted, as you may suppose, with the glorious scenery of Rio, where we spent ten days; and we walked about as much as the

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excessive heat of the month of November would allow us. The profusion and variety of animal and plant life was something perfectly distracting, and seemed almost artificial, communicating a most strange feeling to one at first. The country in the neighbourhood of Monte Video is of a rather uninteresting cast, consisting, as you well know, of miles and miles of pampas, stretching away as far as the eye can reach, and clothed, for the most part, with a very tall-growing Thistle,* with a bluish flower, gorgeous in some places with a carpeting of scarlet and purple Verbenas. A handsome bluish-purple *Echium* also covered tracts in the neighbourhood of the town. We only spent a single day at Maldonado, which, however, was a remarkably pleasant one, employed by a party of us in taking a long ramble, in the course of which we met with a great variety of birds and plants. For the latter it appears to be a specially rich locality, and I was sorry we had not more time at our disposal to devote to it. We reached the Strait of Magellan on the 21st of December, and, with the exception of a short trip to the Falkland Islands to take in provisions and coal, remained there to the 12th of June, when we moved northwards, as the daily increasing severity of the climate necessitated a suspension of surveying operations for the season. All things considered, we were very fortunate during our stay on our ground, for though we encountered a certain amount of dangers and a very considerable number of difficulties, we met with no serious mishaps, enjoyed for the most part excellent health, and accomplished a respectable proportion of work. Excepting a short cruise of a few days in the western half of the Strait, when we were occupied piloting H.M.S. "Zealous" on her way to the Pacific, our time was spent in the *eastern* portion of the Strait, extending from the eastern entrance to the Chilian settlement of Sandy Point, which we made our basis of operations. It is impossible to imagine a greater contrast than that presented between the *eastern* and *western* sides of the Straits,—the land on both sides of the former being formed of low undulating plains, covered with wiry grass, but destitute of trees of any description for the

* Probably *Cynara Cardunculus.*

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most part, and the geology almost exclusively boulder clay; while that on the latter consists of high precipitous mountains, in many instances snow-capped, and here and there presenting glaciers dipping down to the water,—clothed with a vegetation of dense short impassable weeds, and abounding in metamorphic rocks. And the climate is equally different, for that of the eastern portion is dry, bright, and clear, while that of the west abounds in rain and snow. Another peculiarity of the former consists in the great force and rapidity, and the great rise and fall of the tides,—two circumstances which were greatly in our way in our work, as was also the prevalence of strong gales, which arose in the most unexpected manner, and lasted for days and days at a time, making a heavy demand on our patience, as we were occasionally kept a week or ten days on board owing to the impossibility of dispatching boats on surveying work. I used frequently to accompany Captain Mayne and the surveying officers on their expeditions, and know no pleasanter kind of life than camping out for a few days at a time. There is certainly a most wonderful charm in landing on spots for the first time, and a delightful sense of freedom and also of uncertainty as to what we may have to encounter. I need scarcely say that I made use of every opportunity in my power to observe and collect specimens of the plants and animals of all the localities visited by us, and in consequence obtained a tolerable collection of the fauna and flora of the Strait. In making the latter I was greatly assisted by the "Flora Antarctica," supplied to me at my request by the Admiralty.

Some of the Strait plants were identical with old friends at home. Many of them were species new to me, and a considerable number belonged to genera which I had never a previous opportunity of examining. As examples of British plants that I met with in the Strait, I may instance *Sisymbrium Sophia*, *Cerastium arvense*, *Apium graveolens*, *Armeria maritima*, *Galium Aparine*, *Taraxacum Dens-leonis* var. *lævigatum*, *Primula farinosa* var. *Magellanica*, *Hippuris vulgaris*, *Cystopteris fragilis*, and *Botrychium Lunaria*. Most of these plants occur in tolerable abundance, *Apium graveolens* very copiously indeed. *Hippuris vulgaris* I have only obtained in one locality as yet, viz.—

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a small stream running into Oazy Harbour, on the Patagonian side of the Strait. I believe the only other recorded locality in the Strait is Port Famine, where Captain King procured it. *Cystopteris fragilis* is common in part of the woods. *Botrychium Lunaria*, which Hooker mentions on the authority of Banks and Solander as occurring at Good Success Bay, in the south of Fuegia, I found three specimens of at the entrance of Oazy Harbour. Several of the *Algæ* are also, I believe, identical with British species. Thus, *Codium tomentosum* is common. I have found this *Alga* also in abundance in the harbour of Rio de Janeiro. As some of the plants of the Strait that interested me most, I may mention *Calceolaria plantaginea* and *C. nana*, *Bolax glebaria*, the *Myzodendrons*, which are so abundant on the Fagi, *Cœlonarchis Lessonii*, *Chloræa Magellanica*, *Embothrium coccineum*, *Sisyrinchium filiforme*, *Myrtus Nummularia*, *Fuchsia coccinea*,* *Callixine marginata*, *Philesia buxifolia*, and *Cyttaria Darwinii*. The *Myrtus*, *Callixine*, *Philesia*, and *Fuchsia* were met with at Port Gallant on our cruise to the westward with the "Zealous." I was charmed with the *Fuchsia* and the *Philesia*, and realised how much more I valued their exquisite beauty as they occurred in the Strait of Magellan than I would have done had I encountered them at a place like Rio, where there is such a prodigality of splendid flowers. The *Callixine* is also a lovely little thing, and deliciously sweet. I obtained specimens of it, and *Myrtus Nummularia*, also at the Falkland Islands, whose fauna and flora are very much the same as those of the Strait. One thing, however, struck me, and that was, that certain species which I saw at the Falklands I found at the damp woody districts of the Strait, not in the eastern district, which is so much more allied to the Falklands in its general characters. In addition to *Cystopteris fragilis* and *Botrychium Lunaria*, I obtained specimens of seven other species of ferns,—to wit, two species of *Hymenophyllum*, *Aspidium mohrioides*, *Asplenium Magellanicum*, a *Gleichenia* (I believe *G. acutifolia*), *Lomaria alpina*, and *L. Magellanica*. The latter enjoys a wide range, and appears subject to considerable variation. I have obtained specimens of it at Maldonado, the Falkland

* *F. Magellanica*, according to Dr Hooker.

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Islands, and at Port Gallant, and have seen Brazilian specimens of what I believe to be the same plant. At the Falkland Islands I saw no specimens with a caudex, but some of those at Port Gallant had a straight one about two feet high. Among the fungi that occurred to me were species of *Agaricus* (the common mushroom grows abundantly in many localities, on both sides of the Strait), *Polyporus*, *Tremella*, *Clavaria*, *Geastrum*, &c. I got a good many fine lichens, and expect to get many more in succeeding seasons. We arrived at Rio on the 1st of July, and expect to leave it in the course of a few days for the Strait, calling at Monte Video on our way. I hope while we are there to get up the river to Buenos Ayres, to see Burmeister and the Museum. I have enjoyed the three months we have spent here very much, but am very glad at the prospect of our return to the Strait, as the climate here is very enervating. The country is, however, splendid beyond description. As regards plants, I have been specially struck with the great variety and profusion of palms and ferns, and my attention was greatly arrested at first by the *Lygodia*, and other twining ferns, so different in habit from our British ferns. Despite the heat, I have walked about a great deal, and have made one or two excursions to places at some distance. Soon after our arrival here, I made the acquaintance of a most kind and hospitable Scotchman, Dr Gunning, whose name I have no doubt you are familiar with, as an old Edinburgh man; and I have made two visits to him at his house on the Sierra de Mar, about fifty miles from Rio, and saw some splendid illustrations of virgin forest. Our work this next season will be partly in the completion of the eastern portion of the Strait, partly in the survey of Smyth's channel; and we will winter next year at Valparaiso or Conception.

III. *Notice of Mussana Bark* (Albizzia anthelmintica) *from Abyssinia.* By Henry Hunter Calvert, Esq., British Vice-Consul, Alexandria. Communicated by Professor Balfour.

Mr Calvert sent specimens of Mussana (or Mussena) bark, supposed by Brongniart and some other authors to be

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the produce of *Albizzia anthelmintica*, a plant belonging to the *Mimoseæ* section of the natural order *Leguminosæ*. The bark has the reputation in Abyssinia and Senaar of being a specific as a *tænifuge*, for which purpose 2 to 4 oz. powdered are made into an electuary with honey. Mr Calvert stated that he was indebted for the information he sent to Dr Abbate, a gentleman who had travelled a great deal in Upper Egypt and Nubia, and to Dr Guillardot, who has done much towards the exploration of the Syrian flora.

IV. *Extracts from Botanical Correspondence.* Communicated by Mr Sadler.

1. *From* Mr Robert Brown, *of the Greenland Scientific Expedition.*

Copenhagen, *Oct.* 25, 1867.

Dear Sadler,—I have made, in little more than two months, a collection of Greenland plants amounting to more than 5000 specimens, including a fine lot of mosses (in fruit), lichens, hepaticæ, a few fungi, and algæ, marine and fresh water. In addition to these I made a good collection of skulls, skeletons, &c., of seals and whales and birds, fishes, insects, annelidæ, mollusca, echinodermata, zoophytes, &c. and a large collection of diatomaceous gatherings. We have also brought home about a boat-load of fossil plants, with observations and sections of the deposits. In addition to this I have made several hundred astronomical observations for the latitude and longitude of the places we visited. When I tell you that all this, with scarcely an exception, was done by myself, besides doing a fair share of the rest of the work of the expedition, you can conclude that time did not lie heavy on my hands, and that I will have work enough this winter.

2. *From* Mr J. F. Robinson, *Frodsham, Cheshire.*

Mr R. says—" This summer at Oakmere, on Delamere Forest, I found the *Calamagrostis stricta* in tolerable abundance on the part of boggy ground nearest the Abbey Arms Hotel. Two other interesting species were also plentiful—*Lycopodium inundatum* and *Utricularia minor*. This place (I mean the bog adjoining the Mere) is extremely rich in muscological rarities; amongst others the following occur:—

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Sphagnum cymbifolium, *S. compactum*, *S. molluscum*, *S. cuspidatum*, *Dicranum Schraderi*, *Campylopus brevipilus*, *Atrichum crispum*, *Polytrichum gracile*, and *Hypnum Schreberi*; near the Abbey Arms, by the roadside, *Saponaria officinalis* is to be found sparingly, perhaps not truly wild.

Claytonia alsinoides will, I think, soon be a naturalised British plant, for this season I found it plentifully in a little wood by the river Mersey, at Ince, Cheshire. I venture no opinion as to how it reached this wood; it has certainly the appearance of having been there for some years.

About two years ago the *Anacharis Alsinastrum* first made its appearance in our marshes at Frodsham; now it is a sad pest, and will cause much inconvenience to the landholders, if not severe losses. It is in such quantity that in some cases the ditches overflow the roads. In one ditch I have noticed efforts being made to eradicate it, but without the slightest success hitherto.

I have of late paid a little attention to *Utricularia vulgaris*, which is not uncommon in our marsh ditches. In some of the places where it flowered profusely a few years ago, it appeared to be lost, and might be looked for in vain. This was owing, no doubt, to the ditches being partly filled with vegetation. Now that they have been "ditched"—the word used in Cheshire for cleansed—it has again appeared as abundantly as in former years. An interesting question to ask is, How has it lived or existed during these intervening years? as most, if not all, the vegetation in the ditch was in a state of decay—in fact, not unlike a bog or swamp. The beautiful little *Ranunculus circinatus* is also plentiful hereabouts, flowering only at the end of June or beginning of July, long after most of the other *Batrachian Ranunculi* have flowered.

3. From Mr Alexander Buchan, enclosing specimens of *Centunculus minimus* and *Radiola millegrana*, both gathered in August last a few yards from high-water mark, between the blue rock and the sea, Glen Sannox, Arran.

4. From Mr Alexander Curle, Abbey Park, Melrose, recording the discovery, by Mr Alexander Hay, Borthwick, and himself, of *Goodyera repens* in a wood near Melrose in considerable abundance.

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Miscellaneous Notices.

Dr John Lowe sent specimens of double-flowered *Calluna vulgaris*, collected this autumn by Miss Anna Everard, near Bournemouth. Mr M'Nab also exhibited specimens of the same, collected in Aberdeenshire in 1820.

Mr M'Nab laid before the meeting a longitudinal section of the stem of a *Wellingtonia*, 9 feet in height, raised from seed during the spring of 1857, and which died from being transplanted to an exposed situation during the winter of 1866. The *Wellingtonia*, he remarked, is easily transplanted during spring, summer, or the early autumn months. The most successful period was during summer. The present specimen, along with many others, was first transplanted on 1st July 1861. One of the remarkable features of the section now exhibited is the number of apparent woody rings, from five to ten being visible on what is well known to be an annual growth. Several of the known annual growths average, and in some cases exceed, ½ inch in breadth; while in a piece of wood, direct from California, not less than twelve distinct prominent rings or markings are visible over ½ inch of surface. Their closeness in the native-grown timber, as well as the intermediate rings in the home-grown specimens, is remarkable.

Professor Macpherson sent a specimen of an *Iris* from the island of Eigg, measuring 7 feet 4 inches in length; he also stated that he had measured specimens of *Pteris aquilina* growing there 11 to 12 feet high.

Mr W. Stewart, Selms, Mid-Calder, exhibited a specimen of a proliferous monstrosity of *Trifolium hybridum*.

J. G. Heddle, Esq., Melsetter, Orkney, sent a living plant of *Calluna vulgaris*, var. *tomentosa*.

Mr Wm. Gorrie exhibited specimens of species of *Medicago*, *Chenopodium*, and *Atriplex*, which he had collected in Selkirkshire, where they had been introduced with grain.

Mr Wm. Craig exhibited a double-spiked specimen of *Botrychium Lunaria*, and a branching variety of *Gentiana campestris*.

Sir Hugh Dalrymple, Bart., exhibited a section of the

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stem of a myrtle which grew for a hundred years in the open air at Luchie House, and was killed by frost during the winter of 1860–61.

12th December 1867.—Charles Jenner, Esq., President, in the Chair.

The following Gentlemen were elected Office-bearers for 1867–68:—

President.

Charles Jenner.

Vice-Presidents.

Professor Archer.
William Gorrie.
Is. Anderson-Henry.
Alexander Buchan.

Council.

Robert Hutchison.
Robert Traill.
Professor Allman.
Humphrey Graham, W.S.
A. Craig-Christie.
J. Kirk Duncanson.
G. C. A. Stewart.
Thos. Alex. Hog.
James M'Bain, M.D., R.N.
James M'Nab.

Honorary Secretary..........Professor Balfour.
Honorary Curator............The Professor of Botany.
Foreign Secretary............Professor Maclagan.
Treasurer........................Patrick Neill Fraser.
Auditor..........................William Brand, W.S.
Artist.............................Neil Stewart.
Vice-Secretary and Curator..............John Sadler.

Local Secretaries.

N. B. Ward, The Ferns, Clapham Rise, London, S.W.
William Carruthers, British Museum, London, W.C.
Alexander Dickson, M.D., Professor of Botany, Dublin.
George Dickie, M.D., Professor of Botany, Aberdeen.
Philip W. Maclagan, M.D., Berwick.
Charles C. Babington, Professor of Botany, Cambridge.
Thomas Shapter, M.D., Exeter.
James Gilchrist, M.D., Dumfries.
William Keddie, 5 India Street, Glasgow.
Joseph Dickson, M.D., St Heliers, Jersey.
Benjamin Carrington, M.D., Manchester.
William Alex. Stables, Cawdor Castle, Nairn.
Edward Charlton, M.D., Newcastle.
John Lowe, M.D., King's Lynn, Norfolk.

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F. Buchanan White, M.D., Perth.
Rev. W. A. Leighton, Shrewsbury, Shropshire.

John Kirk, M.D., Zanzibar, Africa.
Ferdinand Mueller, M.D., Ph.D., Melbourne, Australia.
George Birdwood, M.D., Bombay.
Thomas Anderson, M.D., Calcutta.
W. H. Campbell, LL.D., Georgetown, Demerara.
Alexander Hunter, M.D., Madras.
George Lawson, LL.D., Ph.D., Dalhousie College, Nova Scotia.
R. J. Shuttleworth, Berne, Switzerland.

The following Gentlemen were elected Fellows of the Society:—

1. *As a Resident Fellow.*
William Ramsay M'Nab, M.D.

2. *As Associates.*
James F. Robinson, Frodsham.
John Brown.

The following Donations to the Library were laid on the table:—

Beiträge zur Ethnographie und Sprachenkunde Amerika's zumal Brasiliens, von Dr Carl Friedrich Phil. von Martius. 8vo.—From the Author.

Lois de la Nomenclature Botanique rédigées et commentées, par M. Alph. De Candolle. 8vo.—From the Author.

Annals of the Lyceum of Natural History of New York, Vol. VIII. Nos. 13, 14. 8vo.—From the Society.

Journal of the Linnean Society, Vol. IX. (Botany), No. 40. 8vo.—From the Society.

Transactions of the Pharmaceutical Society, London, Vol. IX. No. 5. 8vo.—From the Society.

Transactions of the Royal Society of Victoria, Vol. VIII. Part 1.

The following Donations to the Museum at the Royal Botanic Garden were announced:—

From Mr Wm. Gorrie—Male and Female Cones of *Araucaria imbricata*, and branch of *Cupressus macrocarpa*, with Cones, produced at Holkham Hall, Norfolk.

From Mr Edmond—Pitchers of *Dischidia Rafflesiana*, an Indian climber, belonging to the Natural Order *Asclepiadaceæ*.

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I. *On the Nature of the Discoloration of the Arctic Seas.* By Robert Brown, Esq., F.R.G.S.

The peculiar discoloration of some portions of the frozen ocean, differing in a remarkable degree from the ordinary blue or light green usual in other portions of the same sea, and quite independent of any optical delusion occasioned by light or shade, clouds, depth or shallowness, or the nature of the bottom, has, from a remote period, excited the curiosity or remark of the early navigators and whalemen, and to this day is equally a subject of interest to the visitor of these little-frequented parts of the world. The eminent seaman, divine, and *savant*, William Scoresby, was the first who pointedly drew attention to the subject, but long before his day the quaint old searchers after a North-West Passage "to Cathay and Cipango" seem to have observed the same phenomenon, and have recorded their observations, brief enough it must be acknowledged, in the pages of "Purchas—His Pilgrimes," or the ponderous tomes of Master Hakluyt. Thus, Henry Hudson, in 1607, notices the change in the colour of the sea, but has fallen into error when he attributes it to the presence or absence of ice whether the sea was blue or green—mere accidental coincidences. John Davis, when, at even an earlier date, he made that famous voyage of his with the "Sunshine" and the "Moonshine," notes that, in the strait which now bears his name, "the water was very blacke and thicke, like unto a filthy standing pool."* More modern voyagers have more equally noted the phenomenon, but without giving any explanation, and it is the object of this paper to endeavour to fill up that blank in the physical geography of the sea. In the year 1860 I made a voyage to the seas in the vicinity of Spitzbergen and the dreary island of Jan Mayen, and subsequently a much more extended one through Davis' Straits to the head of Baffin's Bay, and along the shores of the Arctic Regions lying on the western side of the former gulf, during which I had abundant opportunities of observing the nature of this discoloration. At that period I arrived at the con-

* The First Voyage of M. Iohn Dauis vndertaken in June 1585. (Hakluyt's Collection.)

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clusions which I am now about to promulgate. In the course of the past summer I again made an expedition to Greenland, passing several weeks on the outward and homeward passages in portions of the seas mentioned, during which time I had an opportunity of confirming the observations I had made seven years previously, so that I consider I am justified in bringing my researches, so far as they have gone, before the Botanical Society.

1. Appearance and Geographical Distribution of the Discoloured Portions of the Arctic Sea.

The colour of the Greenland Sea varies from ultramarine blue to olive green, and from the most pure transparency to striking opacity, and these changes are not transitory but permanent.* Scoresby, who sailed during his whaling voyages very extensively over the Arctic Sea, considered that in the "Greenland Sea" of the Dutch—the "Old Greenland" of the English—this discoloured water formed perhaps one-fourth part of the surface between the parallels of 74° and 80° North latitude. It is liable, he remarked, to alterations in its position from the action of the current, but still it is always renewed near certain localities year after year. Often it constitutes long bands or streams lying north and south, or N.E. and S.W., but of very variable dimensions. "Sometimes I have seen it extend two or three degrees of latitude in length, and from a few miles to ten or fifteen leagues in breadth. It occurs very commonly about the meridian of London in high latitudes. In the year 1817 the sea was found to be of a blue colour and transparent all the way from 12° east, in the parallel of 74° or 75° N.E., to the longitude of 0° 12′ east in the same parallel. It then became green and less transparent; the colour was nearly *grass green*, with a shade of black. Sometimes the transition between the green and blue waters is progressive, passing through the intermediate in the space of three or four leagues; at others it is so sudden that the line of separation is seen like the rippling of a current; and the two qualities of the water keep apparently as distinct as the waters of a large muddy river on first entering the sea."† In Davis' Straits and Baffin's Bay,

* Scoresby—"Arctic Regions," i. 175. † *Ibid.* i. 176.

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wherever the whalers have gone, the same description may hold true—of course making allowances for the differences of geographical position, and the discoloured patches varying in size and locality. I have often observed the vessel in the space of a few hours, or even in shorter periods of time, sail through alternate patches of deep black, green, and cærulean blue; and at other times, especially in the upper reaches of Davis' Straits and Baffin's Bay, it has ploughed its way for 50 or even 100 miles through an almost uninterrupted space of the former colour. The opacity of the water is in some places so great that "tongues" of ice and other objects cannot be seen a few feet beneath the surface.

2. Causes of the Discoloration.

These patches of discoloured water are frequented by vast swarms of the minute animals upon which the great "Right whale" of commerce (*Balæna mysticetus*, Linn.) alone subsists, the other species of *cetacea* feeding on fishes proper, and other highly-organised tissues. This fact is well known to the whalers, and, accordingly, the "black water" is eagerly sought for by them, knowing that in it is found the food of their chase, and, therefore, more likely the animal itself. From this knowledge, and from observations made with the usual lucidity of that distinguished observer, Captain Scoresby attributed the nature of the discoloration to the presence of immense numbers of *medusæ* in the sea, and his explanation has hitherto met the acceptance of all marine-physical geographers; and for more than forty years his curious estimate of the numbers of individual *medusæ* contained in a square mile of the Greenland Sea has become a standard feature in all popular works on zoology, and a stock illustration with popular lecturers. In 1860, and subsequently, whilst examining microscopically the waters of the Greenland Sea, I found, in common with previous observers, that not only were immense swarms of animal life found in these discoloured patches, but that it was almost solely confined to these spaces. In addition, however, I observed that the discoloration was not due to this *medusoid* life, but to the presence of immense numbers of a much more minute object—a beauti-

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ful siliceous-moniliform *diatom*, and it is this *diatom* which brings this paper within the ken of botanists. On several cold days, or from no apparent cause, the *medusæ*, great and small, would sink, but still the water retained its usual colour, and on examining it I invariably found it to be swarming with *diatomaceous* life—the vast preponderance of which consisted of the *diatom* in question.

It had the appearance of a minute beaded necklace about 1-400th part of an inch in diameter, of which the articulations are about 1⅓ or 1¼ time as long as broad. These articulations contain a brownish-green granular matter, giving the colour to the whole plant, and again through it to the sea in which it is found so abundantly. The whole *diatom* varies in length, from a mere point to 1-10th of an inch, but appears to be capable of enlarging itself indefinitely longitudinally by giving off further bead-like articulations. Wherever, in those portions of the sea, I threw over the towing net, the muslin in a few minutes was quite brown with the presence of this alga in its meshes. Again, this summer, I have had occasion to notice the same appearance in similar latitudes on the opposite shores of Davis' Straits where I had principally observed it in 1860. This observation holds true of every portion of discoloured water which I have examined in Davis' Straits, Baffin's Bay, and the Spitzbergen or Greenland Seas—viz., that wherever the green water occurred, the sea abounded in *diatomaceous* life, the contrary holding true regarding the ordinary blue water. These swarms of *diatoms* do not appear to reach in quantity any very great depth, for in water brought up from 200 fathoms there were few or no *diatoms* in it. They seem also to be affected by physical circumstances, for sometimes in places where a few hours previously the water on the surface was swarming with them, few or none were to be found, and in a few hours they again rose. But the *diatom* I found plays another part in the economy of the Arctic Seas. In June 1860, whilst the iron-shod bows of the steamer I was on board of crashed its way through among the breaking-up floes of Baffin's Bay, among the Women's Islands, I observed that the ice thrown up on either side was streaked and discoloured brown ; and on examining this discolouring matter I found that it was

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almost entirely composed of the siliceous moniliform *diatom* I have described as forming the discolouring matter of the iceless parts of the icy sea. I subsequently made the same observation in Melville Bay, and in all other portions of Davis' Straits and Baffin's Bay where circumstances admitted of it. During the long winter the *diatomaceæ* had accumulated under the ice in such abundance that when disturbed by the pioneer prow of the early whalers they appeared like brown slimy bands in the sea, causing them to be mistaken more than once for the waving fronds of *Laminaria longicruris* (De la Pyl.) which, and not *L. saccharina*, as usually stated, is the common tangle of the Arctic Sea. On examining the under surface of the upturned masses of ice, I found the surface honeycombed, and in the base of these cavities vast accumulations of *diatomaceæ*, leading to the almost inevitable conclusion that a certain amount of heat must be generated by the vast accumulations of these minute organisms, which thus mine the giant floes, so fatal in their majesty, into cavernous sheets. These are so decayed in many instances as to be easily dashed on either side by "ice chisels" of the steamers which now form the greater bulk of the Arctic-going vessels, and they get from the seamen, who too frequently mistake cause for effect, the familiar name of "rotten ice." I have since found that, as far as the mere observation concerning the *diatomaceous* character of these slimy masses is concerned, I was forestalled by Dr Sutherland (Appendix to "Penny's Voyage," cxcviii. and vol. i. pp. 91–96). This gives me an opportunity of remarking that though one diatom, as I have remarked, predominates, yet vast multitudes are there of many different species, and even *protozoa* are included; for though Dr Sutherland expressly states that this brown slimy mass was principally composed of the moniliform *diatom* spoken of, yet Professor Dickie (now of Aberdeen) found in it also *Grammonema Furgensii*, Ag., *Pleurosigma Thuringica*, Kg., *P. fasciola*, *Triceratium striolatum*, *Naviculæ*, *Surirellæ*, &c. Is it, therefore, carrying the doctrine of final causes too far to say these diatoms play their part in rendering the frozen north accessible to the bold whalemen, as I shall presently show they do, in furnishing subsistence for the giant *quarry* which leads him thither?

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I have spoken of the discoloured portions of the Arctic Sea as abounding in animal life, and that this life was nowhere so abundant as in these dark spaces which, as I have already demonstrated, owe this hue to the *diatomaceæ* in question.

These animals are principally various species of *Beroidæ*, and other *steganophthalmous medusæ; Entomostraca*, consisting chiefly of *Arpacticus Kronii*, *A. chelifer* and *Cetochilus arcticus* and *septentrionalis*, and pteropodous mollusca —the chief of which is the well-known *Clio borealis*, though I think it proper to remark that this species does not contribute to the whale's food nearly so much as we have been taught to suppose. The discoloured sea is sometimes perfectly thick with the swarms of these animals, and then it is that the whaler's heart gets glad as visions of "size whales" and "oil money" rise up before him, for it is on these minute animals that the most gigantic of all known beings solely subsists. What, however, was my admiration (it was scarcely surprise) to find, on examining microscopically the alimentary canals of these animals, that the contents consisted entirely of the *diatomaceæ* which give the sable hue to portions of the Northern Sea in which these animals are principally found! It thus appears, that in the strange cycle of nature, the "whales' food" is dependent on the *diatom*, so that in reality the great things of the sea depend for their existence upon the small things thereof! I subsequently found (though the observation is not new) that the alimentary canals of most of the smaller *mollusca*, *echinodermata*, &c., were also full of these *diatomaceæ*. I also made an observation which is confirmatory of what I have advanced regarding the probability of these minute organisms giving off *en masse* a certain degree of heat, though in the individuals inappreciable to the most delicate of our instruments. On the evening of the 4th of June, this present year (1867), in latitude 67° 26′ N., the sea was so full of animal (and *diatomaceous*) life, that in a few minutes upwards of a pint measure of *entomostraca*, *medusæ*, and *pteropoda* would fill the towing net. The temperature of the sea was then by the most delicate instruments found to be 32·5 Fahr., and next morning (June 5th), though the air had exactly the same tempera-

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ture, no ice at hand, and the ship maintained almost the same position as on the night previous, yet the surface temperature of the sea had sunk to 27·5 Fahr., and was clear of life, so much so, that in the space of half an hour the towing net did not capture a single *entomostracon*, *medusa*, or *pteropod*. I also found that this swarm of life ebbed and flowed with the tide, and that the whalers used to remark that whales along shore were most frequently caught at the flow of the tide, coming in with the banks of whales' food. This mass of minute life also ascends to the surface more in the calm Arctic nights when the sun gets near the horizon during the long, long summer. In 1860 I was personally acquainted with the death of thirty individuals of the "right whalebone whale" (*Balæna mysticetus*, L.), and of this number fully three-fourths were killed between ten o'clock P.M. and six o'clock A.M., having come on the "whaling grounds" at that period (from amongst the ice where they had been taking their *siesta*), to feed upon the animals which were then swarming on the surface, and these again feeding on the *diatomaceæ* found most abundantly at that time in the same situations. I would, however, have you to guard against the supposition, enunciated freely enough in some compilations, that the whales' food migrates, and that the curious wanderings of the whale north, and again west and south, is due to its "pursuing its living;" such is not the case. The whales' food is found all over the wandering ground of the *mysticete*, and in all probability the animal goes north in the summer in pursuance of an instinct implanted in it to keep in the vicinity of the floating ice-fields (now melted away in southern latitudes); and again it goes west for the same purpose, and finally goes south at the approach of winter—but where, no man knows. There are some other streaks of discoloured water in the Arctic Sea known to the whalers by various not very euphonious names, but these are merely local or accidental, and are also wholly due to *diatomaceæ*, and with this notice may be passed over as of little importance. I cannot, however, close this paper without remarking how curiously the observations I have recorded afford illustrations of representative species in different and widely separated regions. In the Arctic Ocean the *Balæna mys-*

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ticetus is the great subject of chase, and in the Antarctic and Southern Seas the hardy whalemen pursue a closely allied species, *Balæna australis.* The northern whale feeds upon a *Clio borealis* and a *Cetochilus septentrionalis;* the southern whale feeds upon their representative species, *Clio australis* and *Cetochilus australis*, which streak with crimson the Southern Ocean for many a league. The Northern Sea is dyed dark with a *diatom* on which the *Clios* and *Cetochili* live, and the warm waters of the Red Sea are stained crimson with another: and I doubt not but that, if the Southern Seas were examined as carefully as the Northern have been, it would be found that the Southern whales' food lives also on the *diatoms* staining the waters of that Austral Ocean.

I do not claim any very high credit for the facts narrated in the foregoing paper, either general or specific, for really it is to the exertions of the ever-to-be-admired sailor-savant, William Scoresby, that the first faint light which has led to the solution of the question is due, though the state of science in his day would not admit of his seeing more clearly into the dark waters of that frozen sea he knew and loved so well.

At the same time, I believe that I am justified in concluding that we have now arrived at the following conclusions from perfectly sound data, viz.:—

1. That the discoloration of the Arctic Sea is due not to animal life, but to *diatomaceæ.*

2. That these *diatomaceæ* form the brown staining matter of the "rotten ice" of Northern navigators.

3. That these *diatomaceæ* form the food of the *Pteropoda*, *Medusæ*, and *Entomostraca*, on which the *Balæna mysticetus* subsists.

I have brought home abundant specimens of the *diatomaceous* masses which I have so frequently referred to in this paper, and I am now engaged in distributing them to competent students of this order, so that the exact species may be determined; but as these take a long time to be examined (more especially as *diatoms* do not seem so popular a study as they were a few years ago), I have thought it proper to bring the more important general results of my investigations before you at this time, and to allow the less interesting subject of the determination of

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species* to lie over to another time. I have to apologise to you for introducing so much of another science, foreign to the objects of the Society, into this paper; but when the lower orders of plants are concerned, we are so near to the boundaries of the animal world, that to cross now and then over the shadowy march is allowable, if not impossible to be avoided.

Finally, you will allow me to remark that, in all the annals of biology, I know nothing more strange than the curious tale I have unfolded: the *diatom* staining the broad frozen sea, again supporting myriads of living beings which crowd there to feed on it, and these again supporting the huge whale,—so completing the wonderful cycle of life. Thus it is no stretch of the imagination to say that the greatest animal in creation,† whose pursuit gives employment to many thousand tons of shipping and thousands of seamen, and the importance of which is commercially so great that its failure for one season was estimated for one Scottish port alone at a loss of L.100,000 sterling,‡ depends for its existence on a being so minute that it takes thousands to be massed together before they are visible to the naked eye, and, though thousands of ships for hundreds of ocean years sailed the Arctic, unknown to the men who were most interested in its existence, illustrating in a remarkable degree how nature is in all her kingdoms dependent on all—and how great are little things!

II. *Notes on the Flora of Rannoch.* By Dr F. Buchanan White.

To the botanist, who in addition to his love for Flora adds that of the other branches of natural science, the basin of Loch Rannoch, in Perthshire, acquires a peculiar interest, from its great and justly merited celebrity for its insect fauna, which includes many alpine and boreal species as yet undetected in any other part of the British Isles.

* The species principally causing the discoloration is apparently *Melosia arctica.*

† Nilsson, in his "Skandinavisk Fauna," vol. i. p. 648, estimates the full-grown *B. mysticetus* at 100 tons or 220,000 lbs., or equal to 88 elephants or 440 white bears.

‡ In 1867 the twelve screw steamers of Dundee only took two whales, and the loss to each steamer was estimated at L.5000, and to the town in all at the sum I have given.

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As insects and plants are so closely connected together, I deemed that it would be a labour not devoid of interest to endeavour to trace some cause in the Flora by which the presence of so many northern insects might be accounted for. This, however, I have not succeeded in doing altogether to my own satisfaction, for though Rannoch indeed possesses many interesting species, yet the rarer alpine plants do not occur at all, or only in such sparing quantity that it can scarcely be considered that they have any influence on the fauna.

The absence of several alpine plants is the more striking since the Breadalbane mountains (which I may say are the metropolis of the Alpine Flora of Great Britain) are only a few miles distant, and separated by one range of hills from the Rannoch district. The absence (if indeed they are truly absent) of many alpine insects from the Breadalbane district is, I think, equally remarkable. In noticing the Flora of Rannoch, I shall, however, touch slightly on what I think will perhaps account for so many northern insects; and as the facts remain, perhaps they may interest other Entomological botanists.

The district which is comprehended under the title of "Rannoch" includes that part of Perthshire which drains into Loch Rannoch—a lake of about 11 miles in length, lying east and west, and closely approached on its longer sides by high mountains, but more open at either end—at the east, where the Tummel flows out to discharge itself into the Tay, and at the west, where the tributary streams from lochs Gauer, Lydoch, &c., wind through the desolate Moor of Rannoch, to swell the dark waters of the lake. The mountains, unlike those of the Breadalbane range, are well clothed to some height with heather and great beds of the fragrant myrica, and on the lower slopes openly wooded with birch trees—still very numerous, but once, I believe, covering the whole district. In one part of the south shore of the loch a thick primeval pine (*Pinus sylvestris*) forest extends for about 3 miles, and from its sombre appearance is aptly named the "Black Wood." The timber of this forest is celebrated for its durability, and only a few years ago was valued at about L.22,000. In its recesses occur many insects not found in any other part of Britain,

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and some even yet undetected in any other place whatever; but, strange to say, I could not find any of those plants which *ought* to be there, and which I have found in similar forests of pine (*Pinus Cembra*) in the Canton Grisons in Switzerland. I fully expected to have found here *Linnæa borealis*, *Goodyera repens*, *Moneses grandiflora*, and still think that one or more of these plants *must* be there.

From its elevation, and probably poor soil, but little land repays cultivation at Rannoch; and of the cereals, oats appear to be the chief—wheat and barley (which at one time was much attended to for purposes of illicit distillation), scarcely put in an appearance. The springs are late, and autumn long, and (this season at least) snow visible on some of the higher hills throughout the year. On the 3d of October, Schiehallion and the higher hills were quite white with snow; and on the 4th snow fell heavily all day throughout the district, but next day it had disappeared; and in that same week I gathered ripe strawberries and gooseberries in my garden, and saw various flowers (*Erica cinerea*, *E. Tetralix*, *Calluna*, &c.) still blooming on the hills. A few days later, I daresay, a prettier landscape could not have been found in all "broad Scotland" than that from Kinloch bridge. The foreground, an oat field covered with yellow stooks, and fringed by green trees and the clear and rapid river; in the middle distance, the blue loch, reflecting the dark pines of the Black Wood; and the background formed by a range of grand mountains, thickly robed with purest snow, while overhead shone the warm autumnal sun in the bright blue sky. The Vierwaldstattersee from Lucerne, and the Lake Como from Bellagio, were brought at once to our remembrance by this view, but I think that of the three, Rannoch would have borne away the palm.

The Flora of Rannoch is not rich in numbers of species; for owing, I fancy, to its elevation above the sea level, &c., many lowland plants seem to be altogether absent. Probably I should say not more than 300 Phanerogamous species will be found in the district.

The elevation of Loch Rannoch above the sea level is 716 feet. If to this height (which is taken from the level of the Loch) we add 34 feet (not by any means too much

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to allow for the high banks which bound the Loch at many points) we get exactly 250 yards.

Now, in the *Cybele Britannica* various plants have their maximum altitudes placed at a lower level than this, and to certain of these plants occurring at Rannoch I will now briefly draw the attention of the Society:—

Name of Plants.	Altitude in Yards.		Name of Plants.	Altitude in Yards.	
	Cybele Britann.	Probable at Rannoch.		Cybele Britann.	Probable at Rannoch.
Hypericum humifusum,	150	250	Hippuris vulgaris, .	150	250
Drosera intermedia, .	200	300	Neottia nidus-avis, .	200	300
Fumaria officinalis, .	200	250	Potamogeton hetero-	200	250
Vicia Orobus, . . .	200	250?	phyllus, ...	200	300
Ononis arvensis, . .	200	250	Lemna minor, . . .	200	300
Rosa systyla, . . .	200	250	Sparganium ramosum,	200	250
Pyrus Malus, . . .	200	250	,, simplex, .	200	250
Sherardia arvensis, .	200	250	Lycopodium inundatum	200	250
Arctium Lappa, . .	150	250			

With the exception probably of *Vicia Orobus*, the heights given above are rather under than above the mark, and some of the plants might even be placed at 100 yards higher, and still not reach their maximum altitude. Among these would be *Drosera intermedia*, *Hippuris vulgaris*, *Potamogeton heterophyllus*, *Lemna minor*, and *Sparganium simplex*. Regarding *Arctium*, I do not know whether it can be considered truly wild, as I only saw one or two plants, and these near a cottage. It is, however, common elsewhere in the county, and in this case there was no garden, while it is not a plant that is likely to be cultivated for its beauty.

Two other plants, *Ribes nigrum* and *Mentha piperita*, exceed the altitude given in the *Cybele*, but these are no more truly native here than they are in most parts of Britain.

We will now proceed to enumerate some of the more interesting Rannoch plants :—

Thalictrum alpinum, Ben Hulich [I am not certain as to the correct spelling of this name, but it is the hill directly north of Kinloch-Rannoch]; *Thal. minus*, shore of the loch; *Trollius europœus*, *Lepidium Smithii*, near Dall; *Subularia*

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aquatica; Montia fontana, on the top of a wall—rather an anomalous situation, but evidently accidental; *Vicia Orobus*, not rare beside the river; *Alchemilla alpina*, of course abundant, and excessively so on Cross Craig, but, curiously, on this hill, which seems particularly adapted from its numerous rocks for alpine plants, no others, except *Azalea procumbens*, were found. *Sibbaldia procumbens, Rubus Chamæmorus* and *saxatilis, Rosa systyla; Pyrus Malus*, widely scattered and evidently native; *Epilobium alpinum* and *alsinifolium*, on Ben Hulich; *Hippuris vulgaris*, on the high hills between Rannoch and Aberfeldy; *Saxifraga stellaris, Saxifraga aizoides, hypnoides, nivalis* and *oppositifolia*, Ben Hulich, &c.; *Drosera intermedia*, near Cross Craig, and along the shore of the loch,—a beautiful plant when seen (as I first saw it) with its dewy leaves shining forth among the barren darkness of a "peat-hag." *Meum athamanticum, Cornus suecica*, Ben Hulich (*fide* Mr Rogers); *Asperula odorata*, very scarce; *Galium boreale, Hieracium prenanthoides, Carduus heterophyllus, Chrysanthemum segetum*, not rare; *Gnaphalium supinum, Senecio sylvaticus, Campanula latifolia, Vaccinium uliginosum, Oxycoccos*, and the rest of the genus; *Arctostaphylos Uva-ursi*, abundant; *Azalea procumbens*, Cross Craig, common; *Pyrola secunda*, near Dall (Mr Rogers); *Ilex Aquifolium* and *Fraxinus excelsior*, both truly native; *Melampyrum sylvaticum*, not rare; *M. pratense, Mimulus luteus*, abundant in a ditch at the west end of the loch; *Mentha piperita*, Cammachgouran; *Trientalis europæa, Plantago maritima*, very common along roadsides throughout the district; *Littorella lacustris, Oxyria reniformis, Polygonum viviparum, Salix herbacea, Populus alba*, native; *Myrica Gale*, very abundant, *Betula nana*, plentiful on Ben Hulich; *Quercus Robur*, native; *Juniperus communis*, much scarcer than in some other parts of the country (*e.g.* Dunkeld); *Gymnadenia conopsea, G. albida, Habenaria viridis, H. bifolia, H. chlorantha, Neottia nidus-avis; Malaxis paludosa*, lower slopes of Schiehallion (Mr Rogers); *Tofieldia palustris*, Ben Hulich; *Sparganium simplex, Lemna minor*, only in one station among the hills, nine miles S.E. of Kinloch, along with *Hippuris; Potamogeton heterophyllus*, very fine in the river and on the hills; *Carex curta, rigida, sylvatica*, &c.; *Equisetum arvense*,

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very rare; *E. sylvaticum*, *Polypodium Dryopteris* and *Phegopteris*, *Polystichum Lonchitis*, Ben Hulich; *Asplenium viride*, *Asp. Trichomanes* and *Adiantum-nigrum*, rare—*ruta-muraria* altogether absent; *Hymenophyllum Wilsoni* in several places; *Isoetes lacustris* in Loch Chailleach on Ben Hulich (Mr Rogers); *Lycopodium*, all the species; *annotinum*, Ben Hulich; *inundatum*, below Schiehallion (Mr Rogers).

The following varieties and aberrations also occurred at Rannoch:—

Scabiosa succisa, with flowers very pale pink; *Bellis perennis*, with the usually ligulate ray florets tubular; *Achillea Millefolium*, with flowers dark crimson; *Senecio Jacobæa*, flowers with the ray absent; *Calluna vulgaris*, *Erica cinerea*, and *E. Tetralix*, with white flowers; *Erica cinerea*, pink-flowered variety; *Gentiana campestris*, white flowers; *Thymus Serpyllum*, flowers white, and the plant altogether smaller; *Pteris aquilina*, one frond with all the pinnæ bifurcated.

On a future occasion I hope to be able to give some notes on the Bryology of Rannoch, which is much richer than the Phanerogamous Flora.

III. *Notice of a New Carduus gathered during a botanical visit to Ross-shire.* By Mr CHARLES HOWIE and Mr CHARLES JENNER.

The discovery in our day of a large Phanerogamous plant, apparently new among the Scotch mountains, is a subject of much interest, and I confess that I have great pleasure and satisfaction in being able this evening to bring such a plant under the notice of this Society. Our mountain district, comparatively narrow, having been so thoroughly searched, it seems strange that the large Carduus which Mr Howie and I found last summer should have escaped the observation of botanists; and I feel sure that it must be not only limited in its distribution, but in all probability is a natural hybrid of recent origin, perpetuating itself as a determinate well-marked species. We found the plant during an excursion in Ross-shire and Inverness-shire, in July last. It was many miles from any cultivated land, growing in peaty soil,

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among heather, on a high bank above a rocky streamlet. Grim, old, indigenous trees, of the *Pinus sylvestris*, were thinly scattered up and down, and mountains of considerable elevation shadowed the place. So far as our observation enabled us to judge, the station for the plant was limited to an area of twenty feet. The purpose of our excursion having been only to collect cryptogams and the smaller alpine plants for my rockery and frames, we had not taken with us any drying-paper or boards; and we lifted only one root of this Carduus, which is now growing in my garden. The peculiarity of its foliage, however, as well as its head of flowers, was so foreign to our experience, that we preserved a few leaves, part of a stem, and a corymb, which my wife pressed in a small drying-book she carried.*

We left the district on the following day, but each subsequent examination of the fragments more and more excited our interest. We failed altogether to identify it with any species in our British flora. On our return to Edinburgh we made a new examination of the root, which had been sent home on the day it was dug up. We were confirmed in the opinion that the plant was at least new to Britain, if not to Europe.

The only Carduus we could find, in the books to which we had access, that had any near resemblance to ours, was the *Carduus helenioides* of Linnæus, described in his "Species Plantarum," 2d ed. 1763, vol. ii. page 1155: "(21.) *Carduus helenioides* — foliis amplexicaulibus lanceolatis, dentatis; spinulis inequalibus ciliatis, caule inermi (Hort. Cliffortianus, 392; Hort. Ups., 250). Antecedenti simillimus (*C. heterophyllus*) sed duplo, seu homine altior. Radix vix repens, foliis omnibus indivisis, subtus albis, at non ut illi niveis. Caulis sulcatus, totus foliosus. Foliis 40 ad 50, semiamplexicaulibus (auriculis rotundis, reflexis, adnatis) dentatis, ciliatis spinis inermibus; Floralibus subulatis. Habitat in Anglia, Sibiria."

In the 1797 edition by Willdenow, vol. iii. part iii., page 1674, No. 25, we find,—"*Cnicus helenioides*, W.—foliis subcordatis-amplexicaulibus lanceolatis ciliatis subtus tomen-

* The fragments thus gathered in July, as well as the plants subsequently obtained—in all twelve sheets—were laid on the table, at the Society's meeting.

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tosis, inferioribus subincisis; floribus aggregatis, calycinis squamis lanceolatis adpressis mucronatis. W.

"Variat magnitudine; differt vero ab antecedente floribus non solitariis terminalibus, sed ternis aggregatis. W.

"(24.) *Cnicus heterophyllus*, W. = *Cirsium helenioides*, Allioni Flor. Pedemont. 553, tab. 13.

"Caulis sesquipedalis seu brevior. Foliis 5 ad 10 non dentatis ciliatis subtus niveis; aliis integris, aliis laciniatis. Radix repens."

Allioni, in his "Flora Pedemontana," gives a plate of *C. helenioides*, as well as the following account of it:—

Cirsium helenioides, page 152, vol. i., tab. 13.

"*Cirsium* foliis ciliatis subtus tomentosis, radicalibus petiolatis ovato-lanceolatis aut semipinnatis. *Hall. Helv.* tom. i. n. 180, tab. 7.

"*Carduus helenioides. Linn. Sp. Pl.* 1155.

"*Cirsium* singulari capitulo squamato, vel incanum alterum. *Bauh. Pinax*, 377. It is also marked as being *Cirsium anglicum* of Bauhin, Hist. III. p. 45; radice Hellebori nigri modo fibroso, folio longo.

Desc. — Altitudo tripedalis et sexpedalis. Folia semiamplexicaulia, auriculis rotundis, lanceolata, subtus incana denticulata usque ad medium minutis pinnulis ciliata, denticulis majorem spinam exerentibus. Caulis araneosa lanugine indutus longe foliis nudus et semel aut bis in longissimos pedunculos divisus. Calyx ventricosus, conicus, floribus extra calycem instar Centaurea exsertis. Flos purpureus quinquefidus fere bilabiatus, hoc est, segmento uno profundius fisso, tubo purpureo; flosculorum pars inferior alba, qua parte purpureum colorem acquirit, inflectitur, et curvatur. Interni centrales flores minus incurvati, tubo longe extra florem protenso ad extremitatem suam violaceo colore intensius colorata incisa. Calycis squamæ triangulares apice tantum inter se recedunt, non reflexæ. Calyx ea ratione qua semina grandescunt, ventricosior redditur et cogit tubos flosculorum incurvari: Pappus sessilis, plumosus sericeus multus: Receptaculum pilosum.

"*Localis.*—Abunde in pratis fertilioribus editiorum montium et presertim secus fluentes aquas. Circa Tenda, Mont Cenis, Grassonay."

The plate No. 13 in the work seems scarcely to agree

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with Linnæus' description, and I venture to think Allioni had not the same species under his notice.

In De Candolle's Prodromus, *C. helenioides* of Linn., as also that of Allioni, is made a synonym of *Cirsium heterophyllum* under the division *indivisum*, and reference is made to Eng. Bot., plate 675, as well as to the plate of Allioni previously referred to; but neither the plate in English Botany, nor the letterpress description given there, agrees with Linnæus or with Allioni, any more than Allioni agrees with Linnæus, and I cannot think the authors had before them identically the same plant.

In Rees' Cyclopedia occurs the following notice, under *Carduus helenioides.* Linn. Spec. Plant. 21. *Cnicus helenioides* (Willd.), 25. "Leaves embracing the stem, lanceolate toothed ciliated with small unequal spines, stem spineless, (Linn.) In habit much resembling *C. heterophyllus*, toothed, not laciniated, half embracing the stem, with round reflexed adnate auricles, floral leaves awl-shaped. Flowers four or five at the top of the stem, only half the size of those in *C. heterophyllus* (Willd.) From a living plant; a native of Siberia. Dr Smith assures us that he has not seen it, either wild or cultivated, in Great Britain."

The editor of the Cyclopedia omits all mention of *Anglia* as a habitat for the plant, but that station is given by Linnæus in his 1753 as well as in his 1763 edition of Spec. Plantarum, though in Willdenow's edition of 1794 Anglia is omitted; and all subsequent authors seem also to have dropped it. In a footnote to the letterpress description of *C. pratensis*, in English Botany, date 1793, botanists in Britain are requested to look for *C. helenioides.*

I now give the descriptive characters of our plant, and leave it to be seen how far it coincides or differs with the plants of the authors.

CARDUUS CAROLORUM. *The Charles Thistle.*

Root **perennial, fibrous, deeply rooting in the soil, crown cæspitose, producing several stems.**

Stems **from two to four feet high, furrowed, slightly cottony, leafy from top to bottom, terminating in a corymb of from five to nine capitula.**

Leaves.—**Root leaves lanceolate, gradually tapering at the base**

into a long petiole, sinuate-dentate, fringed with short unequal bristles, cottony beneath (but not so snowy white as *C. heterophyllus*), the upper surface pilose.

Stem leaves from twenty to thirty (cottony beneath also, and pilose above), lower, narrowing into long winged petioles, lobed as well as deeply toothed, upper leaves more nearly sessile, semi-amplexicaul with decurrent auricled prolongations; nearer the summit smaller, sharply toothed, acute at the point; floral leaves awl-shaped.

Involucres obovate or globular.

Phyllaries lanceolate, adpressed, acuminate, dentate towards the apex.

Pappus deciduous, short, rigid, feathery, forming a ring at the base.

Achenes ovate, compressed with a circular depression into which the pappus is inserted.

Flowers purple.

A very handsome plant.

There are, in my opinion, some peculiarities in our plant which are not specified by Linnæus; and that it differs from Allioni's I feel quite certain. But I leave the determination of this question to more able botanists than myself.

In the hope that I might be able to throw some light on the plant by an inspection of the herbarium of Linnæus, I took an opportunity of seeing it at the rooms of the Linnean Society in London; but although I found plants in his Hortus Siccus named *C. helenioides*, and also in the Cliffortian collection at the British Museum, they neither agreed with the letterpress description of Linnæus, nor with our plant. Indeed, whether I looked to the sources I have named, to the synonyms in De Candolle's Prodromus, to the plate often referred to in Allioni's Flora Pedemontana, or to the synonyms given in those works, or in our later botanical publications, I found nothing but confusion; and the more I searched books and dried specimens, with their manifold alterations of names, the more confounded my confusion became. Under these circumstances, I betook myself again to nature, and an independent examination of my plant, and endeavoured, at least, to understand well what I had got. Mr Howie, with the love of science which distinguishes him, kindly undertook to improve our position by going north to the station again, and collecting more plants. We had lost, however, much

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valuable time, for it was now October, and wind, frost, and snow had been there before him. Our plant, so full of beauty in July, was now dried, dashed, broken, and faded. He procured, however, a dozen roots, which are thriving well in my garden, and will, I trust, during the next summer, supply us with abundant details for interesting investigation, and the determination of all questions about the plant. Whether it is the *C. helenioides* of Linnæus or another, it seems to me a very notable scientific incident that this plant should now be found for the first time in a place that must have often been traversed by botanists and other students of nature. It is also to my mind no less remarkable that a plant, at least very like to it, is located in the north of Asia, and under conditions not dissimilar from those that govern the appearance of our stranger here. I can scarcely think that, however closely the two plants resemble each other, they have one common origin. That they originated in the same circumstances, or had an origin in common, I cannot doubt; and that which is common to the two localities may explain the case. I refer to the occurrence, both in Siberia and in our district, of *Carduus palustris* and of *Carduus heterophyllus*, to both of which the *C. helenioides* of Linnæus and our plant have a close resemblance, though distinguished by marked differences. Yet even in the differences there is a wonderful analogical affinity. At our station we found a few stray plants of *C. palustris* within a short distance, and also some isolated patches of *C. heterophyllus* not far removed. Mr Howie and I have made a strict and critical examination of the three plants, and I will submit a few of those relational attributes which lead me to think our plant is a true natural hybrid between the two species I have mentioned. It possesses some of the typical characters of both, but evolves in its individual form qualities different from the plants I suppose to be its progenitors. I ask your kind attention, in the faith that the matter is very worthy of notice, and if I am right, will be sure to come up again in connection with important physiological problems.

In the first place, we will see what relation the roots of these three species bear to each other, in what particulars they agree, and in what they differ. The root of our new

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plant is perennial, cæspitose, fibrous, rooting down deeply into the soil, and the young shoots push out from the axis of the roots, forming a clump of closely clustered stems. The root of *Carduus heterophyllus* is perennial also, but it is stoloniferous, and the stolons give off solitary stems a little removed, forming patches. The root of *Carduus palustris* is small and branched; it sends up only a solitary stem, and is biennial. In my judgment our plant has its rooting habit from *C. palustris*, but obtains its perennial powers and numerous stems from *C. heterophyllus.* The general aspect of *C. palustris* is so very different from our plant, that but for the accordance just noted in common with some others, which we shall presently refer to, affinity between them would not be suspected. *Carduus palustris* is all over a very spinous stiff plant (stem and leaves), the spines being hard and prickly; it has a slight, branched, solitary, winged stem. The stem leaves are lobed, the root leaves petiolate, and it has a clustered head of flowers. Each capitulum is small, and the pappus is short and rigid.

Both our plant and *C. heterophyllus* are flexuous, the spines that arm them are soft, and they are thus easily handled. In *C. heterophyllus* the root leaves are ovate, lanceolate, glaucous on the upper surface, and have short petioles. The stem leaves are all sessile, with large rounded auricles; they vary very much in their external contour, as the name of the plant implies, and as is well shown by the specimens on the table. Many of the leaves are waved in their outline, tending somewhat to contraction about the middle. Many are deeply laciniated or incised, others have smooth entire margins. They do not appear, however, to be ever lobed, nor to attain the fine long narrow lanceolate form of those of the new plant. The flowers of *heterophyllus* are usually limited to one capitulum, but sometimes two and even three are met with. The capitula are broadly ovate, large, loose in habit, and the pappus partakes of the same character, being long, light, and thin; in this, as in both the others, the pappus is deciduous.

The root leaves in our new plant are very long, and finely lanceolate, with long slender petioles frequently exceeding the length of the laminæ. The lower stem leaves have also very long petioles, but they are deeply lobed;

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while the upper stem leaves, also lobed, are sessile, with winged prolongations. The topmost leaves are sessile, with short auricles; and the floral leaves are delicately awl-shaped. The heads of flowers, five to nine in number, are placed on the axis in a corymbose form, are much smaller than those of *C. heterophyllus*, but larger than those of *C. palustris.* The habit of each capitulum is close and contracted; the pappus is comparatively short and rigid. Some individual plants have a looser habit in flower, and indicate a leaning to *heterophyllus.*

Detailing now in a cursory way my idea of this hybrid, it appears to me that our new plant has its flexuose habit and soft spines, its lanceolate entire leaves and numerous stems, from *C. heterophyllus;* while its decurrent lobed stem leaves, its numerous capitula, the stunted form of the capitulum, and the short rigid pappus, are derived from *C. palustris.* The late period of the year when we got our plants (October), prevented that examination of the stamens and pistils, the corolla, the pollen, the ovary, &c., which we trust to make during next summer.

Hybrid forms of thistles seem to be not infrequent in nature, but I am not aware that any one has made them a subject of special study. Our *Carduus Forsteri* is regarded as a hybrid between *C. pratensis* and *C. palustris.* *C. tuberosus* is suspected to be a hybrid between *C. crispus* and *C. acaulis* (Bab. Flora, page 202, ed. 1867), and other crosses with *C. acaulis* are somewhat doubtfully referred to by the same authority. In Hartmann's "Hand-book of the Scandinavian Flora" (Stockholm, 1849), page 16, a hybrid is described between *C. heterophyllus* and *C. acaulis*, one between *C. oleraceus* and *C. heterophyllus*, and another between *C. acaulis* and *C. oleraceus.* Stations are given for each, and the degrees of affinity are explained, but no information is given as to the constancy of their forms.

I understand that *C. Forsteri* is a rare form, but I do not know whether it is a true species, always to be found by careful search in the localities where it may have been previously gathered. The interest that attaches to such hybrid forms must, it appears to me, vary with the power each form may have of maintaining its place in nature under her ordinary conditions, and of transmitting

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its specific differences from generation to generation. When they do this I can but think they are good and true species, whether they had their origin in hybridisation, or in any other way.

Referring now to the *Carduus* which is the subject of this paper, my present experience demonstrates, that although the plants, so far as we at present know, are few, they must have been many years in the place we found them, and they have produced new young plants from seed. In proof of this we have perennial roots of considerable age and seedling plants of last year growing now in my garden. We have also among our dried specimens a first year's floral stem of a seedling with its corymb of small abortive flowers. The cauline leaves are on the stem, as is not unusual on the first year's growth of herbaceous perennial plants. If it shall prove that the plant is really limited to the small area within which we found it, the circumstances may be explained by the fact, that of sixteen capitula which were gathered in October from the withered stems, no less than fifteen had the seeds destroyed by insects, the larvæ being found among the pappus and chaffy scales of the receptacle. It will be borne in mind, too, that the pappus being deciduous does not favour the dispersion of the seed.

Should subsequent research prove this *Carduus* to be a persistent species of recent origin; if time confirm its power of perpetuating itself in descendants with like distinctive characters to those which it possesses; if its peculiarities are conserved in young new plants developed under natural conditions from its seed;—I think we shall have ascertained one way, at least, in which nature enriches and varies the flora of the earth.

IV. *On the Botany of Frodsham Marshes, Cheshire.* By Mr JAMES F. ROBINSON. Communicated by Mr SADLER.

Frodsham Marsh is a large tract of low-lying land, bounded on the north-east by the river Weaver, and on the north-west by the river Mersey; it is mostly well drained by gutters, which empty themselves into large ditches, the water eventually being conveyed to the river.

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As might be expected, the plants are principally aquatic species. The most conspicuous are *Butomus umbellatus* and *Epilobium hirsutum.* The Frogbit (*Hydrocharis Morsus-ranæ*) covers the surface of many of the ditches; it is difficult to secure good specimens for the herbarium, owing to the under-surface of the leaves being the home of a kind of gelatinous animalcule, which adheres to the drying paper. All the four species of Duckweed are to be met with. *Lemna gibba* must be looked for only in muddy water, where there is plenty of decaying vegetable matter—it is never seen, so far as my limited experience is concerned, in clean and apparently pure streams; *Ranunculus Baudotii*, *R. peltatus*, and *R. trichophyllus*, show their star-like blossoms in the early spring months in plenty. *R. circinatus* is abundant in deep water, but does not flower until the end of June. *Scutellaria galericulata*, *Samolus Valerandi*, *Œnanthe crocata*, and *A. Lachenalii*, are not uncommon; some states of the latter approach very closely to *Œ. pimpinelloides*, which I have not observed about Frodsham. The meadows are frequently gay with *Orchis mascula*, *O. maculata*, *Genista tinctoria*, *Primula veris*, and *Ononis spinosa.* Hedges, such as they are, are principally composed of *Prunus spinosa* and *P. insititia.* By the river side, on what is termed the Score, *Cochlearia Anglica*, *C. officinalis*, *Lepigonum neglectum*, *L. salinum*, *Armeria maritima*, and *Glaux maritima*, occur in profusion, intermingled with *Plantago Coronopus* and *P. maritima.* The prevailing grass is *Festuca ovina.* *Rumex Hydrolapathum*, *Œnanthe fistulosa*, *Typha latifolia*, *Scirpus maritimus*, *Utricularia vulgaris*, and *Hottonia palustris*, are not rare. *Myriophyllum alterniflorum*, *M. spicatum*, *Helosciadium inundatum*, *Veronica Anagallis*, and *Scirpus lacustris*, on the contrary, are to be classed amongst the rare plants of our marsh ditches. In the marsh about Helsby, *Epilobium brachycarpum*, *Ceratophyllum demersum*, *Thalictrum flavum* the variety *Morisoni*, and *Barbarea præcox* occur sparingly; those about Woodhouses contain *Œnanthe Phellandrium*, *Valeriana officinalis*, *Carex Pseudo-Cyperus*, and *Petasites vulgaris;* the latter is not at all common about Frodsham. *Anacharis Alsinastrum* will soon be a sad pest. Rushes muster in great force, yet they are only such as are gener-

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ally found in boggy situations—namely, *Juncus effusus*, *J. conglomeratus*, *J. acutiflorus*, *J. lamprocarpus*, and *J. supinus;* on the other hand, sedges are neither numerous nor plentiful. *Carex disticha*, *C. riparia*, *C. panicea*, *C. pallescens*, *C. glauca*, and *C. vulpina*, are the only species I have as yet seen. *Setaria viridis* has been found, but I have no doubt it has been introduced with agricultural seeds.

V. *Botanical Rambles up the Weaver Valley.* By Mr JAMES F. ROBINSON.

The author gave an account of a botanical excursion which he had made up the valley of the Weaver in Cheshire, and noted the principal plants collected.

9th January 1868.—CHARLES JENNER, Esq., President, in the Chair.

The following Donations to the Library were laid on the table:—

Transactions of the Pharmaceutical Society, London, Vol. IX., Nos. 7 and 8.—From the Society.

Notes on a New or Rare British Carduus, by Charles Jenner, Esq.—From the Author.

Abhandlungen herausgegeben von Naturwissenschaftlichen Vereine zu Bremen. Band I. Heft 2 —From the Society.

The following Communications were read:—

I. *Obituary Notices of Professor Daubeny, Oxford; Rev. Dr Hamilton, London; and Dr Schultz, Deidesheim, late Fellows of the Society.* By Professor BALFOUR.

PROFESSOR DAUBENY.

Charles Giles Bridle Daubeny was born in 1795, at Stretton, in Gloucestershire, where his father, the Rev. James Daubeny, was rector. He received his early education at Winchester, and afterwards went to Oxford, where he became a Demy of Magdalen College in 1810. He graduated at Oxford, taking the degree of B.A. in 1814, and being

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second-class in classics. In 1818 he gained the Chancellor's prize for an essay. He afterwards prosecuted the study of medicine, took the degree of M.D., and went to Edinburgh for the sake of acquiring practical information on the subject. He became a Fellow of Magdalen, and subsequently a Fellow of the College of Physicians of London. For some years he practised as a medical man, and was physician to the Radcliffe Infirmary at Oxford. He afterwards relinquished practice, and devoted himself to the sciences of chemistry, botany, and geology. In 1822 he was elected Professor of Chemistry at Oxford, and on 19th December of that year he became a Fellow of the Royal Society. In 1826 he published a work on extinct volcanoes, in which he dwelt on the effect of chemical agencies in producing these phenomena. On 16th March 1830 he was elected a Fellow of the Linnean Society. In 1834 he became Professor of Botany and Rural Economy, and he continued for several years to discharge the duties of the chair along with those of the Professorship of Chemistry. Subsequently he gave up the latter, and devoted himself entirely to botany. He was also curator of the Botanic Garden at Oxford. His knowledge of chemistry aided him much in his botanical examination of the phenomena of vegetation, such as the degrees of selection exercised by plants in regard to the earthy constituents presented to their absorbing surfaces, the rotation of crops, the effects which plants produce on the atmosphere, and the action of light on plants. The subject of soils and manures also occupied much of his attention. As Professor of Rural Economy, he entered largely into the application of science to agriculture. He spent some time at Geneva, with Auguste Pyrame de Candolle, whose biography he afterwards wrote. He published Lectures on Roman Agriculture, Lectures on Climate, an Essay on the Trees and Shrubs of the Ancients, and in 1867, a short time before his death, he printed a collection of his various papers, a copy of which he presented to our Society. This latter work is in two volumes 8vo, and is entitled "Miscellanies, being a Collection of Memoirs and Essays on Scientific and Literary Subjects, published at various times. Vol. I.: Experimental and Geological Memoirs. Vol. II.: Essays, Scientific and Literary." He did much

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to promote the study of science in Oxford, and advocated the institution of scholarships and fellowships in science. He wrote a paper on University Education, which was published in the *British Medical Journal.* He took a warm interest in the British Association, and in 1856, when it met at Cheltenham, he was elected President. On that occasion I spent some days with him at Oxford, and was delighted with his arrangements, botanical and agricultural. He travelled extensively, and visited Italy, Sicily, Auvergne, Eiffel, and indeed the greater part of Europe. In 1858 he crossed the Atlantic, and visited the United States and Cuba. He contributed much to the Botanic Garden at Oxford, and took a warm interest in its arrangement. He contributed papers to the Transactions of the Royal and Linnean Societies, as well as to numerous periodicals. He was also a fellow of the Chemical and Geological Societies, and an honorary member of the Royal Irish Academy. He was elected an honorary fellow of the Botanical Society in 1866. He died at the Botanic Garden at Oxford on 13th December last, after a distressing illness of some weeks. At the time of his death he was senior Fellow of Magdalen. He was a kind-hearted and liberal man, and he did much to promote the study of science. He was a painstaking and accurate observer, and his papers on the Physiology of Vegetation have done much to advance that department of botany. At the present day we want some one to follow in his steps — one who possesses a knowledge alike of chemistry and botany, and who can conduct experiments relative to the nutrition of plants.

REV. DR HAMILTON.

James Hamilton was born at Paisley, on 27th November 1814. He was the son of the Rev. Dr William Hamilton, minister of the parish of Strathblane, in Stirlingshire, from 1809 to 1835. He was descended from the Hamiltons of Raploch, in Lanarkshire. His early days were spent in the manse of Strathblane, where he imbibed those lessons which told so effectively on his after life. Besides being an able divine, his father was fond of science, and instructed his son in various departments of natural science, as well as in ecclesiastical history. After acquiring his preliminary

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education at Strathblane, he repaired to the University of Glasgow, where he was associated with Mr Archibald C. Tait, now Bishop of London, and Mr James Halley, both of whom were distinguished *alumni.* Besides the literary classes, Hamilton also attended chemistry, botany, natural history, and some classes more directly medical, such as anatomy and *materia medica.* He gained distinction in the chemistry class, at that time taught by Dr Thomas Thomson. Botany was his favourite science, and throughout the whole of his after life a love for plants was conspicuous in his writings and discourses. In some of his articles in periodicals he speaks with delight of his rambles with Dr Hooker in the Highland hills, and talks in glowing terms of the alpine plants which he collected. He alludes to his enthusiasm when gathering plants on Ben Lawers—the alpine gentian of loveliest blue, the alpestran forget-me-not, whose tints put to the blush its namesake of the lowland brooks, and other beauteous flowers whose colours seem to have been wrung from evening skies. He enjoyed God's works, and during the course of his pastoral labours in after life he turned his knowledge of them to the best account. From Glasgow Hamilton went to Edinburgh to study under Dr Chalmers, for whom he ever entertained a warm affection and high admiration. He was licensed as a preacher by the Presbytery of Edinburgh, and his first sphere of active duty was the parish of Abernyte, in Perthshire, where he acted as assistant to the minister. On 11th May 1837 he joined the Botanical Society, and he continued to be a resident Fellow till 23d July 1841, when he went to London to become minister of the Scotch Church, Regent Square. He then became a non-resident Fellow. In 1840 he placed a brother, Andrew, under my care when I was an extra-academical lecturer on botany; and he expressed a strong desire that his brother should become fond of that science from which he himself had benefited so much. Before going to London he had acted as a minister of Roxburgh Church in Edinburgh, to which he was appointed in 1839. His immediate predecessor in London was the famous Edward Irving. Hamilton's induction took place on 22d July 1841. Before this he had published a memoir of his father, and had edited Dr Barrow's life and sermons. On

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12th April 1838 he read to the Botanical Society a paper on the Gardens of the Ancient Hebrews, an abstract of which is published in the Proceedings of the Society for that year. In 1842 he began his writings in London, which have been continued ever since. He wrote many valuable tracts and essays, some of which showed in a remarkable degree his knowledge of natural science, and his desire to turn it to good account in his ministerial work. He wrote several valuable papers on theology and science, which were published in the *Presbyterian Review* and *North British Review*. In one of these articles he gives a masterly criticism of the Darwinian and other development theories. With the aid of literary and scientific friends he brought out a valuable work in six volumes, called "Excelsior; or, Helps to Progress in Religion, Science, and Literature." The publication of this work extended over three years—1854–56. The subjects embraced in the work are theology and Christian ethics, political economy, church history, the history of societies, essays, mathematics, zoology, botany, geology and mineralogy, physiology, astronomy, natural philosophy, naval architecture, useful and fine arts, and criticisms, tales, parables, poetry, voyages and travels, biographies, and mechanics. He wrote a great number of the articles, both literary and scientific. Among his contributors were Dr Gladstone, Mr Gosse, Professor Masson, Rev. Dr Bonar, Mr Jukes, Mr Ryland, Mr James Wilson, Mrs Gatty, Dr Latham, Mr Hunt, Archbishop Whately, Rev. T. Binney, Dr Richardson, Dr Baird, &c. He wrote also papers on Christian classics, and articles on Chalmers, Doddridge, Isaac Watts, &c. Among his other writings we may enumerate articles on the "Plants of the Bible," "Lessons from the Great Biography," "Life in Earnest," "Dew of Hermon," "Mount of Olives," "The Royal Preacher," "The Happy Home," the botanical articles in Fairbairn's "Imperial Bible Dictionary," and the "Life of James Wilson, of Woodville," brother of Professor Wilson. He was a Fellow of the Linnean Society, which he entered 1st February 1848; and the College of New Jersey, Princeton, United States, conferred on him the degree of D.D. His life in London was one of great energy and activity. He was zealous in every good work. He was a very genial,

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warm-hearted man, of a loving disposition, and without bigotry. He had a truly catholic spirit, and gained friends wherever he went, and never lost an opportunity of speaking a seasonable word for his Master. His health was not strong, and he had occasionally to retire for a season from his labours, with the view of gaining strength in the country. Last summer he was confined to bed for several months with illness, and he died peaceful and happy at 48 Euston Square, on Thursday, 24th November 1867, at the age of fifty-three. A friend, in writing to me recently, says:—"I am glad you are going to notice James Hamilton at the next meeting of the Botanical Society. For two years I sat in Regent Square Church after I came to London, and I was specially struck with the frequent use he made of nature in illustrating his subjects, and the remarkable accuracy and precision of all his references to science. While he looked on nature with a poet's eye, he had all the exact knowledge of a student. He did not use his science to round a sentence or ornament a paragraph; but his scientific illustrations always made more obvious his meaning or advanced his argument. He was the most lovable man I ever met with."

DR SCHULTZ.

Dr Carl Heinrich Schultz (Bipontinus), a well-known German botanist, died at Dreidesheim, on 17th December last, at the age of sixty-three. He was a corresponding member of the Society.

II. *Notice of a New British Moss* (Amblystegium confervoides *of Bruch and Schimper*) *in Dovedale, Staffordshire.* By Dr JOHN FRASER. Communicated by Mr JOHN SADLER. (Plate IV.)

I have had the good fortune to add one more to the list of British Mosses, and beg to submit an account of the new species to the Botanical Society, with drawings and specimens.

Specimens have been forwarded to Mr Wilson, author of the "Bryologia Britannica," and likewise to Professor Schimper of Strasburg, both of whom have examined it, and

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come to the same opinion respecting it. They both state that, although not new to science, it was not previously known to exist in the British Isles. It has been found in some parts of Europe, and is considered a very rare and interesting moss. It is known by the name of *Amblystegium confervoides.*

On the 29th November 1866, I visited Dovedale, along with another gentleman, for the purpose of examining it for mosses. It is well known to geologists that this singularly romantic dale is formed of mountain limestone. The rocks rise on both sides to a considerable height, at one time with a gradual slope, and again quite abruptly from the margin of the stream which flows through it. The moss was picked up in that portion of it which belongs to Staffordshire, growing in patches more or less extensive, not on the bark of trees, nor on the solid rock, but on detached stones of small size in shady places. I have revisited the dale this summer with Mr Wilson. There was not leisure to examine much of the valley; but we did not succeed in finding it, except on the spot where it was first discovered, and in the immediate neighbourhood, and that in small quantity. It is to be hoped that it may be found in other parts of the limestone in that district, as well as in other parts of England.

The moss itself is one of the smallest species. It has much affinity to *Hypnum incurvatum*, differing chiefly in its smaller size, hair-like depressed branches, and in the lax texture of the leaves which are quite destitute of nerve. At first it was thought to be *Amblystegium subtile*, but this has a straight, nearly erect capsule, no cilia to the inner peristome, and leaves faintly nerved.

The drawings were made by Mr Wilson himself at my request. He has also furnished the following description of it:—

Amblystegium confervoides of Bruch and Schimper is monœcious, growing in patches on stones in shady places; stems creeping, very slender, sub-pinnate, sparingly branched, branches capilliform, leaves scattered, secund, more or less spreading, ovate-lanceolate, acuminate, entire, nerveless; perichætial leaves longer, erect; capsule cernuous, oblong, slightly incurved, pale brown, semi-pellucid;

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operculum convex, apiculate, annulus small, deciduous; inner peristome with cilia, outer peristime yellow; fruit-stalk one-third of an inch long.

I am sorry that I have not more perfect specimens to lay before the Society. Some of the capsules are immature, others are old. Indeed, the plant does not appear to fruit freely.

III. *Account of a Botanical Trip to the Vosges Mountains.* By R. M. STARK, Esq.

IV. *Letter from* Mr WM. BELL, *dated Kaoligir* (*Dera Doon*), 2*d November* 1867, *to Professor Balfour.*

Forest management now receives a much larger share of the public attention than it formerly did, judging from the number of articles bearing on that subject that have lately appeared in some of the Indian papers. I shall endeavour to give, as it were, a bird's eye view of some of the forests which I passed through in a visit to the hills about two years ago. In doing so, I need not trouble you with any remarks about the vegetation, from the plains upwards—why some are well wooded, and others close to them are quite bare—why those with a western aspect are better wooded than those with an eastern one—why the crests of both the first and second ranges on the side facing the plains have nothing but a scrubby, scanty vegetation, while the back slopes have, as a rule, quite an arborescent one—but proceed to tell you what they are chiefly composed of, and the appearance they present to a stranger.

They are chiefly composed of oak—perhaps four or five species—I have observed one* only, perhaps two, on the outer range. Next Rhododendrons in point of size and numbers, and a sprinkling of Arbutus, which can scarcely be called a tree; *Ilex*, *Benthamia*, a few horse-chesnuts, and a *Cedrela*. There is very little underwood, and climbers are entirely wanting. In these respects hill forests contrast strikingly with those of the plains.

In the bottom of the deep valleys, *Cæsalpinia*, *Mimosa*, *Guilandina*, *Smilax*, &c., form most impenetrable thickets,

* *Quercus incana.*

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which no animal of any size could possibly make a way through. These, and a few others, such as *Vitis*, *Porana*, *Lettsomia*, *Bauhinia*, &c., give a character to the Dhoon forests. It is the entire absence of creepers that gives the hill forests, where the trees are well grown, a lightsome pleasant appearance. In rather shady places, a wild *Solidago* is very abundant, in more open drier places, two or three species of *Gnaphalium* are widely diffused. On the dryish spaces, where there is but little shade, a small *Androsace* forms quite a carpet; along the edges of open spots *Primula denticulata* is most abundant, with magnificent scapes, some of them 20 inches in length; and on damp shady rocks *Primula Stuartii* fills every chink, also several *Hedysarums* and a little *Geranium*. On the very top of one of the highest peaks of the Tine range, a spot several acres in extent was covered with a large *Potentilla*. This plant seemed to have taken almost exclusive possession of the spot, which might easily have been mistaken for a strawberry field. The decaying foliage formed a contrast to the bright blue flowers of a handsome *Aconitum* which was sparingly scattered over the spot. During the rainy season, the villagers always graze their cattle on the high ridges; the sheds are generally surrounded with a brushwood fence, and outside that on the lower side, there is generally a fine mound of pure manure, not unadulterated with straw or grass. The vegetation around these hills is peculiar. The common *Bhang** seems as vigorous and healthy there as in similar places 9000 or 10,000 feet lower. Nettles† of enormous size, most fierce-looking, but not nearly so bad as they look, thistles, ragweeds, bedstraws, chickweeds, docks, crowfoots, shepherd's purse, and one or two geraniums, give quite a Scotch look to the district.

The *Rhododendron arboreum* looks gorgeous when in full bloom. The trees are both large and numerous, and, generally speaking, are well furnished with flower buds. The largest one I saw measured 17 feet round, but like many other fine trees in that neighbourhood, it was only a shell. It is much more difficult to find a sound tree than an unsound one; enormous numbers have been shelled out to a greater or less extent by fire. The wood of both the oaks and

* *Cannabis indica.* † *Urtica heterophylla.*

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Rhododendrons—I do not know that any use is made of the last except burning—seems very perishable. Insects go into it vigorously when slightly decayed, woodpeckers follow after and pick them out. After that process has been repeated a few times, a slaty headed or the Alexandrine parrot, a barbet, or perhaps a woodpecker, fancies that particular spot for a nest, and does not find it difficult work to gouge or chip out as much half-rotten wood as will make a respectable house for the expected family. It will very probably be full of water during the whole of the next rainy season. It may do a second or perhaps a third time to shelter another brood. But meanwhile insects, damp, and the spawn of some fungi, are still at work. It requires a little time, but some fine April afternoon, when the stems of the herbaceous composites and grasses are as dry as tinder, with the view of improving the pasturage for his cattle, some villager, with a cake of dried cow-dung, sets fire to the rubbish on the bottom of the slope. On and upwards the fire travels, sometimes quickly, sometimes leisurely, all depending on the way the wind blows. It may reach it in an hour, or perhaps not in a fortnight. But when it does, we find that from the external rounded opening the stem may be hollow for 3 or 4 feet downwards, and the whole of that side entirely dead, the bark cracking and peeling off, as dry and nearly as inflammable as the dead herbaceous stems standing around it. They may not burn an hour, but it may not go out for a week. The tree may not die after that, nor after two or three such burnings; those branches and that portion of the trunk that remains, may even seem to grow vigorously. By the amount of new bark and wood which may have formed round the edges of the shell—from above downwards, from below upwards, and internally—nature tries to repair the injury done. But the old saying, "a burnt stick is easily rekindled," is as true there in a literal sense as it is in the metaphorical one in which I have often heard it used. It may stand there until it is fairly burnt down, or repeated burnings may have rendered it so weak that a fall of snow or a gust of wind easily brings it down, and the next fire is sure to consume what remains.

In the neighbourhood of the cattle sheds they strip the

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bark off the oaks, for the purpose of making a floor,—a thing very much needed in the wet weather, when the shed is knee-deep in dung, urine, and mud. At one of these places, in particular, I saw a number of white oaks* with the bark stripped off, from the ground up as far as a man could conveniently reach, and in different stages of decay, showing that it was not the work of one year. Some were on the ground in the last stage of decay, others had lately fallen, some were about to fall, and others were dying. It might be said, what is the use of them? As oak is comparatively useless timber, they would not pay for the cutting and carriage to even the nearest village; they will ultimately die of old age; and if the bark be useful on the spot for flooring buffalo sheds, why not use it? Were such a question asked, it might receive a variety of answers. The buffalo herd would gravely assure you that Khuda had caused it to grow there for no other purpose than that to which it had been put. A man with an eye for railway sleepers would calculate the loss in copper annas and pice. A man engaged in house-building would calculate so many roofing beams at so much per cubic foot. The sportsman, if he be on the roughing plan, with rather a small rig-out, perhaps two black blankets, at the very sight of the prostrate giant, in such excellent condition for burning, will exclaim in delight, "What a jolly windfall for me! When fairly lighted up it will drive away the frosty air." Firewood is not at all scarce, but the coolies greatly dislike collecting much of it. You may ask what is the use of his sleeping under a bush on a frosty night when there is a shed close at hand; yes, but unless he has a skin much less sensitive and considerably thicker than that of most Europeans, the fleas will prevent his taking possession, no matter how determined he may be. If we ask a Paharee where they have all come from, he gravely answers—*Zamin se paida hua*—from out of the ground. Entertaining such a belief, he sees no occasion for surprise or further inquiry. After tea, and a turn at the cutty, the sporting gentleman, after a hard day's walk, will feel inclined for bed. For that, a few green branches—(dry grass is dangerous)—are placed on the lower side, and with a Balmoral drawn

* *Quercus incana.*

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tightly over his ears, and rolled up in his black blanket, he can lie there snug till he sees the faint rays of the morning sun gleaming on the snowy peaks, far away in Thibet, it may be. The same log will not only cook his breakfast, but may last him one or two nights longer if he chooses to remain in that place. Why should he find fault with forest burning, as the young grass is as good for the deer as it is for buffaloes—or with the girdling of an oak; its bark was of greater use in the buffalo shed, and the worm-eaten, half-rotten trunk was of both use and comfort to him. Without its pleasant warmth, his teeth might have chattered the whole night long, or occasionally his heels might have been drawn up to his hips by cramp.

The forest officer,—not one so called merely out of courtesy, but one who possesses qualifications to entitle him to the name,—sets himself to think over the probable effects of drenching rains on bare sun-baked hill-sides, as impervious to water as the feathers on a duck's back, with no vegetation that will in the least retard the first little trickling stream, which, if retarded, would have prepared the dusty dry soil for receiving what was to follow. On the stream of water goes, at first gently, but doubling in volume and force at its confluence with that from some neighbouring ravine, and along the whole of its downward course, which may be miles, still increasing at the same rate. Brownish and thick, from the great amount of soil the torrent holds in suspension, it flows on, in some places rolling over pebbles, in others loosening and overturning massive rocks, or, when washing the base of an earthy slope, causing land-slips of no inconsiderable extent; and in the bottom of the valley, sometimes denuding, sometimes covering with shingle, to such an extent as to render unculturable the rice-fields of some miserable village. The construction of the roads and terraces, to render some spots fit for cultivation, often require a considerable amount of labour. So it rushes on throughout its course, which may be some days' march, till it joins some other less turbulent but larger stream.

The effects of these floods do not vanish when they subside. If the woodman be of a practical turn of mind, he will see enough close at hand to engage his attention.

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That massive piece of worm-eaten, rotten timber lying there, which must have fallen last year before the rains, or immediately after their commencement, has in its fall smashed completely one fine oak, one or two others have had half of their branches stripped clean off, another old tree with a slight bend has had a large piece of bark stripped off the one side (an injury that cannot soon be repaired), and the fallen tree, as it lies, is touching the stem of the growing one. Now the chances of its being burnt some fine dry day are perhaps ten to one against its escaping. Should that take place, a number of young trees standing close beside it, if not at once burnt down, will get sufficient injury to kill them; and some of the main roots, as well as a portion of the stem of the old one, will certainly be burnt into. After which a shrewd guesser could nearly tell how many more years it has to live. Should grasses and the other herbaceous plants have got a severe burn, the crowns of a great many of them will have been destroyed, and next year's crop will be a light one,—one that will take a good deal of trouble to burn. The following season's crop is certain to be a heavy one, which, when fairly dry and well lighted up, will burn fiercely. But while the grass has been growing, the tree has also been doing a little. It is highly probable that the spawn of some fungus has also been growing. Insects have been multiplying in these spots where the bark was torn off, because the woodpeckers have been there. Now, whether such a tree may live half a dozen or a dozen years longer depends on a number of circumstances not easy to take into calculation. What is it worth, or to what account can it be turned when it does fall?

Within and around the hill station of Mussoorie* they are clearing vigorously, and planting potatoes. The greater part of the slope is already bare, if we except Bhang and nettles, and some other herbaceous plants neither ornamental nor useful. Whether such a plan has improved, or will improve, the appearance, healthiness, and general comfort of the station, may fairly be doubted. However, the Municipal Commissioners ought to be the best judges. Were the potatoes raised there consumed by the

* The ground here alluded to is private property.—Ed.

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residents, the case would be quite different. I understand that considerable quantities reach Meerut and other more distant stations. While there is a great demand for this esculent, still I think potatoes might be produced sufficient for the wants of all, without barbarously stripping the northern and eastern slopes of a fine station like Mussoorie. In the newspapers I see some people bitterly complain of the great heat of the weather—up at 7000 feet; those who do so never spent a hot season on the plains without punkahs or tatties. Clearing the hills of wood is not the plan to make it cooler. The scarcity of water is also a complaint heard everywhere; these clearances will certainly not remedy the evil. Moreover, the generality of these slopes are so steep that, with the present careless lazy system of cultivation, before a great number of years pass by, they will be completely denuded.

In some of my rambles about Mussoorie I have seen deserted potato fields. In a few years hence there are likely to be many more. Spear grass may grow on them, but I doubt if much else will. Had the wood on these spots been taken a little care of, it would ultimately have become highly valuable for firewood, if nothing better. The demand for fuel is increasing, and the supply fast decreasing. But now the wood is gone, and the soil fast going. Charcoal there sells for much less than it does in the Dhoon, where timber is more plentiful—a fact of some significance in the eyes of those who look a little way ahead. The slovenly, ruthless way in which the trees are hacked and cut down, for the purpose of burning lime or being turned into charcoal, is a disgrace not less to individuals than to the legislature that permits it. However, those who would prefer a penny in hand rather than a pound in prospective won't take that view of the case.

It seems possible that before many more decades pass by—assuming that things move on as at present—the discovery may be made, that the supply of wood and charcoal is far short of the yearly increasing demand for lime-burning and domestic purposes. The rise in price will then prevent many from using it; they will not be able to afford it. However, railways are likely to be far more numerous than they now are, and coal may be brought

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from Raneegunge or Central India. Or what is quite as probable—in second-class drawing-rooms—dried cow-dung will take the place of charcoal. Mosquitoes will not come near to where it is burning, which is one little advantage.

Regarding the forests in the Deyrah Dhoon—between the Ganges and the Jumna—I have seen too little of them to enable me to speak. But there is a small tract, perhaps 1500 acres or so, a part of this estate, with which I am well acquainted. Perhaps it does not differ widely from a great portion of the tract just named. It is not more than five years since Dr Jameson asked for it for the use of the Kaoligir Plantation, and it was sold with the estate. Like all other pieces of Indian forest that I have seen, it looks best at a distance, and appears as if it were a dense mass of fine healthy Sal trees. However, a walk into it shows a state of things the existence of which one could not have believed from a look at the outside.

A few remarks on the native mode of felling, thinning, and pruning, will help you to understand how such a state of things came about. The felling-axe is a thickish wedge with a round hole in the thick end, and in that a round stick about 2 feet in length for a shaft; its weight is generally about 4 lbs., often less. The pruning-axe is a miniature of the felling one, generally less than half the weight. I am not aware that there are any grindstones in the North-west Provinces, excepting one or two at the Roorkee Foundry. When blunt they are put into the smiddy-fire, get a dress up on the anvil, a rub with a rasp, and are again ready for work. At the best the edge is rarely better, and oftener not so good, as that of a stone-cutter's chisel.

In felling, a native woodsman, unless for some extraordinary reason, never takes a tree close off by the ground; he much dislikes stooping, and, whether by instinct or custom, prefers leaving a stump never less than 1½ and seldom more than 2½ feet high. If the tree be a rather branchy one, and the trunk short and thick, he merely hacks off the main branches, and goes on. If the trunk be somewhat longer—ten or twelve feet—but partly shelled out by fire, the process is the same. Of course, the amount of wood left in the stump is as variable as the sizes of the trees cut, but, as a rule, all trees cut as low as twenty

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inches or two feet were round, or apparently round, when standing. One day I had the curiosity to make a rough estimate of the quantity of timber left standing in one of these evidently unsound trees. The branches had all been taken clean off, and a short trunk was left with two massive arms measuring not less than 80 cubic feet. These are not common, still it does not require a day's searching to find one. If for nothing more than look, such trunks ought never to have been permitted to stand. Judging from the number of young vigorous shoots on some, they must have stood for many years, and are still likely to stand until fire and white ants remove them out of the way.

A native's ideas of thinning are always to take the best trees and leave the worst to improve. Or if a few acres of Sal poles are wanted, he does not think of going into a patch of young Sal and removing those that interfere with the growth of others. To do so would be far too much trouble: he prefers taking those nearest and most easily got at. Or if a piece of timber be wanted for some particular purpose or other—say, for cart-naves, felloes, or shafts—the first tree, or branch of a tree, that will suit is the one always preferred. If a couple of naves, the first tree he meets with that seems suitable for naves, irrespective of its suitability for other purposes, has the honour of supplying the naves. And where more is taken than is wanted, the remainder is left on the spot. If a heavy branch promises good material for felloes, disfiguring or injuring the tree is of no consequence. To notch it on the under side is difficult, and besides it does not save labour. By the time it is half cut through the weight of itself will break the other half, and often takes with it a large splinter, causing an injury to the stem that can never be repaired. Pruning is an operation never thought about: no matter if a young tree form half a dozen spurious tops, all are allowed to grow.

From these few remarks you will perhaps understand why it is that a tract of forest always looks better at a distance than when inside of it. You may perhaps think that some of these remarks, if not downright stories, are gross exaggerations. I beg to assure you that exaggeration on such a subject would be difficult. The man who could

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picture a state of things worse than it really is must have far higher artistic powers than I am possessed of. Anything more disgraceful and slovenly, vicious and wasteful, than the system that has hitherto been in operation—perhaps is not yet quite extinct—it is impossible to conceive. Wretched management, with periodical burning as an auxiliary, is what has brought things to their present state—one certainly miserable enough, and only now beginning to bear fruit.

I believe there are few tracts of forest in this district that escape burning for more than two or three years at the longest. Sometimes the fire is accidental, but oftener it is lighted intentionally. Travellers, when they rest to smoke, after finishing, throw down the hot ashes amongst the dry grass, which may smoulder there for a few hours in an inoffensive manner, but the instant a slight breeze springs up the fire spreads rapidly. Again, villagers whose land lies on the outside of some forest tract, take the opportunity of burning the grass on their own lands at a time when they are sure that it will spread into the Government or other adjacent forest, that they may now and then have an opportunity of clandestinely feeding their cattle there, when grass may be scarce on their own lands. But the simple honest man never intended that the sircary or the sahib's jungle should be burned. The wind was, no doubt, blowing in a particular direction, but how could he help the jungle taking fire; *kismat se jali*, or it was fated to burn; he was only burning the grass upon his own land, and that he had a right to do. It seems possible, too, that those men who make a living by prowling about with a gun, have sometimes a hand in the burning of a piece of forest. It is difficult to find jungle-fowl and peafowl when the grass is long and thick; and what more annoying to the European sportsman than, when creeping through the tall grass after deer, to hear a whole herd get up not forty yards in advance of him, and go clear off without his ever getting a sight of the tail of one; or, when confident that he has mortally wounded one, to think that he may pass and repass within half-a-dozen yards of it, without finding what he looks for. This may sometimes make him wish that the grass and tall trees were in a blaze,

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rather than he should lose that prize pair of birds. Wishes are sometimes springs to action, and if that be resolved on, working is easier. I don't believe that any respectable European would do such a thing, although I have heard as much hinted on one occasion. Government formerly was in the habit of allowing cattle to graze on these reserved forest tracts, at so much per head for the season. The herdsmen do not require to be told that burning improves the grass for feeding purposes. When the means for doing so are simple, effective, and cheap, it is not to be wondered at that they should try the plan. Such a system seems to me to offer a direct premium on forest burning; but the few thousand rupees that are realised for the season's keep of the buffaloes blind them both to the present and future effects of the system. The policy in that respect is, Take no thought for the morrow—rupees, to-day, is what we want and must have; besides, it has hitherto been the custom of the country; such a prohibition would be an interference with ancient rights.

The effect of forest fires on those old trees are such as I have described when speaking of hill forests, only much slower. Maggots don't seem to touch the heart-wood of Sal—only white ants, and they do not make quick work with it. When a Sal tree has lost a long limb, perhaps the half of the original tree, or even a minor one, carelessly taken off, and perhaps along with it a large flake of bark, in a short time the dry atmosphere and the white ants leave it in a good state for charring. The same place is again and again ignited, reduced to a mere shell, and then burned out. I have met with specimens, shells of trees, 3 to 3½ feet through, with the centres burned completely out, the inside all black, with a few irregular spots of mud on the charred surface, showing that the ants were busy at work underneath it. Although they must touch the charred portion, they find no difficulty in getting to the sound, yet dead wood. The outside of these heartless objects was not only fresh, but covered with young shoots growing vigorously. I have seen shoots from these mutilated stumps as much as 8 or 9 inches in diameter; and, supposing that the stumps were to escape further burning, still they would never form good trees, because their root, so to speak, was an

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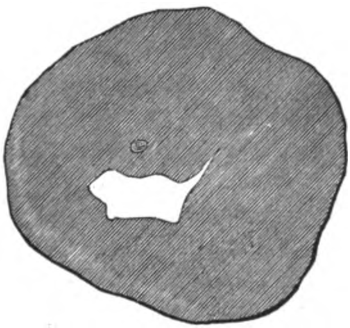
unsound one. It is seldom that they become so large; they are easily seen and easily got at, and, when large enough, are in great demand for roofing purposes. Shoots and young trees, if the grass has not been very rank, often escape with only the tops and the points of the branches, an injury from which they rapidly recover; but when the rubbish has been very rank and thick, thousands may be seen 25 ft. to 30 ft. in height, with the leaves and the points of the branches singed off to the very top, and on the side facing the direction in which the fire has come. A cut through the bark will show that the cambium layer is black, its vitality completely gone, excepting a narrow strip, and the tree will survive that; but as living tissues can never unite with dead, it will cover it over, but nothing more. Will that individual, when felled, perhaps twenty or thirty years hence, yield a sound piece of timber? I think it pro-



No. 1. Section of an apparently sound tree, 8 feet from the base of the trunk. The irregular spot in the centre is entirely hollow.

bable that it will not, and will now offer you one or two reasons for so thinking.

Enclosed are four rough sketches of transverse sections from trees that were seemingly sound, at least no one on seeing a little chink in the base of No. 1, or the little rotten spots at the base of No. 2, would have suspected that these would extend up the trunk for 10 or 12 feet. Or on looking at a scar on No. 4, where a branch had broken off, who would have expected that the effects of it would have been seen for 8 feet below that point? How these lobes projecting into the rotten wood in No. 2 came to be

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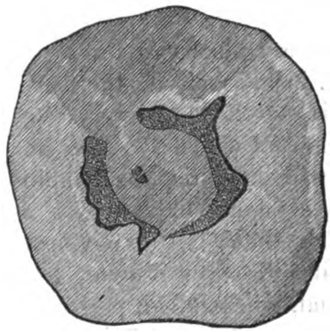
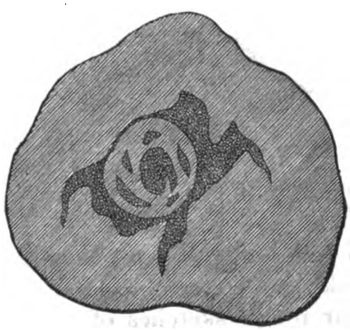
covered with bark, I can only account for in one way. In the section shown, all outside the lines in the centre is sound red wood; otherwise how could there be lobes of sound wood projecting into rotten wood which is evidently older? It would seem, in that case, that the effects of some



No. 2. Section of an apparently sound tree at 8 feet from the base, disappears at 10 feet—the centre sound. That included within the irregular semicircular spots is rotten; the outer line more or less covered with bark.

fire had extended deeper than even the cambium layer. The white wood in Sal is no exception to that of other trees: it very soon rots when its vitality has been destroyed. The fact of No. 1 being hollow, merely shows that the white



No. 3. As above, the irregular spots in the centre are rotten wood, the rest sound—the irregular lines outside the centre cavities and rotten wood.

ants or other insects had got easy access to the rotten wood, and cleared it entirely out. These trees from which the sketches were taken were not cut up in expectation of finding them unsound. It was because they seemingly were sound, and likely to cut up well, that they were tried; their

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turning out unsound was both a disappointment and a loss. Were I to assert that nine out of every ten trees, of from 16 to 20 inches through, now growing in the Dhoon, are unsound, I would not be wide of the truth. A person told me a few days ago, that out of six trees which he had got for first-class logs, intending to cut beams out of them for a flat roof, only one could be used—the other five were useless; but that is no new story, it is just what occurs every day to those engaged in building. It is but a short time since there was a new road, 40 feet in width, made from Hurdiwar to Mohun, a distance of about 22 miles. In some

No. 4. Section 6 feet below where a large branch had been taken off, disappears about 9 feet down; all above where the branch springs from quite sound; all contained within the irregular curved lines is rotten wood.

places the road was quite within the forest, in others only on the outskirts of it. Out of all the trees cut in making the road there were not half-a-dozen that could be called sound. I have this from good authority. Every one has of course heard of the disturbances as to railway sleepers. A contract is given, and in some instances more than one-half of the sleepers supplied were rejected. I don't know that the rejected ones were even made firewood of. Natives assert (but they are notoriously addicted to lying) that a very few good sleepers will make a great many bad sleepers go; that cannot be true. I have seen a few stacks of sleepers that were cut in the eastern Dhoon, and had my opinion been asked about them, I would have asserted that for every really sound one there were three unsound ones; but possibly my judgment may have been deficient.

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Although these remarks do not exactly prove that forest fires were the cause of this unsoundness, they may be taken as proving that the number of unsound trees to sound ones is enormously large. I am not aware that Sal is more liable to a heart disease, omitting accidents, than other plants are. I have seen several fine trees cut that never had been singed. They showed no signs of disease. When, therefore, we take into consideration the fact that diseased, unsound trees are chiefly confined to districts which have been ravaged by fire; also that trees 25 and 30 feet high, have not only the leaves and the points of the branches singed off, but often have a portion of the cambium layer on the one side (that facing the direction in which the fire has come) completely discoloured, there is a presumption in favour of the supposition. Young trees, 12 to 15 feet in height, are often entirely killed by these fires. After they have had time to dry, inspection will show a few irregular patches of mud on the outer bark, a sure sign of what is going on within. A smart tap with the butt of the rifle or the toe will leave only the core standing of what appeared to be a healthy young tree.

You may think that some of my remarks, if not decidedly ill-natured, are at least unnecessarily severe. To say anything too severe on the working of such a radically ruinous, vicious system is impossible. Or you may say, that to interfere with the right of the individual to do with his own as he likes would be a dangerous precedent to establish. Government have already interfered with more than one time-honoured abuse, which now lies in tradition, and in the pages of a Government Gazette. They are daily tinkering at tenants' rights, land tenures, &c., undoing to-day what they did yesterday;—things that are neither more beneficial to social comfort or to commercial prosperity than the forest question is. Yet, somehow or other, if they do trouble themselves with it, it is only some half reform that is proposed and sanctioned—something that leaves things neither better nor worse than they were before.

Dr Brandis has, I believe, written one or two elaborate reports on Indian Forests, which I regret not having seen. Indeed, I have not seen a single report on that subject, excepting Dr Stewart on the Cashmere Forests.

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I expect you have seen his reports, and if so my remarks on the subject contain nothing new to you. I speak only of what I have seen; and though these remarks have special reference to only one tract, still I believe that they will apply to one much larger than that to which I have confined them.

You may, perhaps, ask what I know about forests that entitles me to presume to offer an opinion on Indian ones. In Scotland I have assisted to form new ones, to prune and trim young ones, and to fell old ones. Presuming to know a little about that, makes me a little freer in my criticisms than I otherwise would have been.

I was at the further end of the Western Dhoon last week. I have been there several times before; there may be seen thousands upon thousands of acres of hard dry shingly ground, which at some time or other have been the bed of a watercourse. It would seem that the district had once been entirely covered with a fine clay loam, in some places to a great depth; but large tracts of it are now entirely denuded, in others only isolated mounds remain, of different shapes and different sizes. From the base of the Himalayas proper to the bottom of the valley, the whole district is furrowed and denuded. The same on the Sewalik side. During the rains these fill rapidly, and dry up as rapidly. After two hours' heavy rain, where a person could have crossed without wetting his feet, an elephant could not ford the stream; and a few hours after the sky clears up it may again be crossed dryshod. The slope is pretty uniform, but not steep, with a tolerably level grassy bottom, except when the course is changed by some obstacle or other. None of the soil is left, and what remains in these cases is only an irregular mound. None of that soil is again deposited in the Dhoon. I think it possible that no inconsiderable quantity of it reaches the Bay of Bengal. On some of these mounds thére is a sprinkling of trees, chiefly Sal. On these denuded tracts trees may once have grown—at least there are a few old stumps to be seen, probably the remains of what was once a forest. There are also to be seen a few scrubby plants of *Begonia*, *Bauhinia*, *Shorea*, *Bombax*, *Dalbergia*, *Pentaptera*, *Nauclea*, *Spondias*, and others, some of which look as if they had been burnt

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many times. They do not make strong shoots, as the land is poor, hard, and dry, but what they do make in one season, seems to be burnt off the next. Now, the fact that the trees continue to grow, although burnt to the ground every year, is a good proof of the suitability of the gravelly soil for timber-growing. Not that trees don't grow quicker and stronger on good soil than on gravel, but that no other crop would be so remunerative on such a place. On the spots that have not been denuded, water for irrigation cannot be had, and on the gravelly places no cereal or root crop would pay, supposing water were available, which it is not. Would it pay Government to plant such spots, or cause them to be planted, when private? The first cost would not be great were red-tapeism to let the planter have his own way. It would cost a little for watchmen to prevent burning, but in ten or twelve years at the most it would pay, and after that the profits would, I think, increase in a geometrical ratio, assuming that burning were prevented. For a straight Sal log of from 25 to 30 feet in length (and that would square to from 10 to 14 inches), three shillings per foot lineal could be got for merely the liberty to cut; and in Saharunpore, Meerut, and other large stations, if I am not misinformed, such like beams cost not much less than six shillings per lineal foot, before they are placed on the walls. Now, the sort of land I have been speaking of grows spear-grass well, and Zizphus; against the seeds of the one and the prickles of the other leather trousers are hardly proof. There are several species of *Andropogon*, *Saccharum*, which are not such insufferable pests as the plants above mentioned, but as far as regards feeding qualities, probably not much better. The leaves of *Saccharum Munjia* (Rox.) will, if not carefully handled, cut the hands like a knife. The leaves of *S. spontaneum* (?) no one would touch, unless it were a case of starvation. Cattle seem to like *Andropogon muricatus*, at least they eat it in preference to the others when they can't get anything better. Now a buffalo or a bullock can get his belly filled every day from suchlike dainties for twelve months by his owner's paying the sum of two shillings or thereabouts, a goat for one shilling or so. In many places, if he is not a heavy eater, two or perhaps three acres might keep him

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during the twelve months. Now the cost of either sowing seeds or planting per acre would not be heavy, neither would the cost of protection. And thinnings of ten years' growth or upwards would be worth on the spot from ten to twenty shillings per acre. But on that head I need not trouble you with any calculations, as they would not be accurate. For all such calculations I have a deep-rooted dislike. Not that I think foresters or tea-planters bad arithmeticians—the reverse of that—they, as a rule, are far too good. I sometimes think that if, after striking off fractions and odd numbers they would halve or quarter, the results, though less attractive, would certainly be much nearer to the truth. In all calculations that I have yet seen, differences in the quality of soil, moisture, habitat, season, &c., are always completely ignored. Hence the glaring discrepancies that always stand between the ideal and the real. Sissoo and catechu, which are excellent timbers, grow wild on the old beds of the Jumna. The soil, if it may be so called, seems a mixture of sand, gravel, and big stones, some of them of a large size, but all water-worn rounded; but anything bigger than a man's fist is in this part of the world called a boulder. Ansted and Lyall are no authorities on that subject here. Trees growing in such situations are no doubt much better off for moisture than they would be on those waste places spoken of. But again, sections made by water oftentimes show banks of clay loam alternating with the gravel—in some places to a considerable depth—but extremely irregular. And often where the upper soil has been washed away and seemingly only gravel left, a little way down there may be a fine bank of slightly ferruginous heavy loam. The roots of trees will go through that readily, even when it is seemingly a conglomerate fit for building purposes, the material being a compound of sand and carbonate of lime. When the roots manage to get through that—which they often do—into a loam beneath, they might thrive as well there as they do on the old beds of the Jumna. There might be some difficulty in planting such a piece of ground; still, rupees, time, care, and perseverance will overcome many difficulties far greater than that. Analogy may not always be a safe guide to go by; still, it is one that I am a firm believer in,

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if we take with us a few scraps of physiology as a sort of regulating principle. Keep always in mind the reciprocity of action between stem, leaves, and root. With that as a guide, one need never go far astray. To show you exactly what I mean: lately there was no more orthodox dogma in the whole of the Dhoon tea-planter's creed, than that plants, whether big or little, will not succeed unless taken up with a ball of earth; and if the tap-root happen to be cut, success is not expected. That was a law supposed to be as unalterable as that of the Medes and Persians. But, whether by accident or not, I do not presume to say, still it is a fact, that one-year-old plants or twenty-years-old plants will not only live but grow vigorously without balls, with both tap and laterals cut. That fact is mentioned merely to show that in any such experiment success may be arrived at by different roads.

V. *Notice of Plants collected near Kirkmichael, Strathspey.* By Mr ALLAN COLDSTREAM.

VI. *Observations on New Zealand Plants, No.* 3. By Dr LAUDER LINDSAY.

Miscellaneous Communications.

Mr H. FOX TALBOT, Lacock Abbey, exhibited photographs of *Spiræa venusta*, *S. betulæfolia*, and *Stanhopea insignis*, coloured by the hand. They were executed by artists who live at Berlin and Prague. The process is an improvement which is likely to be very useful. It will enable a tourist to make pictures on the spot of any plants he may meet with.

Dr THOMAS ANDERSON, Calcutta, sent a report on the progress of the cultivation of *Cinchona* at Darjeeling during 1867.

Dr JOSEPH DICKSON, Jersey, presented to the Herbarium a large collection of British and other plants, mostly named and mounted on paper.

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Professor BALFOUR read a letter from Dr P. Phœbus, Giessen, intimating that he wished to sell his Herbarium. It contains upwards of 6500 plants, and the sum asked for it is L.31, 10s.

Dr CLEGHORN presented to the Museum sections of 30 different kinds of native woods of Ceylon.

A letter was read from Mr CARRUTHERS, of the British Museum, regarding the "Journal of Botany," a magazine now published by Reeve & Co., London, and asking the Society to promote its circulation.

13*th February* 1868.—CHARLES JENNER, Esq., President, in the Chair.

The following Gentlemen were elected Members of the Society:—

As a Corresponding Member.
WILLIAM WILSON, Warrington.

As an Associate.
ADAM MATHESON, Curator of the Jedburgh Museum.

The following Communications were read:—

I. *Notice of Botanical Excursions in the Highlands of Scotland during the Autumn of* 1867. By Professor BALFOUR.

Professor Balfour remarked—It is useful to record every year the results of excursions, more especially when new localities have been examined. Several places of interest were visited by myself and pupils last autumn, and the results I will now lay before the meeting.

On 5th August 1867, a party, consisting of myself, the Rev. Charles T. Astley, the Rev. Robert C. Colvin, Dr W. Lauder Lindsay; Messrs P. Neill Fraser, Alexander Craig Christie, James W. Edmond, W. John Kennedy, Arthur A. Green, Thomas Jackson, Walter Dickson, and Alfred T. Coore, visited the district of Dalwhinnie, in Inverness-shire. We were all accommodated at Pullar's Inn, which

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is the only house near the station. Dalwhinnie is 1157 feet above the level of the sea, and the district is composed of bare moors surrounded by lofty hills, and containing several lochs, some of which, such as Loch Ericht, are of great extent. On the evening of our arrival at Dalwhinnie we gathered *Pyrola secunda, Genista anglica, Cryptogramme crispa, Rumex aquaticus, and Utricularia minor.* Although the bedroom accommodation for the party was not very extensive, still we all got comfortably housed, and we were well supplied with provisions. In this respect the inn is in a better state than it was when the Queen visited it in 1861. The Queen remarks in her journal lately published, p. 226:—

"When we reached the inn of Dalwhinnie we went up-stairs; there was a drawing-room and a dining-room, and we had a very good-sized bed-room. Albert had a dressing-room of equal size. Mary Andrews (who was very useful and efficient) and Lady Churchill's maid had a room together, every one being in the house; but unfortunately there was hardly anything to eat, and there was only tea and two miserable starved Highland chickens, without any potatoes! No pudding and no *fun;* no little maid (the two there not wishing to come in) nor our two people—who were wet, and drying our and their things—to wait on us! It was not a nice supper, and the evening was wet. As it was late we soon retired to rest. Mary and Maxted (Lady Churchill's maid) had been dining below with Grant, Brown, and Stewart (who came the same as last time with the maids) in the 'commercial room' at the foot of the stairs. They had only the remnants of our two starved chickens!"

Our party, however, had no reason to complain of the provisions given by Mr Pullar, and the waiter, James, was most indefatigable and very good-natured. The inn has certainly improved since the time it was visited by the Queen.

On Tuesday, 6th August, we left after breakfast for Dalnaspidal (which is 1408 feet above the level of the sea) by train. One portion of the railway is about 1500 feet above the sea-level. We visited the mountains called Sow of Athole and Boar of Badenoch. On the former we found

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Phyllodoce cærulea sparingly, but not in flower or fruit; *Azalea procumbens*, *Lycopodium clavatum*, *L. Selago*, *L. selaginoides*, *L. alpinum*, and *L. annotinum*, the latter being very abundant; *Cryptogramme crispa*, *Sibbaldia procumbens*, *Gnaphalium supinum*, *Listera cordata*, *Arctostaphylos Uva-ursi*, *Vaccinium Vitis-Idæa*, *Carex rigida C. sp.?* perhaps a peculiar form of *pilulifera; Rubus Chamæmorus*, *Cornus suecica*, *Epilobium alpinum*, *Hieracium alpinum*, *H. cæsium*, and many other alpine plants. The view from the summit of the mountain was very grand and extensive. The Boar of Badenoch is not such a productive mountain. A high hill called Benudemann is worthy of examination.

On Wednesday, 7th August, as the morning was favourable, we started between four and five A.M. for Ben Aulder, a high hill, 3741 feet above the level of the sea, near Loch Ericht. We hired two boats, and rowed for about 12 or 13 miles down the loch, taking provisions with us for the day. One of the boatmen, Donald Kennedy, also acted as our guide, and assisted in carrying plants wanted for the Botanic Garden. We all took our turn in rowing, and now and then encountered squalls, which rendered the work not a little fatiguing. Upon the whole, however, the day was fine, and the morning view of the loch scenery was charming. Loch Ericht is 1000 feet above the sea. We had permission from Lord Henry Bentinck to visit a part of his deer forest, and we landed at his shooting-lodge 6 or 7 miles down the loch, for the purpose of consulting with his gamekeeper as to our mode of procedure. At ten A.M. we reached the point where we proposed to ascend the hill, and there we lunched most heartily. We ascended the side of the hill, gathering numerous ordinary alpine plants, and ultimately reached the top of the ridge, after passing various large patches of snow, on one of which we had a *glissade* with our poles. We saw several herd of red deer in the course of our ascent. We found the summit to be a long way from the top of the ridge, but we were determined to persevere, and on reaching it were well rewarded by the splendid view which we obtained of the surrounding country. We saw Schihallion, Ben na MacDhui, Ben Lawers, Ben Nevis, and the fine snowy hills about Loch Laggan. We descended by a deep corry where there was abundance of

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snow, and where there was some difficulty in finding a path. We saw many good alpine plants—among others *Tofieldia palustris*, *Carduus heterophyllus*, of various forms; *Juncus trifidus*, *J. triglumis*, *Carex rigida*, *C. vaginata*, *Veronica alpina*, *V. humifusa*, *Trollius Europæus*, *Gentiana campestris*, *Cochlearia grœnlandica*, in a very fine state, with large flowers; *Azalea procumbens*, *Sibbaldia procumbens*, *Gnaphalium supinum*, *Silene acaulis*, *Salix herbacea*, *S. lapponum*, *Cerastium trigynum*, abundant; *Rubus Chamæmorus*, *Cornus suecica*, *Saussurea alpina*, and *Luzula spicata*. Among the ferns collected were *Cryptogramme crispa*, *Polypodium vulgare* and vars., *P. Phegopteris*, *P. Dryopteris*, *P. alpestre*, and *P. flexile*. The last-mentioned species was gathered sparingly near the lower part of the corry, but Mr Christie discovered it in large quantity among rocks at the base. The specimens were very marked in their appearance. The small specimens of *P. alpestre* had some resemblance to the *P. flexile*, but Mr Christie observed that the former never showed any fructification, while the latter did. This seems to be one of the best stations of this rare polypody. The best ground on Ben Aulder is the corry just mentioned. It is, however, frequented by the deer, and therefore the access to it is not free, especially in particular conditions of the wind. Like all places where deer-stalking prevails, the botanist is not allowed to ramble as he chooses without running the risk of being attacked by gamekeepers and gillies. The corry may be visited by going up the valley from the shooting lodge on Loch Ericht, but the road is long and tedious. Mr Fraser and Mr Edmond, who visited the corry on the 9th, went by the lodge, and had the gamekeeper with them; but there was obviously much unwillingness on the part of officials to encourage "herb-gatherers" (as we were once called by the Prince Consort's head gamekeeper, Grant) visiting the recesses of the Highland hills. Having a letter from Lord Henry Bentinck, we were better off than visitors generally are, and we had the assistance of the forester, Mr Clark, who was very obliging. On reaching the lower part of the corry we had to ascend the hills between it and Loch Ericht—no easy matter after a hard day's work. The descent to Loch Ericht was very troublesome and steep, and, to add to our annoyance, when

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we reached the shores of the loch, our boats were found to be several miles up the loch, so that we had to wait for some time until our guide went for them. In the loch we gathered *Isoetes lacustris*, *Subularia aquatica*, *Littorella lacustris*, and on its shores *Drosera anglica*. We did not reach Dalwhinnie till ten P.M., after having spent 18 or 19 hours in the excursion. In these circumstances the Queen's fare would not have been satisfactory.

Thursday, 8th August.—The weather was upon the whole promising, although there were showers now and then. After the fatigue of yesterday, the party were disposed to take easy work, and accordingly, after putting their plants in paper, they made short excursions in different directions. Mr Fraser and Mr Craig Christie examined the rocks on the south side of Loch Ericht, gathering *Polystichum Lonchitis*, *Asplenium viride* (these two plants are not common in the district), *Botrychium Lunaria*, *Carex vaginata*, and *Littorella lacustris*. Mr Coore examined the rocks on the side of the railway, north-east from Dalwhinnie, and found many good alpine species. The rocks are rather steep in some places. Among the plants gathered were *Hieracium alpinum*, *H. calendulifolium*, *Dryas octopetala*, in flower; *Salix arbutifolia*, *S. herbacea*, *Pyrola media*, *Habenaria viridis*, *Saxifraga oppositifolia*, *S. hypnoides*, *Silene acaulis*, *Juncus trifidus*, *Tofieldia palustris*, *Sibbaldia procumbens*, *Luzula spicata*. Mr Coore examined a corry about 2 or 3 miles from Dalwhinnie, on the right hand of the road going to Dalnaspidal, and he considered it to be well worthy of further exploration. Mr Kennedy and Mr Dixon went to Killiecrankie and Pitlochry by rail, while Mr Astley and myself walked to Cat Lodge, near Loch Laggan, the residence of my friend Mr Armitstead. This day Dr L. Lindsay and Mr Astley left for Perth and Edinburgh.

Friday, 9th August.—The party divided into two sets. Mr Fraser and Mr Edmond visited the great Ben Aulder corry, accompanied by Mr Clark. After reaching Ericht Lodge they walked about 7 miles to the corry. They gathered most of the plants picked on the 7th, and saw large quantities of *Polypodium alpestre*, *P. flexile*, *Cryptogramme crispa*, and *Carex pulla*. The remainder of the

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party, now numbering eight, proceeded at seven A.M. by a drag driven by John Macdonald to Loch Laggan, calling at Cat Lodge on the way, and meeting Mr and Mrs Armitstead, who wished us to breakfast with them. Their kind offer was declined, as we had breakfasted before our departure from Dalwhinnie. After reaching Laggan Inn, we drove about 3½ miles along the shores of Loch Laggan (836 feet above the level of the sea), and then proceeded under the guidance of Donald Fraser (Captain Edwards' keeper) to a high alpine corry called Corryarder. The mountain called Aberarder reaches 3600 feet. The road taken by our party extended to 7 or 8 miles before we came to the rocks, which are very lofty and precipitous, and were in many places covered with snow. Some wreaths of snow in the rocky ravines were about 100 feet in length. One of the large patches, filling up a deep ravine, was found to be hollowed out below so as to form a fine vaulted passage or snow tunnel, extending for 100 or more feet, and with an arch 7 feet high. The snow was very hard, and a constant dripping took place at the edges of the arch at the entrance. In the lower part a small alpine stream of ice-cold water was running. Under the arch our party took shelter from a shower, and had our lunch. The rocks at first sight seemed to be very promising, and we certainly expected to add something new or rare in the way of plants. We were, however, disappointed, although we gathered very good alpine species. We walked by the foot of the high cliffs to the gap in the mountain range, called the Window or Corryarder, intending to visit the corry on the opposite side; but we had spent too much time in the early part of the day, and now the wind, hail, and rain became so terrible that we were fairly driven back at the pass, and compelled to return. We believe that the mountains in that quarter are well worthy of further examination. Among the plants collected I may enumerate the following:—*Polystichum Lonchitis*, *Polypodium alpestre* and vars., *Lastrea dilatata* and vars., *Cystopteris fragilis* and vars., *Cryptogramme crispa*, *Polypodium Dryopteris*, and *Phegopteris; Blechnum boreale*, *Veronica alpina* and *humifusa*, *Saxifraga oppositifolia*, *stellaris*, and *hypnoides; Cerastium alpinum* and *trigynum*, the latter in very large patches, and in fine flower;

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Cochlearia grœnlandica, also very fine; *Armeria maritima*, *Hieracium alpinum, vulgatum, calendulifolum, eximium, and strictum; Vaccinium uliginosum*, very fine; *Rubus Chamæmorus*, in fruit; *Cornus suecica, Gymnadenia albida, Poa Balfourii*, in two states; *Aira alpina vivipara, Carex atrata, vaginata*, and *pauciflora; Epilobium alpinum, Sibbaldia procumbens, Gnaphalium supinum, Juncus triglumis* and *trifidus, Saussurea alpina.* The characteristics of the part of the mountain we visited may be said to be the ferns and *Cerastium alpinum* and *trigynum.* At six P.M., the party reached Loch Laggan Inn, and returned by the drag to Dalwhinnie a little after nine, very wet and fatigued. Many mountains we noticed near Loch Laggan seemed to be worthy of full examination. We could not get quarters at Loch Laggan Inn, as it was occupied by Dr Skae and a fishing party.

On Saturday, 10th August, our party concluded their labours in the district, and left Dalwhinnie by train at ten A.M. Mr Coore proceeded to Aberfeldy with the view of examining Ben Lawers; Messrs Fraser, Christie, and Edmond went to Dunkeld, in order to visit Stenton rocks; while the rest of the party proceeded to Edinburgh, which was reached about four P.M.

Professor Balfour then referred to other excursions made in August. On visiting the Pass of Killiecrankie, *Lathyrus niger* was found to be still growing there. On Ben-y-gloe, a mountain 3756 feet in height, he searched in vain, on 23d August, for *Rubus arcticus*, under the guidance of Mr Henry Gordon, who knew the locality in which the plant was said to have been gathered many years ago. In Glen Tilt, under the guidance of Miss M'Inroy of Lude, many rare mosses and *Jungermanniœ* were collected, particularly *Dicranum Grevilleanum.* Near Aberfeldy, on 23d August, along with Mr Sadler and Mr Macfarlane, *Polypodium calcareum* was gathered in an old limestone quarry. On the hill of Tulloch, near Blair Athole, *Asplenium viride* and *Draba incana* were collected. On 30th August Ben-y-Vrackie, a hill 2757 in height, near Pitlochry, was examined, and on it the following plants were collected:—*Polystichum Lonchitis, Asplenium viride, Potentilla alpestris, Draba incana, Saxifraga oppositifolia*, and other alpine *Saxifrages;*

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Sibbaldia procumbens, *Gnaphalium supinum*, &c. During the visit of the British Association to Dundee in September, *Aster salignus*, *Allium carinatum*, and *Astrantia major* were gathered on the banks of the Tay, near Seggieden, by Col. Drummond Hay. The Aster was formerly found by Professor Balfour near Dalguise, and it has since been found in England.

The President remarked that these excursions were of great interest and importance, and that students and others competent should be encouraged to undertake them. He subscribed for some travelling botanical excursions on the Continent, and would willingly contribute towards the expense of sending two students, or other eligible competent persons, to work together for a few weeks in autumn in some imperfectly explored Highland district. He was ready to give L.10 for this purpose, provided others would help in the matter. A zealous botanical student, well acquainted with Phanerogamous and Cryptogamous plants, might do much to advance our knowledge of the Scottish alpine flora.

II. *On Plants and Animals used for Food in Old Calabar.* Extracted from the MS. Journals of the late Mr W. G. Milne, by Mr John Sadler.

In the public markets of Calabar, Mr Milne remarks that the kinds of food are not in such variety as amongst the different islands in the South Pacific which he had formerly visited. These islands have generally a heavy rich soil fitted for the cultivation of almost every tropical fruit and vegetable, while the soil in Western Africa is incapable, even in the most favourable locality, of producing anything like a heavy crop.

In the Calabar markets he observed for sale Indian corn, ground-nuts, several kinds of plantain, one species of banana, two species of fungi, two kinds of pepper, fruit and foliage of a species of gourd which are much used, apples of a Solanum, eight kinds of yam, two of cassava, sugar cane, coco nuts, pods of several leguminosæ, palm oil, palm nuts, oranges, mangoes, mints, pine apples, sweet potatoes (a kind of convolvulus), and the kernels of a native mango,

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which are dried, mashed, and made into bread, and then baked on a strong fire.

Among the items of animal food exposed for sale he noted shrimps from the sea, wild hog, porcupine, the animals of several kinds of land shells, monkeys, fresh-water eels, alligator, iguana, ducks, fowls, goats, beef of the native cow, fowls' and alligators' eggs; also, a large ground beetle.

The same food materials he found in the markets in the Ebibio country, with the exception of snakes, which they eat. The people in many parts are cannibals. When they intend having a great feast, a man is killed. He is soaked in palm oil for one night, at the same time they fill up his interior until the liquid runs out of his mouth. In this state he is cooked, and many friends invited to the feast. Rats are a common article of food amongst the Ebibios—in fact, nothing seems to come amiss to that savage dirty race.

Mr Milne, after noticing some of their customs, refers to the principal plants cultivated at Old Calabar for food, including ten kinds of yams, four of tarro, seven of plantains, five of gourds, &c. "Calabar Chop" is the favourite dish, both with blacks and whites, at Calabar. The following form the principal ingredients of this delicious dish: yams, shrimps, fish, palm oil, pepper, the seeds of a leguminous plant called "Uyayak," Calabar onion, monkey, fowls, and deer-flesh. Another favourite dish is called "Fugu," which consists of mashed yams and tarro. A soup is also made with oil, fish, pepper, and salt. The natives on the West coast of Africa are, like all other natives over the world, slaves to the use of pepper—they never can get their food hot enough.

III. *Remarks on species of Elymus, Triticum, and Phleum from Vancouver's Island.* By Professor BALFOUR.

Under the name of Bunch-grass, several kinds of grasses have been sent from Vancouver's Island and Columbia. Two distinct plants have been sent by Mr Robert Brown to the Botanic Garden under that name. One is a species of *Triticum*, perhaps a variety of *T. repens*, of which specimens are now shown. The other is an *Elymus*, which appears to be the *Elymus condensatus* of Presl. In this I am con-

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firmed by Col. Munro, who has devoted much attention to grasses.

The following are the characters given by Presl:—"*Elymus condensatus*, Presl in Rel. Haenk. I. 265. Culmo tereti vaginisque glabris; foliis planis, scabris; paniculæ strictae condensatae, ramis verticillatis, brevibus, simplicibus brevissimisque, spiculis sexfloris; glumis setaceis; palea inferiore obsolete quinquenervia, acuta, mutica.—California."

I examined the plants in the Botanic Garden in August 1867, and I drew up the following description:—

Plant, 6 feet 2 inches in height; culm, ¾ of an inch in circumference near the base; sheaths of leaves, 6 to 8 inches long; blade of leaf, 18 to 20 inches long; broadest part of leaf, ¾ of an inch; leaves, linear-lanceolate drawn into a long narrow point, which becomes brown as the plant increases in age; ligule about ¼ inch broad, brown, divided at the margin, and afterwards splitting into two or more divisions; inflorescence a compound interrupted spike; spikelets in two clusters placed laterally, each cluster containing two spikelets; glumes, two, placed on one side, linear, drawn out to a long point, unequal margins with sharp serratures, particularly on the upper half; florets 4—6, outer palea herbaceous, ovate lanceolate, five ribbed, three prominent ribs and two smaller, midrib excurrent into an awn; the margins of the palea and the ribs having sharp serratures, inner palea linear lanceolate, with inflexed margins, which are green coloured, apex bifid, covered with glandular hairs, which are abundant at the apex; scales two, oblong; stamens four, anthers rather longer than the slender filaments, pollen rounded; styles two, with numerous feathery branches which are serrated.

Another plant sent turns out to be a *Phleum*, resembling *P. pratense*, although growing to a larger size. The following are the characters:—Length of plant, 5—8 feet; length of spike, 4—6 inches; length of sheath, 7–9 inches; blade of leaf, in some cases 14 inches long and ½ inch broad; glumes, two, truncated, serrated on the margin, each awned and very hairy; midrib with long hairs, awns with sharp serratures. Florets single with an ovate outer palea, the midrib with sharp serratures, and ending in a projecting

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awn, upper part of palea marked by three projecting points, inner palea with a short projecting point, which is not marked by sharp serratures; anthers short and broad, bifid at each end.

IV. *Report on the Open-Air Vegetation in the Royal Botanic Gardens.* By Mr M'Nab.

Name of Plant.	Date on which first flower expanded.	
Galanthus nivalis,	January	23.
Crocus susianus,	„	28.
Rhododendron atrovirens,	February	1.
Eranthis hyemalis,	„	1.
Leucojum vernum,	„	3.
Rhododendron Nobleanum,	„	4.
Crocus vernus,	„	4.
Galanthus plicatus,	„	6.
Scilla sibirica,	„	8.
Hepatica triloba,	„	10.

V. *Miscellaneous Notices.*

Dr David Christison presented dried specimens and fruit of *Martynia lutea* (Devil's Horn) and *Jatropha Manihot* from Buenos Ayres.

Mr Jenner exhibited a growing plant of *Saxifraga Rocheliana*, from the Straits of Magellan. The plant, which is perfectly hardy, expanded its first flowers in the beginning of January in the open air.

Mr M'Nab placed on the table a flowering specimen of *Ophrys insectifera.*

Professor Maclagan exhibited a bunch of wheat, which was so placed in water that the grains had germinated in the ears, and thus formed a pretty ornament of green vegetation for a room.

Mr James Knox sent specimens of the root of an ash which had become curiously flattened by growing in rocky soil at Ardindee, Kirkcudbright, and which contained several pieces of rock in its substance.

Mr C. E. Smith exhibited a collection of Arctic plants collected by E. P. Philpots, surgeon, during the wintering voyage of the ship "Queen," of Peterhead.

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Professor Balfour reported that there had lately been added to the Museum of the Botanic Garden, two series of models, executed by R. Brendel, Breslau, and M. Auzoux, Paris, illustrating the different parts of flowers, fruits, &c. Professor Balfour exhibited the following recently published works:—"New Zealand: its Physical Geography, Geology, and Natural History," by Dr F. von Hochstetter; and "Oesterreichs Holzplanzen," by Dr Alois Pokorny, Vienna.

12*th March* 1868.—CHARLES JENNER, Esq., President, in the Chair.

The following Communications were read:—

I. *Obituary Notice of John Baddeley, M.B., C.M., late Fellow of the Society.* By Professor BALFOUR.

Dr Balfour remarked—I have this evening to perform the melancholy duty of recording the premature death of John Baddeley, M.B., C.M., one of the Fellows of our Society. He was well known to many of us, and his sudden and unexpected departure from our midst has thrown an additional gloom over our medical school, which has this winter sustained other severe losses.

John Baddeley, second son of Paul Frederick Henry Baddeley, late surgeon of the Bengal Army, was born at sea, in the Bay of Bengal, on 22d January 1846, and was baptized at Calcutta shortly after. For the first 4½ years of his life he was with his mother at Simla in the Himalaya, after which (in 1851) he accompanied her to England, and resided first at Birkenhead, then at Tunbridge and London. In 1858 he was sent to Bonn, in Prussia, with the view of acquiring the German language. At the age of fifteen he was under instruction in the military preparatory establishment at Tunbridge Castle. In May 1862, at the age of sixteen, he entered the University of Edinburgh as a

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medical student, and there he continued during the remainder of his studies, except in 1864-65, when he spent the winter at King's College, London—attending anatomy under Professor Partridge, and surgery under Professor Fergusson.

I am indebted to his father for details in regard to his early history, and his character as a son and a brother. He was, from his earliest childhood, a favourite with most people, and exhibited at times a dry humour which attracted and amused. He was early taught to fear God by a pious mother. His parents were anxious that he should become a medical missionary. His character was without guile. He was generous, courageous, humane, and affectionate, but very independent, determined, and somewhat irascible. Many a painful struggle he had against the besetting sin of a hot temper. During the last year of his life in particular, he seemed to acquire more mastery over his passion, and spoke and wrote more seriously on matters of eternal moment. He greatly endeared himself to his family when at home, and to many others with whom he was brought into contact. He was very fond of animals, and nothing gave him greater annoyance than wanton cruelty towards them. Devotedly attached to his home, the idea of joining the domestic circle at the close of a session afforded him the most pleasing anticipations, and acted as an incentive to constant diligence in his studies, which were often rendered painfully arduous and wearisome by attacks of physical suffering. He possessed very fair abilities, and what was wanting was compensated by a determined will; so that whatever he undertook he generally succeeded in accomplishing. As regards his person, his features were peculiar, not likely to be soon forgotten. He was tall, upwards of six feet in height, and possessed of a somewhat martial bearing. He was muscular, and fond of athletic sports, in which he excelled, and he entered with great spirit into the proceedings of the Athletic Club of the University of Edinburgh. To the late secretary of that club, Mr Howard Stark, I am indebted for the following statement:—

"In the winter of 1866 Baddeley first started the idea of forming an athletic club in our University, and he, together

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with a few others, worked it out, so that in May of that year the club was formally organised. To him the University is indebted for that movement, until then so novel, and all the more so in that he was not even a native of Edinburgh, or indeed of Scotland, and therefore might not have been thought so likely to have at heart the improvement of our Scotch University ways. We all know how eagerly he supported the senate in its attempt to provide a gymnasium for students, and the indefatigable zeal with which he prosecuted a successful canvass for members of the club to whom the gymnasium was presented. In the athletic contests of last June we find him a competitor and winner in a very varied series of sports. He carried off first prize for fencing, an amusement of which he was very fond, and in which he was very proficient. He in the swimming competition came in third, after a most splendid struggle, being second the greater part of the course. He constantly afterwards expressed great regret that he did not win this race; and it was his intention, had he lived, to have entered for the race this year. He won the competition in throwing the hammer on June 26, and the last event for which he entered was for the pair-oar race at the University Boat Club races on July 14, which he won, pulling stroke in the winning boat. We here see that his accomplishments in athletic exercises were very varied, and showing both the presence of great bodily strength, and of a quick hand and eye, by no means always combined. At the time of his death he was the President of the Athletic Club. The principal feature in his character was the ardour which he evinced in all his pursuits, whether mental or physical, and the unabating zeal and energy displayed in all his undertakings. The interest he displayed in the good of his fellow-students was truly wonderful, and to effect this he was always on the alert. He had a great desire to bring athletic sports of every description within the reach of every student, and he spared no trouble to effect this. He it is to whom the present movement regarding the formation of a cricket club in our University is due. He insisted upon the Athletic Club making inquiries as to a suitable field, &c., although not himself a cricketer, and he made the investigations which have led to the hope that we may get a part of

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the West Meadows set apart for that purpose. In this, as in many other ways, his extremely unselfish character was made apparent, and must be considered by us to have been one of his most amiable qualities.

"In his hospital life he was noted for his strict attention to his duties and his studies, and he was so much engrossed by these that he had comparatively little time to spare for relaxation. His private character was in every way irreproachable. He was abstemious as regards intoxicating liquors, to a degree, perhaps, rather injurious than otherwise. He was never heard to utter an oath, or anything bearing any similarity to one; and altogether he was as well calculated as perhaps any man alive to give one the idea of a true gentleman and a thorough Christian.

"The great regard entertained for him was manifested in the deep regret evinced by his friends and fellow-students at his sudden and unexpected death, and by the immediate and general wish to erect to his memory a slight token of the universal regard which a short but happy career had ripened into true friendship."

From another friend, Mr M. W. Rice (Middlesex Hospital), who graduated with him, and was intimately associated with him during his studies in Edinburgh, I have received the following particulars:—

"As it was my good fortune to have enjoyed Baddeley's friendship during the whole time we were at college together, and to have lived with him for a great part of that time, it seemed to me that I might possibly furnish you with a few details respecting him, which might add to what you may have already heard of him from others. The chief feature in his public character was his determination of purpose; after deciding on the propriety of any project, he threw himself into it with his utmost energy. This, I think, was fully illustrated by the success which attended his University career, as well as by his unflagging exertions to insure the welfare of the University Athletic Club, of which he was in reality the founder. His main desire was that all he did should be well done, rather from the wish to do his duty than from any motive of self-glorification and prominence. He always shrank from pushing himself forward, and yet, from his quiet,

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decided manner and good judgment, he invariably found himself taking the lead and looked up to for advice by the most active of his fellows at college.

"In private life one was attracted to him by his perfect honesty, simple tastes, warm-heartedness, and generosity. One could depend on him, knowing that he always spoke what he felt and meant; that he always loved what he professed to love, and that he always retained the same feeling towards his friends, and was ever willing to assist those who were in need of help. His well-cultivated mind and refined disposition led him to pursue the recreations which mark the index of his character. The natural sciences and music occupied the spare moments of his life, which in many men of his age are devoted to lounging and idleness.

"Towards his family he had the most affectionate regard, not only from the fact of relationship, but from the many sympathies which existed between its members and himself. His father was his acknowledged best friend and adviser; love for his mother was a subject he frequently spoke of; and the same may be said with regard to his sisters, with whom he passed many an hour in the enjoyment and acquirement of music, which he was always willing to dispense to the gratification of his friends. I attribute much of the sterlingness of his character to the close association he had with his family at that period immediately preceding his student life, when the mind and habits are so easily moulded for good or evil. Fortunately for him whose virtues were so marked, he had learnt not to depend too much on himself. Without making a loud profession of religion, he was at heart a religious man; he was a constant Bible reader, a true believer in Christ; and consequently we, his friends, must feel the sorrow at his death much relieved by the thought that salvation was extended to him, and that he now enjoys eternal happiness.

"Time forbids me to dilate more on my late lamented friend's character; his good points would furnish matter for long description, and his life generally could stand more scrutiny and publication than that of the majority of even highly virtuous men.

"Amongst the many kindnesses of which he was the recipient, he frequently mentioned what you had done for

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him, and testified to the good he had derived from attending the fortnightly Bible meetings at your house."

I knew Mr Baddeley well during the whole courses of his studies here, and he was a frequent visitor at my house. I was led to form a high opinion of him, and I feel very deeply the loss which I have sustained. He was an enthusiastic student of natural science, and chemistry was also a favourite pursuit. In 1863 he gained a second class Hope Scholarship in Professor Playfair's class, and he devoted much time to work in the laboratory. In the summer session of 1862 he gained a first prize in the Botanical class for a series of specimens illustrating the venation and conformation of leaves, and he also gained a second class certificate for 55·3 per cent. of marks in the junior class examinations. In 1863 he gained 61 per cent. of marks in the senior division of the class; and in 1864, 75·6 per cent., entitling him to a certificate in the first class of honours and a class medal. In the class of the Institutes of Medicine he also gained first-class honours and a medal. In 1864 he passed with honours the University examinations in chemistry, botany, and natural history. His interest in these subjects led him at one time to propose taking a degree in science. In 1866 he passed anatomy, physiology, and surgery, with good marks; in 1867 he took the degrees of M.B. and C.M. He joined the Botanical Society on 14th December 1865. He was fond of the practical prosecution of botany, and joined heartily in the class excursions. He became a member of the Royal Medical Society on 23d November 1866. On 31st January last he read to the Society a paper on Exercise and Training, in which he showed that gymnasium work is not prejudicial to the prosecution of University studies. The paper elicited a good discussion. The Society has expressed deep sorrow for his death, and have prepared a minute to that effect for transmission to the members of his family. In 1866 he joined the Medical Students' Christian Association.

Mr Baddeley took active work in the Infirmary. He was a dresser in Mr Syme's wards, acted as a clinical clerk to Professor Bennett, and ultimately became a resident clerk under Dr G. W. Balfour, who writes to me as follows:—

"To you who was so intimately acquainted with poor

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Baddeley, I can give, I fear, no information of any interest, as I have only known him during the short period of four months that he acted as resident-physician in the wards under my charge. It is superfluous to say that he endeared himself to all with whom he came in contact by his great amiability and warm-heartedness. I can but speak of his untiring devotion to science and the self-sacrificing assiduity with which he laboured to accumulate accurate data, especially in regard to the temperature of the body, and its relation to the pulse in fevers, which has resulted in the collection of a considerable body of facts, which may yet be of great service in relation to the clinical history of this disease. And all this was done with the heroic self-devotion of a soldier marching calmly on his path of duty through an unseen but not unknown death-storm, for he was well aware of the risk he ran, yet not unwilling to run it when duty called; and this was still more strongly exemplified in his assiduous and unwearied attendance on the death-bed of his friend Dr Henderson, whom he tended with all the gentle care of a nurse as well as the skilful watchfulness of a physician and a friend—Dr Henderson died on 31st January 1868—wholly regardless of ulterior consequences to himself. Repeatedly declaring that in consequence of such close attention he could not escape the fever, and that he felt sure it would go hard with him, he yet never relaxed his attention, and never quailed before the prospect which his forebodings perhaps helped to realise. As our intercourse was mainly professional, and always *coram publico*, I had no means of gaining insight into his inner life; but love of science, or a sense of duty, however they may enable one to act, are insufficient to enable one to bear patiently, even though regretfully, the loss of all one's cherished earthly hopes; and Mr Baddeley's firm principles and Christian fortitude were, to my mind, most clearly though silently evinced by the calm manner in which, during the first few days of his illness, he assisted in the diagnosis of his disease by taking his own temperature, as well as by the quiet resignation with which he received the information that he undoubtedly laboured under typhus. Mr Baddeley had the great satisfaction of being most assiduously attended during his illness by his

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father—also a medical man—for whom he entertained the greatest reverence and affection, and this must have been a great gratification to him during his conscious moments. Of a most robust and athletic frame, Mr Baddeley was one of the last whom a non-professional would expect to succumb to fever; but, alas! we know too well that strength of frame is of no avail against such an insidious foe. Nevertheless, the fever, though not a mild attack, progressed favourably enough without any bad symptom till, after two days' delirium, Mr Baddeley died suddenly during the night, between the eleventh and the twelfth days of the fever—just when crisis had apparently commenced. The estimation in which he was held, and the regret his sudden death had produced, were very fully manifested by the spontaneous attendance at his funeral of so many of his professors and fellow-students; but of this you were an eye-witness, and are perhaps better fitted to judge of its significance than I am."

Mr Baddeley's death took place in the Royal Infirmary on the 29th February, and he was interred in the Grange Cemetery on 1st March. The Rev. D. T. K. Drummond officiated on the occasion; and the pall-bearers were, his father, Dr Baddeley; Professors Balfour, Playfair, and Maclagan; Dr G. W. Balfour, Mr Livesay, Mr Carruthers, and Mr Howard Stark. There was a large attendance of medical men and students. A few of his friends in the University and Medical School are anxious to assist in raising a monument to his memory in the Grange Cemetery.

The following resolution was adopted by the Royal Medical Society:—

"The Royal Medical Society record with the deepest regret the untimely death, from typhus fever, caught in the arduous pursuit of his professional duties in the Royal Infirmary, of John Baddeley, M.B., &c., one of the most esteemed and promising members.

"From the time Dr Baddeley joined the Society in November 1866, till his lamented death on 29th February 1868, he made himself universally beloved, and unconsciously gained the regard of all its members.

"While unwilling to intrude on private grief, the Society feel they cannot but express their profoundest sympathy

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with his relations, and their own sense of the loss they have sustained."

I had always much pleasure in my intercourse with Mr Baddeley, and regarded him as a truly Christian student. During his illness his father told me that he expressed his reliance on Christ, and his assured hope of God's mercy through Him.

We have lost in Mr Baddeley one of our most promising graduates, and we have been deprived of one who would, I doubt not, have distinguished himself in after life in India, to which country he was about to proceed.

Truly God's ways are not as our ways. "We bow under the rod, and say, Thy will be done."

II. *Notes on some New and Rare Mosses gathered in Ross-shire and Inverness-shire in July, by Mr Charles Jenner and Mr Charles Howie.* By Mr Charles Howie, with Drawings and Descriptions by Professor Schimper. Communicated by Mr Sadler.

In July 1867 I made a botanical excursion in company with Mr Jenner over a part of Inverness-shire and Ross-shire, when, in addition to the mosses more generally distributed over our southern counties, we gathered some sufficiently interesting to induce us to bring them under the notice of the Society. Several are new to Britain, and one, a Didymodon (which we are assured by Professor Schimper), is new to Europe, and consequently a very valuable addition to our British flora.

One prominent feature of the bryology of the districts we visited was the ever-recurring forms of Dicranaceæ, as represented by specific forms of Dicranum and Campylopus. We may enumerate *Dicranum Blyttii*, *D. Starkii*, *D. falcatum*, *D. Scottianum*, and *D. fuscescens*. The genus Campylopus was ever present in some of its forms throughout the districts we traversed. Some of them at first sight were obscure and difficult to determine, as *C. longipilus*, growing in swampy bogs, presenting different shades of colour and habit; but on closer examination they were readily distinguished. *C. flexuosus* forms large clumps among the heath, *C. torfaceus* and *C. fragilis* among the lower rocks;

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and as we climbed the mountain summits we gathered *C. alpinus*, and down among the deep gullies of Wester Ross we gathered *C. setifolius*, where we also collected the more recently discovered *Dicranodontium aristatum* of Schimper. Among the Splachnaceæ, *Splachnum sphæricum* and *Tetraplodon Mnioides* are very abundant, forming large tufts of surpassing beauty in full fruit. To illustrate their abundance in this part of the country (Ross-shire), I may state, that when travelling on the top of the mail-coach, large patches were readily recognised at considerable distance from the road among the partially heath-clad bogs. We secured them on our return as pedestrians.

On the mountains at the head of Loch Torridon, at an elevation of about 2000 feet, we had the pleasure of finding *Bryum Muehlenbeckii* on wet rocks, forming large tufts, presenting even, at first sight, a distinct appearance from *Bryum alpinum*, to which it was considered to bear some relation. We were glad to be able thus to give a determinate station in Britain for this plant, for although it is recorded in Wilson's "Bryologia Britannica," it was understood by the author to be on doubtful authority. We submitted the plant for verification to Mr Wilson, and his judgment has been confirmed by Professor Schimper. The question, therefore, as to this moss having a claim to be retained in the British flora may be held now as settled. Another moss found by us in two stations, viz., in the east and west of Ross-shire, at considerable elevation, growing in deep pools, was *Hypnum fluitans* var. *purpurascens*. This has been determined by Professor Schimper, who informs us that he has recently received it also from the Norwegian Alps and from Switzerland. This form of *H. fluitans* may yet prove common on our more lofty mountains.

The next and last plant to which, on this occasion, I beg to call your attention, is the new species, *Didymodon Jenneri*, Sch., to which I have already referred. This very distinct species is an interesting one, not only to British bryologists, but also to bryologists throughout the world. The four Didymodons constituting that genus in "Bryologia Britannica," are all that occur in "Bryologia Europœa;" and in Sullivant's "Mosses of America," the same species, with the exception of *Didymodon flexifolius*, only

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occur. The few species representing this genus being so widely distributed, heightens the importance of this addition from our Scottish Alps. I need not enter into the detailed characters of the species—the form, serrature, and nervation of its leaves, their position on the branched stem, the structure of the peristome, the operculum, the inflorescence—as these are accurately given by Professor Schimper in his elaborate drawings and descriptions, which are subjoined. I have done myself the pleasure, with the assent of Professor Schimper, to name this last addition to our cryptogamic flora, after my friend and companion, Mr Jenner, whose valuable and continued labours in the more obscure departments of botany entitle him to this mark of respect; and I have no doubt you will consider this a well-deserved compliment to the president of our Society. I cannot too highly express my obligation to Professor Schimper for the deep interest he has shown; and as his beautiful drawings will be reproduced in the Society's Transactions, he will have conferred a benefit on all the members, as well as on science in general.

Didymodon Jenneri, *Sch.: a new species found in Ross-shire* by Mr Charles Howie and Mr Jenner, in July 1867. Verified and delineated by Professor Schimper. (Plate V.)

Description.	*Translation.*
Cæspites molles, virides inferne fuscescentes.	*Tufts* soft; green; brownish-black below.
Plantæ sesqui- et bi-unciales, pluries dichotome-ramosæ, fastigiatæ, parce radiculosæ.	*Plants* from an inch and a half to two inches in height; most of them dichotomously branched; fastigiate; with but few radicles.
Folia ex erecta basi patentia, sursum curvata vel divaricata, flexuosa, sicca, cirrhato-crispata, longa, lineali-lanceolata, basi subamplectante, concava, pallida, dehinc ad apicem subcomplicato-carinata, remoteque irregulariter serrata, haud papillosa, gramineo-viridia; costa semicylindrica usque versus apicem producta, extremitate superiore dorso hirta. Foliorum rete basilare laxum rectangulum, hyalinum, supra-basi-	*Leaves* spreading out from an erect stem; curved upwards, or divaricate; flexuous; dry; cirrhately-wavy; long; linear-lanceolate, with the base partly embracing the stem, concave, and of a light colour; from thence to the point carinate with a slight twist, and irregularly serrate at intervals; not papillose; of a grass-green hue; with a semi-cylindrical nerve prolonged on towards the tip; covered with hair

lare minutum, quadratum, chlorophyllo obrutum.

on the back at the upper extremity. The net-work at the base of the leaves is loose, with a rectangular arrangement, and transparent; above the base it is minute and in squares, and, as it were, buried in chlorophyll.

Flores in eadem caulis extremitate conjuncti; masculus monophyllus, antheridiis perpaucis magnis; femineus oligophyllus, foliis involucralibus caulinis similibus, archegoniis paucis, longistylis; paraphysibus valde elongatis, exacte filiformibus, hyalinis.

Flowers, male and female—growing together at the same end of the stem. Male, monophyllous, with its antheridia very few and large. Female, oligophyllous, with the involucral leaves like those of the stem. The Archegonia few and with long styles; the paraphyses very long, absolutely filiform and translucent.

Fructus: perichætium vix distinctum, e foliis compositum subarcuatis, basi paulo latioribus et tenuioribus, cæterum, caulinis similibus. *Vaginula* longa, cylindracea. *Capsula* in pedicello pallide-lutescente, leniter cernua, ovali-oblonga, mollis, pallide-fuscescens, deopercalata vacua, erecta, truncato-oblonga. *Operculum* obtuse brevirostrum, basi erosa rubellum, cæterum pallidum. *Annulus* simplex, persistens. *Peristomii* dentes lineali-lanceolati, usque ad medium bifidi, cruribus alternatim longioribus et brevioribus, subulatis, transversim articulati, ad medium usque aurantio-fusci, dehinc pallidi, minuto-granulosi. *Sporæ* minutæ, minuto-punctulatæ, ochreo-virides.

Fruit.—Perichætium scarcely distinct; consisting of leaves that are slightly curved and a little broader at the base, and more slender than those of the stem, but in other respects like them. *Vaginula* long and cylindrical. *Capsule* on a pedicel of a pale yellowish colour; slightly drooping; oval-oblong; soft; of a pale brownish-black hue; after the operculum falls off it is empty, erect, truncate-oblong. *Operculum* with a short obtuse rostrum, reddish in the base which is irregularly toothed; elsewhere of a pale colour. *Annulus* simple, persistent. Teeth of *Peristome* linear-lanceolate; bifid as far as the middle; crura alternately long and short, and subulate; transversely jointed; of an orange-brown colour as far as the middle; from that point pale and minutely granular. *Spores* small, minutely punctulate, of a yellowish-green colour.

Tabulæ explicatio.

Fig. 1. Planta magnitudinis naturalis.

Fig. 2. Pars ejusdem sublente augmentata.

Fig. 3. Folium inferius.

Figs. 4, 5, and 6. Folia superiora.

Fig. 7. Rete basilare.

Fig. 7-*b*. Cellulæ ejusdem magis augmentatæ.

Fig. 8. Rete apicale.

Fig. 8-*b*. Folii acumen magis augmentatum.

Fig. 8-*b′*. Cellulæ ejusdem, augm. 200.

Fig. 9. Flos; A, folium perigoniale; B, folium perichætiale.

Explanation of the Figures.

Fig. 1. The plant of the natural size.

Fig. 2. Part of the same slightly magnified.

Fig. 3. A lower leaf.

Figs. 4, 5, and 6. Upper leaves.

Fig. 7. The net-work of the base.

Fig. 7-*b*. Cells of the same, more magnified.

Fig. 8. The net-work of the point.

Fig. 8-*b*. The point of the leaf more magnified.

Fig. 8-*b′*. Cells of the same magnified 200.

Fig. 9. Flower—A. Leaf of perigonium. B. Leaf of perichætium.

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Fig. 10. Fructus.	Fig. 10. Fruit.
Fig. 11. Operculum fragmentum basilare augm. 100.	Fig. 11. Operculum; a piece of the base magnified 100.
Fig. 12. Pars peristomii et capsulæ, augment. 120; *a*, annulus.	Fig. 12. Part of peristome and capsule magnified 120. *a*. Annulus.
Fig. 13. Dentis pars inferior magis augmentata.	Fig. 13 Lower part of one of the teeth more highly magnified.
Fig. 14. Pars summa.	Fig. 14. Extremity of one of the teeth more highly magnified.
Fig. 15. Sporæ.	Fig. 15. Spores.
Fig. *x*. Foliorum segmenta transversalia.	Figures *x*. Transverse sections of the leaves.

III. *On a peculiarity in the Structure of the Stem of* Hedera Helix. By W. R. M'Nab, M.D., Edinburgh.

The difficulty experienced in obtaining thin sections of vegetable tissues prevents to a great extent the employment of the higher powers of the microscope in their investigation. It is apparently impossible to cut sections beyond a certain degree of thinness, and artificial means must be adopted to render the sections more transparent before they can be examined satisfactorily under high powers. Canada balsam was employed by the older microscopists for this purpose, but there are so many objections to its use that very few would now think of spoiling a good section of wood by preserving it in balsam. The sections so prepared are in general too transparent, and much of the structure is lost. Polarised light often brings much of this apparently lost structure back to view; but the employment of polarised light with higher powers is difficult unless powerful illumination can be obtained. Staining the tissues with iodine or magenta has also been of some service. Perhaps the best plan is that which has been so very successfully adopted by Dr Beale in investigating the structure of the animal tissues with very high powers. It consists in the employment of glycerine as a preservative. Sections placed in glycerine become transparent enough to be easily examined with a power of 600 diameters, while the detail is not obliterated, as is the case when Canada balsam is employed. By tinting the sections with a solution of acetate of mauvine in glycerine, or of carmine in ammonia and glycerine, the differences of the texture become very evident.

While examining sections of the stem of the ivy, which

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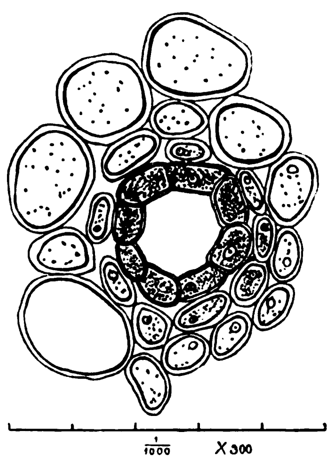
had been prepared by soaking in glycerine, and then treated with a dilute solution of acetate of mauvine and glycerine, certain peculiarities were observed. A series of canals were noticed in close proximity to the ligneous tissue of the young stem. These canals or intercellular spaces were circular, smaller than many of the single cells in the neighbourhood, and bounded by from six to eight small cells, filled with protoplasm, many of them containing nuclei. The densely granular protoplasm contrasts strongly with the contents of the neighbouring cells. These were generally nucleated, and the protoplasm was more homogeneous, and with but few granules. The canals lie either internal to the ligneous layer, or external to the small cambium cells, which lie



Sections of Ivy, showing Laticiferous Canal.

next the wood. The diameter of the canal varied from the $\frac{1}{1500}$ to the $\frac{1}{800}$ of an inch. The cells surrounding the space were from $\frac{1}{1300}$ to $\frac{1}{2000}$ of an inch broad, and $\frac{1}{400}$ of an inch long. One of the canals with the surrounding cells measured $\frac{1}{400}$ of an inch across, while a large cell in its immediate neighbourhood had a diameter of $\frac{1}{300}$ of an inch. The canal is not lined by a fine layer of secreting cells, epithelium, as is seen in resin canals of the coniferæ; only the simple cell-wall can be detected. They appear in general to be empty, but one or two of them were filled with a granular substance.

These canals could be traced from the stem into the

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petiole. In the petiole the vascular tissue breaks up into several small bundles, each of which was surrounded by these peculiar canals. They were also traced into the leaf, but it has not yet been noticed how they end. In the petiole they are rather smaller than in the stem, but they present exactly the same characters.

These intercellular spaces are probably to be placed in the same category as the laticiferous canals of certain Monocotyledons, as Alisma. These are large regular canal-like spaces, containing a juice resembling latex, and called by the German botanists *Milchsaftgaenge*, or laticiferous canals. They differ essentially from the resin canals of the coniferæ, the delicate lining being wanting. The existence of latex canals in the higher plants seems to be of rare occurrence. Of course there exist plenty of laticiferous vessels, but these have simple branched anastomosing walls, and are not intercellular canals.* The fact of their closely following the layers in which vital activity is always being employed in the formation of new ligneous tissue gives them great importance, and it may be that they supply material for building up the tissues. The presence of nuclei in the cells, and the ease with which they can be tinted by magenta, &c., shows that they are in a state of active vitality, and are serving a higher purpose than merely conducting the fluid. They have only been examined at a short distance from the growing part of the axis, so that their condition in the stem is as yet unknown.

In conclusion, I may mention that the sections were all cut from a fresh portion of ivy, and placed at once in a watch-glass, containing a mixture of one part of glycerine and two parts of water. The tinting was effected by the use of a very dilute solution of acetate of mauvine in solution of glycerine, or with Beale's carmine. Dilute solutions were found to work best, and their action more easily controlled. A solution strong enough to colour the section in ten or twelve hours answers best. If the solution be too strong, or the specimen allowed to remain for too long a time in it, the whole is stained one uniform colour, and of course spoiled.

* [Many authors believe them to be intercellular canals.—Ed.]

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IV. *Recent Botanical Intelligence.* By Professor BALFOUR.

I. M. A. Famintzen, Professor in the University of St Petersburg, in a recent paper on the influence of artificial light on *Spirogyra orthospira*, Naeg., arrives at the following conclusions:—1. The formation of starch in the cells of Spirogyra proceeds rapidly under the influence of light from a petroleum lamp. At the end of half an hour its presence can be detected by means of iodine. In twenty-four hours all the chlorophyll bands are full of it. Some days later the starch is in such quantity that the bands of chlorophyll are increased considerably, and become swollen often into rounded masses or into clusters of irregular forms. By degrees they lose their green colour, and assume a clear yellow tint. In the dead cells they become colourless, and are always filled with starch. 2. The formation of starch is due to the action of yellow light only. In the blue rays as well as in darkness, no starch is formed, and if it exists, it disappears by degrees. 3. No division of cells takes place under the influence of the yellow rays except as a consequence of the previous existence of starch in the cells. When the cells contain starch they divide by transverse septa, alike under the influence of blue and yellow light and in darkness. 4. In blue light the bands of chlorophyll continue to live during nine days at least, provided they contain no trace of starch. In darkness the same chlorophyll bands contract to one-third or even to one-half of the length of the cell. They then become narrower, take a smoother and more undulating contour, and present a more regularly moniliform appearance. 5. Both in blue light and in darkness the starch disappears more slowly than it is formed under the influence of white light or of yellow light.

M. Famintzen also found that the Volvox avoids the light in the first period of its development, and that it only seeks it at the period when it passes into a resting or non-moving condition. *Protococcus pluvialis*, on the contrary, is only directed towards the light in its first stage, and avoids it when passing into the resting state.

He also states that the movements of the filaments of *Oscillatoria insignis* are chiefly owing to light; that in

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darkness the movements also take place but very slowly; and that the filament of the plant prefers diffused light of moderate intensity, avoiding alike the direct rays of the sun and darkness.

Again, he finds that in *Mnium punctatum*, and other species of that genus, the grains of chlorophyll exhibit daily a change of position in the cells of the leaves; during the day they occupy the upper and lower surfaces of the cells, while during the night they are applied to the lateral walls. This migration of chlorophyll granules is effected solely under the influence of light. The diurnal position of the grains is only produced by the more refrangible rays of artificial light; the yellow rays acting in the same way as darkness. The migration of the chlorophyll grains is altogether independent of the position of the plant relative to the horizon, and takes place in the manner described, whether the plants are vertical or horizontal.

II. Dr THOMAS ANDERSON, superintendent of the Calcutta Botanical Garden, and in charge of Cinchona cultivation in Bengal, has sent specimens of Cinchona bark from Darjeeling for analysis. The bark was taken from plants of *Cinchona succirubra* and *C. officinalis.* The two trees of *C. succirubra*, which yielded the specimens of red bark, were planted in 1864, when they were about 10 inches high, and cut down in 1867, 31 and 28 months respectively after planting. The plants grew at 2556 feet above the sea. The bark of *C. officinalis* was taken from two plants of the narrow-leaved variety of the species, which were planted on 15th October 1864, at 3332 feet above the sea, and cut down 28 months after.

Mr JOHN ELIOT HOWARD has analysed the specimens of bark, and finds the results encouraging. The oldest red bark from the tree cut down 31 months after planting gave the following results:—Quinine, crystallising freely as oxalate, 3·20; cinchonadine and a little quinine, 2·27; cinchonine, 0·61; total, 6·10.

In September 1867 the following was the state of cultivation of Cinchona at Darjeeling:—*Cinchona succirubra*, 589,337 plants, cuttings, and seedlings; *C. Calisaya*, 8254 do.; *C. micrantha*, 30,667 do.; *C. officinalis* and vars., 599,908 do.; *C. pahudiana*, 5092; total, 1,233,258.

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III. M. Maximilian Kuhn gives the following enumeration of the species of ferns and their allies:—Hymenophyllaceæ, 200 species; Loxsomaceæ, 1 do.; Polypodiaceæ, 2821 do.; Cyathaceæ, 197 do.; Parkeriaceæ, 2 do.; Gleicheniaceæ, 38 do.; Schizæaceæ, 66 do.; Osmundaceæ, 10 do.; Marattiaceæ, 32 do.; Ophioglossaceæ, 27 do.; Equisetaceæ, 28 do.; Lycopodiaceæ, 107 do.; Selaginellaceæ, 301 do.; Rhizocarpeæ, 58 do.;—total, 3085.

In Africa the number of species of ferns and their allies is 683, of which there are found only in the continental parts of Africa 156, on the continent and the islands 198, and on the islands alone 329.

Of the African species there are found—in Asia, 147; in America, 87; in Polynesia, 68; in Europe, 54; in New Holland, 26. No species of Botrychium has been found in Africa.

V. *Report on the Open-Air Vegetation in the Royal Botanic Garden.* By Mr M'Nab.

The weather during the past winter, with the exception of the severe gales, has been favourable to vegetation in this district, very little frost being experienced throughout. During December on seven mornings only did the thermometer fall below the freezing-point, the lowest being on the morning of the 20th, when it indicated 24°, 26° on the 2d and 31st, 28° on the 19th, 21st, and 30th, and 29° on the 7th. During January, on seven mornings likewise, the thermometer fell below the freezing-point, the lowest being on the 21st, when the marking recorded was 20°, 21° on the 22d, 22½° on the 10th, 23° on the 4th, and 25° on the 3d, 11th, and 24th. Only during two mornings of February was the thermometer observed below the freezing-point, viz., 27° on the 9th, and 29° on the 23d; and during the past twelve mornings of March, only twice was the thermometer below the freezing-point, viz., 1st and 7th, when both indicated 29°.

In consequence of the recent mild winter, vegetation, it may be said, has had no proper check, and many plants of roses, thorns, &c. have never altogether parted with their leaves. Stocks, wallflowers, primroses, and all the varieties of helleborus, have been flowering profusely the whole

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winter; and in some parts of the garden, plants of the Tom Thumb scarlet geranium are still alive, a circumstance never before noticed here. The clumps of *Rhododendron atrovirens* have this spring gone through their flowering without interruption; and had it not been for the want of sun during last summer to ripen the flower-buds of the *Rhododendron Nobleanum*, they also would have been quite a blaze—instead of this, only a few flowers are seen on each.

	1868.	1867.
Knappia agrostidea,	Feb. 12.	April 1.
Arabis albida,	„ 13.	Feb. 22.
Nordmannia cordifolia,	„ 13.	„ 28.
Orobus vernus,	„ 13.	„ 15.
Doronicum caucasicum,	„ 14.	„ 18.
Sisyrinchium grandiflorum,	„ 14.	„ 4.
Aubretia grandiflora,	„ 14.	„ 23.
Omphalodes verna,	„ 14.	„ 22.
Symplocarpus fœtidus,	„ 15.	„ 18.
Scilla bifolia,	„ 15.	„ 16.
Symphytum caucasicum,	„ 18.	„ 22.
Pulmonaria mollis,	„ 18.	„ 18.
Nuttalia cerasiformis,	„ 18.	„ 20.
Primula nivalis,	„ 22.	April 6.
Sisyrinchium grandiflorum, album	„ 27.	Feb. 23.
Iris reticulata,	„ 27.	Mar. 2.
Daphne Mezereum,	„ 28.	
Draba aizoides,	„ 28.	April 2.
Narcissus minimus,	„ 29.	Mar. 5.
Corydalis cava,	„ 29.	„ 26.
Scilla bifolia, major,	Mar. 1.	„ 10.
alba,	„ 1.	„ 22.
Gagea lutea,	„ 2.	„ 21.
Mandragora vernalis,	„ 3.	April 9.
Hyoscyamus Scopolia,	„ 4.	Mar. 31.
Muscari botryoides,	„ 6.	April 6.
Narcissus pumilus,	„ 6.	Mar. 4.
Puschkinia scilloides,	„ 8.	„ 28.
Corydalis tuberosa, rubra,	„ 9.	„ 26.
Ribes sanguineum,	„ 9.	April 3.
Erythronium Dens-canis,	„ 11.	Mar. 25.
Corydalis solida,	„ 12.	April 1.

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VI. *Proposal for an Alpine Botanical Club.*

Mr Jenner proposed the formation of an Alpine Botanists' Club on the plan pursued at some of the German universities, the object being to send out at the expense of the club, during summer, two competent young botanists to some desirable districts of limited area in the Scotch Highlands, with a view to the collection, in fresh stations, of new or rare cryptogamic and phanerogamic plants. Mr Jenner advocated a wide basis for the club, with small annual subscriptions, providing, however, for larger contributions from those who received living plants. In conformity with Mr Jenner's recommendation, a committee, consisting of Professor Balfour, Mr Gorrie, Mr Jenner, and M M'Nab, was appointed to consider the subject, and to report to next meeting.

The following note was read from Mr J. F. Robinson, Frodsham :—

A short distance west of Frodsham lies a small valley, called Dunsdale Valley, intermediate betwixt Overton and Woodhouse Hills. At the head of this valley (called by the country people "Hollow") are to be seen a few small trees of the common lilac (*Syringa vulgaris*). How it was originally introduced to this locality it is now impossible to tell. It has been growing there for many years. In the same locality three very interesting plants occur, viz., *Orthodontium gracile*, where I suppose it was first found by Mr Wilson, and named by him *Bryum gracile ;* also in exposed sand-pits very plentifully, *Schistostega osmundacea.* In the spring of the year 1866 I carefully searched for fruit, but failed to find any ; yet in 1867 it fruited abundantly, and this season (1868) I cannot find a single fruiting example. Is it not a biennial moss ? In the "Bryologia Britannica" it is stated, "stems annual, from a perennial conferva-like thallus." I think it will be eventually proved that the stems are biennial. But the most interesting plant is *Asplenium marinum*, which grows in the crevices of the rocks in this valley, at a distance of many miles from the sea-shore.

Dr John Lowe, Lynn, Norfolk, sent the following list

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of plants in flower as noted by Mr Bray. The flowering has been noticed in the same native localities as last year, and Mr Bray finds the season about a fortnight earlier :—

Mercurialis perennis,........................	Feb.	15.
Primula vulgaris,........................	„	15.
Ulmus campestris,........................	„	15.
Salix caprea,........................	„	22.
Tussilago Farfara,........................	„	25.
Viola odorata,........................	„	29.
Salix viminalis,........................	Mar.	7.
Ranunculus Ficaria,........................	„	7.
Lychnis diurna,........................	„	7.
Anemone nemorosa,........................	„	9.
Lamium album,........................	„	9.
Adoxa Moschatellina,........................	„	9.
Caltha palustris,........................	„	22.
Veronica Buxbaumii,........................	Feb.	25.
Narcissus Pseudo-Narcissus,........................	„	23.

Mr Anderson-Henry exhibited the ripe fruit of a species of *Solanum*, which he had raised from seed received from Peru. It is about 2 inches long, and of a light yellowish colour. The taste is pleasant, much resembling that of the melon. Mr Henry believes it is an undescribed plant.

The Rev. Mr Clouston, Orkney, sent a curious specimen of the common turnip, where apparently the fibrous part of the root had, in the young state of the plant, become entangled round the tap root, and thus caused strangulation, which gave it the appearance of a double turnip.

Professor Balfour exhibited a specimen of the dry-rot fungus (*Merulius lachrymans*), which was found growing on herbarium cases in the class-room at the Royal Botanic Garden, its growth being caused by damp and bad ventilation.

Professor Archer presented to the Herbarium collections of plants from India, Malay Islands, Africa, Arctic Regions, and Switzerland.

Dr John Alexander Smith exhibited a specimen of fruit, apparently of a Strychnos, collected at Old Calabar, West Africa, by the Rev. A. Robb.

Mr Howie exhibited a specimen of *Primula vulgaris*, in which the calyx consisted of five distinct filiform sepals.

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9th April 1868.—Professor Balfour in the Chair.

The following Gentleman was duly elected a Resident Fellow—

George W. Davidson, M.D., Ph.D.

The following Donations to the Library were announced:—

Journal of the Linnean Society (Botany), Nos. 42–44.—From the Society.

Transactions of the Pharmaceutical Society for March 1868.—From the Society.

Proceedings of the Royal Physical Society, Edinburgh, Session 1864–65.—From the Society.

Proceedings of the Royal Society of Edinburgh, Session 1866–67.—From the Society.

Journal of the Quekett Microscopical Club, Nos. 1 and 2.—From the Club.

Bulletin de l'Académie Royale des Sciences, des Lettres, et des Beaux Arts de Belgique, No. 12, 1867, No. 1, 1868.—From the Academy.

Zoologiskh Botaniske Observationer fra Hvaloerne, af Robert Collett, Christiania, 1866.—From the Author.

Beretning om en botanisk Reise i Omegnen af Fæmundsoen og i Frysil, af H. L. Sorensen, Christiania, 1867.—From the Author.

Report on the Vegetation of the Andaman Islands, by Mr S. Kurz, Curator of the Herbarium of the Botanic Garden, Calcutta.—From Dr Thomas Anderson.

The following Communications were read:—

I. *On the* Genus Lophiostoma *of British Fungi.* By M. C. Cooke, Esq. (Plate VI.)

The revision of our lists of British Fungi, especially of the more minute forms for which microscopical examination is essential, is a daily increasing want. Unfortunately those who are most capable of performing this task are otherwise fully employed, and the study is one which, from its unpopular character, attracts but a few new investigators. In the hope that a small contribution towards this

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object would prove acceptable I am induced to present to this Society a monograph of one group of the Sphæriaceæ, which I think is entitled to the rank of a genus, and as such to be separated from that of *Sphæria*, with which it has hitherto been generally associated.

The illustrious Fries, in his "Summa Vegetabilium Scandinaviæ," recognised as a sub-group of the series "Erumpentes" an association of species, under the name of *Lophiostomæ*, almost identical with the tribe *Platystomæ* of his "Systema Mycologicum" (vol. ii. p. 467), of which the *Sphæria macrostoma* of Todè was the type. This, the *Sphæriæ erumpentes Lophiostomæ* of Berkeley's Outlines, De Notaris, in his "Schema di classificazione degli Sferiacei Italici," accepts as the foundation of the Genus "*Lophiostoma;*" a genus which has been very generally accepted, although many others of the genera there proposed have not been adopted.

The characters of this genus, as given by De Notaris, are thus briefly enumerated in the Appendix to the second edition of my "British Fungi."

Lophiostoma.—Perithecia carbonaceous, erumpent, Ostiolum large, compressed. Sporidia two- or many-celled, coloured or hyaline.

It may be objected, as it has been heretofore, that in some of the species included in this genus, the *ostiolum* is *occasionally* not compressed, and to all appearances is the same as in the section *Pertusæ;* but the same objection would apply to placing them in Fries' section *Platystomæ;* or, if classed with the *Pertusæ*, it might fairly be urged against them that such species as *S. excipuliformis*, for instance, are, in the normal state of their perithecia, entirely different from the rest of the *Pertusæ*. Notwithstanding the remark under this species in the British Flora—where it is the only species of the section *Platystomæ*—that "in this, as in other species, the true form is frequently accompanied by individuals in other respects altogether the same, but with a merely obtuse ostiolum, having completely the appearance of some species of the division *Pertusæ*." This objection, if valid, against the establishment of a separate genus, under the name of *Lophiostoma*, would be equally valid against a sub-genus, of which *S. excipuliformis* and

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S. macrostoma are the types. The question of the generic or sub-generic value of the ostiolum being left open.

Recently, some mycologists have thought fit to propose most extensive alterations in the classification of the *Sphæriaceæ*, based almost entirely on the fructification. It is not clear, however, that such a classification will be generally accepted, or that its basis is sufficiently sound for its permanent maintenance, if accepted. Yet, there are undoubtedly groups of species heretofore included in the large and widely constituted genus *Sphæria*, which might with advantage be separated, and would in themselves constitute very natural and well characterised genera. Of such groups it is assumed that the one selected as the subject of the present communication may be accepted as an example.

If the fruit of the twelve species now associated be examined, no charge can be maintained of a similarity in the form of the sporidia being the bond of union, for this partakes of three separate types, or two at least—the coloured and hyaline; the latter, however, seem to indicate two groups, of which *L. angustilabra* and *L. sex-nucleata* form one, and *L. Jerdoni*, *caulium*, *arundinis*, *semilibera*, and *excipuliformis* the other. The outer investing membrane of the sporidia in *L. viridaria* is less developed—except at the extremities of the sporidia—in *L. angustilabra* and *L. bicuspidata*, and exhibits itself only in the small hyaline tips in *L. macrostoma*.

In pursuing the investigation of this group, so far as British species are concerned, much valuable aid has been afforded by Dr E. Capron of Shere, through whose perseverance all the species now described for the first time have been obtained.

1. **Lophiostoma macrostoma**, Fr. De Not. Schema di Class. p. 45.

Sphæria macrostoma, Todè, Fungi Meckl. f. 76, 77.
Fr. Sys. Myc. vol. ii. p. 469. Scler. Suec. No. 345.
Berk. and Br. Ann. Nat. Hist. (No. 881).
Desmaz. Pl. Crypt. No. 772.
Currey, Linn. Trans. xxii. p. 321, pl. lviii. fig. 65 ?
Berk Outl. Fung. pl. 397.
Fuckel Fung. Rhen. No. 923.

Perithecia scattered, at first immersed, at length emergent, black. Ostiolum compressed, labiate. Sporidia uniseriate, yellow,

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then brown, 7-septate, the last joint at each extremity small and colourless (·0014 in.) ·035 m. m. long.

On bark of Sycamore. (Dr Capron.) On Holly twigs (C. E. Broome, Esq.).

Mr Currey describes the fruit of *S. macrostoma* thus:—"Sporidia biseriate (? sometimes uniseriate) yellow at first, eventually brown, 5-septate, rarely with six or more septa, frequently with longitudinal divisions rendering the sporidia multicellular; ·0010 to ·0012 in. long." This does not agree with my specimens, or any which I have examined, but approaches more closely to my *L. bicuspidata*. The sporidia figured by Mr Currey (fig. 65) appear to belong to the present species.

Desmazieres' and Fuckel's published specimens accord with my figure and description. (Pl. VI. fig. 1, and sporidia.)

2. Lophiostoma bicuspidata, n. s.

Sphæria macrostoma. Currey, Linn. Trans. xxii. p. 321. pl. lviii. f. 64?

Perithecia scattered, black, immersed, elevating and pushing through the matrix with their narrow elongated ostiola. Asci clavate. Sporidia biseriate, 5-septate, with occasional transverse septa, constricted, brown, each extremity at first furnished with a hyaline beak bent at both ends in the same direction, so as to give a curved appearance to the sporidia; ·0228 m. m. long, (·0009 in.)

On decorticated twigs. Shere, Surrey, Oct. 1866. (Dr E. Capron.) (Pl. VI. fig. 4, with sporidia.)

Var. β. Sporidia larger (·0012 in.) ·03 m. m. long, with no transverse septa; otherwise identical.

On dead *Clematis vitalba.* Shere, April 1867. (Dr Capron.)

This species is very distinct from *Sphæria macrostoma*, Todè. It is possible that Mr Currey's fig. 64 may belong to it. Externally there is considerable resemblance, except that the perithecia are smaller.

3. Lophiostoma viridaria, n. s.

Perithecia scattered over conspicuous green spots an inch or more in length, semi-immersed, black. Ostiolum linear. Asci cylindrical. Sporidia uniseriate, tri-septate, attenuated towards each extremity, constricted at the septa, brown, with a large nucleus in each cell. When free the sporidia exhibit a distinct outer transparent membrane which invests them. Length ·035 m. m. (·0014 in.)

On decorticated twigs of Maple. Shere, Surrey, Jan. 1866. (Dr E. Capron.)

The conspicuous green patches on which the perithecia are usually found resemble those caused by the mycelium of *Helotium*

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æruginosum, indeed, it is not improbable that the latter originates the patches upon which the *Sphæria* locates itself. Hitherto the green patches and the perithecia have always been found associated. The perithecia are larger and more prominent than in *Lophiostoma bicuspidata*, and both are very distinct from *S. macrostoma*, Todè, in their fructification, although somewhat resembling small forms of it in external appearance. The fruit much resembles that of somes pecies of *Massaria*. (Pl. VI. fig. 2, with sporidia).

4. Lophiostoma nucula, Fr. De Notaris, Schema di Class. p. 46.

Sphæria nucula, Fr. Syst. Myc. vol. ii. p. 466. Scler. Suec. No. 230.
Berk. Eng. Fl. vol. v. p. 2, p. 266.
Fuckel Fungi Rhen. No. 929.
Berk Outl. Fung. p. 396.

Sub-gregarious, black. Perithecia minute, innate, superficial, ovate, even at first papillary, then pierced. Sporidia uniseriate ellipsoid, brown, 7-septate, constricted at the centre (·001 in.), ·025 m. m. long.

"The ostiolum is sometimes of exactly the same nature as in the *Platystomæ*." (*Berkeley.*)

On Oak Bark.

The figures of the fruit, and the description and measurements, are taken from specimens published by Fuckel.

It is uncertain whether De Notaris is quite correct in placing this species in his Genus *Lophiostoma*. The examination of a good series of specimens is necessary, and this I have not at present secured. The species, therefore, is inserted doubtfully, and upon the authority of Professor de Notaris. (Pl. VI. fig. 7, with free sporidia.)

5. Lophiostoma fibritecta, Berk. De Notaris, Schema di Class. p. 46.

Sphæria fibritecta. Berk. in Hook. Journ., 1853, p. 43.
Berk. and Br. Ann. Nat. Hist. (No. 777).
Berk. Outl. Fung. p. 397.

Scattered, minute, black, often slightly elongated, depressed. Ostiolum sometimes quite obselete, but frequently present, and varying from punctiform to linear. Asci clavate, varying greatly in length, paraphyses slender. Sporidia curved, sub-fusiform, yellow-brown, quinque-septate (about $\frac{1}{650}$ in.), ·04 m. m. long.

"The perithecia are rather larger than those of the other fungi commonly present in similar situations. The contents are white. Nothing can be more variable than the ostiola of this species. Even in extreme cases it is entitled only to a place amongst the

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Platystomæ from affinity rather than from well defined characters." (*Berkeley*).

On bleached larch planks. King's Cliffe, Dec. 1851.

6. Lophiostoma angustilabra, B. and Br.

Sphæria angustilabra, Berk. and Br. Ann. Nat Hist. (No. 881), t. xi. f. 27.
Berk. Outl. Fung. p. 397.

Perithecia half-immersed, rugulose, somewhat elongated. Ostiolum compressed, narrow. Asci clavate. Sporidia biseriate, (·0015–0016 in.) ·04–·043 m. m. long, fusiform, curved, uniseptate, constricted at the septum, each articulation containing from two to three nuclei, and terminating in a hyaline point.

" Differing from *S. excipuliformis* in the structure of the spores, which are possibly at length multiseptate; but if so, they are at first composed of two very elongated cones opposed to each other at their bases, and strongly constricted at the commissure." (*Berk. and Br.*)

On gorse. Leicestershire (Rev. A. Bloxam). Common, at Shere. (Dr E. Capron.) (Pl. VI. fig. 3, with free sporidia.)

7. Lophiostoma sex-nucleata, n. s.

Scattered. Perithecia elongated, black, slightly rugose; at first immersed, then emergent. Ostiolum compressed. Sporidia biseriate, fusiform, hyaline, slightly curved, five-septate, constricted at the centre, and but little at the other septa, each articulation containing a single nucleus (.0014 in.) ·035 m. m. long.

On nettle stems. March 1868. (Dr E. Capron.) Shere, near Guildford.

This can hardly be considered as a form of *S. angustilabra*, since that species, even when the septa can be discerned still remains quadri-nucleate. The length is slightly less, and the hyaline membrane absent. It appears to succeed *Sphæria coniformis* on old nettle stems, and has been overlooked from its casual resemblance to the remains of the dispersing perithecia of *S. coniformis*. (Pl. VI. fig. 8, with sporidia.)

8. Lophiostoma excipuliformis, Fr. De Notaris, Schema di Class. p. 45.

Sphæria excipuliformis, Fr. Obs. t. 4, f. 5.
Fr. Scler. Suec. No. 88.
Fr. Syst. Myc. vol. ii. p. 469.
Berkeley Eng. Fl. vol. v. pt. ii. p. 266.
Berk. Outl. Fung. p. 397.
Berk. and Br. Ann. Nat. Hist. (880.)

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Scattered. Perithecia emergent, ovate, black, rugulose; lips of the ostiolum longer than the short neck. Sporidia uniseriate, fusiform, curved, with about six septa (·0012 in.) ·03 m. m. long; commissures not constricted.

On bark, dead wood, and furze. King's Cliffe, &c. (Rev. M. J. Berkeley.)

The Rev. M. J. Berkeley says that the typical form published by Fries in *Scleromycetes Sueciæ* has sporidia of precisely the same shape, but twice as long, and that he finds them sometimes ·0028 in. long. "It is distinguished from the other wide-mouthed species by its short cylindric neck." (Pl. VI. fig. 10, with free sporidia.)

9. Lophiostoma Jerdoni, B. & Br.

Sphæria Jeodoni, Berk. & Br. An. Nat. Hist. (No. 975), t. xvii. f. 28.

Perithecia scattered or slightly crowded, sub-globose, with narrow linear astiola. Asci clavate. Sporidia biseriate (·0012–·00125 in.) ·03 to ·033 m. m. long, strongly constricted in the centre, as also each of the two bi-tri-nucleate joints.

On *Rubus idæus* (Mossburnford). A. Jerdon, Esq., on Elm (?) East Bergholt (perithecia more scattered). Rev. C. Badham.

From the figures and description of the fruit of this Sphæria it would appear to approximate very closely to *Lophiostoma caulium*, except in the constrictions at the septa, and the colour of the sporidia. (Pl. VI. fig. 5, with free sporidia.)

10. Lophiostoma caulium, De Not. Spheriacei italici (No. 70), Micromy. Ital. viii. cum icone.

Lophiostoma herbarum, Fr. V. A. H. 1818, p. 114.
Sphæria caulium, Fr. Sys. Myc. vol. ii. p. 510. Scler. Suec. No. 465.
Desm. Ann. and Sc. Nat. xv. t. 14, f. 2, a.
Berk. and Br. Ann. Nat. Hist. No. 982.
Fuckel Fungi Rhen. No. 927.

Perithecia immersed, globoso-elliptic, black. Ostiolum naked, elliptic or linear. Asci clavate. Sporidia crowded, or bisenate fusiform, attenuated, straight or curved, 7-septate, with a greenish tint (·0015 in.) ·04 m. m. long.

On dead stems of *Epilobium hirsutum*, &c.

"Sporidia fusoidea, uno latere convexiore, sublunulata, 4–6 locularia, ad polos obtusiuscula loculis mediis sub-inde non-nihil tumescentibus, pallide olivacea, diaphana, 1·100 millim long vix excedentia." (*De Notaris.*) (Pl. VI. fig. 6, with free sporidia.)

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11. Lophiostoma arundinis, De Not. Schema di Class. p. 46.

Sphæria arundinis, Fr. Sys. Myc. vol. ii. p. 510.
Berk. and Br. Ann. Nat. Hist. (No. 639.)
Kunze. Exs. No. 55. Currey, Linn. Trans. xxii. p. 330, pl. lix. f. 124.
Rabh. Herb. Myc. ii. No. 641.
Berk. Outl. Fung. p. 397.
Fuckel Fungi Rhen. No. 926.

Sporidia biseriate, yellowish, 3–5 septate, slightly curved, pointed at each extremity (·0010–·8016 in.) ·03–·04 m. m. long.

"The spores are at first uniseptate, and the contents of the two portions are then divided into two or three endochromes, in which respect there is an essential difference between this species and all forms of *Sphæria culmifraga*." (*Berkeley.*)

"Sporidia fusoidea 4-6 locularia, sæpe curvula fuliginea." (*De Notaris*). (Pl. VI. fig. 9, with free sporidia.)

12. Lophiostoma semilibera, De Not. Schema di Class. p. 46.

Sphæria semilibera, Desm. Pl. Crypt. No. 1787.
Ann. Sc. Nat. ser. iii. vol. vi. p. 78, 1846.
Berk. and Br. Ann. Nat. Hist. (No. 641).
Berk. Outl. Fung. p. 400.
Fuckel Fungi Rhen. No. 1705.

Scattered. Perithecia minute, ovate-elliptical, semi-immersed, black, shining. Ostiolum compressed, cristate. Asci clavate. Sporidia fusiform, straight or curved, acute at each extremity, quinque-septate ·033–·03 m. m. long.

On the culms of grasses.

"Sporidia elongata fusiodea 4-locularia, cum Leptosphæriis fere confluit." (*De Notaris.*)

II. *On the British Species of Delphinium.* By W. R. M'Nab, M.D.

In the last edition (6th) of Professor Babington's "Manual of British Botany," two species of Delphinium are described. One of them is from Jersey, the other from the south of England, and is therefore the only proper British species. While examining the Delphiniums in my private herbarium, and consulting authorities, some confusion regarding the British species was found to exist. Through the kindness of Professor Balfour, a large series of British and European specimens were sent to me for examination; and I now propose to give the results of that examination in the present paper:—

In Smith's "English Flora"* (1825), the English Delphinium is described as *D. Consolida*, L.; but the *capsule* (follicle) is described as *pubescent*, and numerous stations are recorded for it in various parts of the south of England. In Lindley's "Synopsis of the British Flora"† (1835), the character of *Delphinium Consolida* are given from Decandolle, Lindley stating that the *follicles* are *smooth*. In the first edition of Babington's "Manual"‡ (1843), *D. Consolida*, L., is described thus:—"St. erect, branched, racemes few-flowered, spur larger than the calyx, pet combined, &c.; pedicels larger than the bracts, caps downy," &c. Again, in the fifth edition (1862) of the same work, § *D. Consolida*, L., is thus described:—"St. erect, with spreading branches, racemes few-flowered, spur larger than the calyx, petals combined; E. B. 1859, about 1 foot high; pedicels usually larger than the bracts; caps downy; flowers of a vivid and permanent blue, rarely red, pink, or white. L. deeply multifid. Although the caps are downy, our plant is not *D. ajacis*," &c.

Irving‖ mentions *D. Consolida*, L., and says that the fruit is "smooth, or nearly so, terminating in a slender beak."

In Hooker and Arnott's "British Flora"¶ *D. Consolida*, L., is said to have the follicle glabrous. The same statement is also in Hooker's "British Flora" (1848); and the localities given are, "Suffolk, Kent, Cambridge," and "St Helier's, Jersey," Mr Babington. Bentham** figures *D. Consolida*, L., with a smooth capsule, and mentions that *D. ajacis* has a "long dense spike, and a shorter spur."

From this it will be seen that there are great discrepancies in the descriptions given by the different authors just quoted. Some say the follicle is smooth, others that it is pubescent; but all agree that the Cambridge plant is *D. Consolida*, L.

De Candolle †† gives the following description of *D. Consolida* (Linn. sp. 748):—"Caule erecto, subglabro divari-

* Smith's English Flora, vol. iii. p. 30.
† P. 13. ‡ P. 9. § P. 12.
‖ Irving's Illustrated Handbook of the British Plants (1858), p. 790.
¶ Eighth Edition. 1860. ** Illustrated Handbook, vol. i. p. 22.
†† Prodromus, vol. i. p. 51.

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catim ramoso, floribus paucis, laxé racemosis, pedicellis bracteâ longioribus capsulis glabris." He also thus describes *D. ajacis* (Linn. sp. 748):—" Caule erecto, subglabro subsimplici ramis vix divergentibus longe floriferis, floribus densé racemosis, pedicellis bracteæ longitudine, capsulis pubescentibus." These descriptions agree perfectly with numerous European specimens sent to me for examination by Professor Balfour.

Professor Babington, in the sixth Edition of his " Manual," gives *D. ajacis* (Gay) as a British species, with spreading branches, 4 to 16 flowered racemes, and a downy follicle. He also gives *D. Consolida*, L., with patent branches, few-flowered racemes, and a glabrous follicle; from cultivated land in Jersey.

Here, then, the matter rests. The most recent authority gives us but one British Delphinium, and a Jersey one not yet found in England.

Among the British specimens sent for examination by Professor Balfour, and which were all named *Delphinium Consolida*, three very distinct forms were noticed—

1. *D. Consolida*, Linn. DC.
2. *D. ajacis*, Gay, Bab., 6th ed.
   D. Consolida, Auct.
3. Nov. sp.? (*D. Consolida*, 1st and 5th ed.?)

1. *D. Consolida*, Linn., DC.

Two specimens were sent and examined. The first is labelled, " *Delphinium Consolida;* Devonshire; Veronge, 1838." The second, " *Delphinium Consolida;* St Aubin's Bay, Jersey; 2d August 1845; ex Herbario J. Dickson." These are undoubtedly the *D. Consolida* of European authors, as they agree in every particular with the specimens of *D. Consolida* in the University Herbarium from different parts of Europe. The follicle is smooth, with a longish style; the flowers few at the end of long pedicels; the bracts small, the spur being about one-and-a-half times as long as the calyx. Dr Julius Veronge's specimen from Devonshire agrees perfectly with the Jersey one. The true *D. Consolida* is therefore here recorded as truly English for the first time.

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2. *D. ajacis*, Linn., DC.

Numerous examples of the Cambridge Delphinium were examined, as well as a specimen from Kent. The follicle is pubescent, with a short thick style. The flowers are in long recemes of from 4 to 10 flowers. The flowers are large; the calyx as long as the spur. The pedicels are short, and the bracts long, sometimes divided. This is without doubt the same as the European *D. ajacis*, as it agrees with Decandolle's description, and cannot be separated from European specimens in the herbarium marked *D. ajacis*.

3. *D. addendum*, n. sp.

Among the Cambridgeshire specimens are nine examples, collected in 1835 by Sir W. C. Trevelyan, which differ from both the other species. It seems very probable that it was after examining examples like those now before me that Professor Babington came to the conclusion that the Delphinium from Cambridge, although having a downy capsule, was not *D. ajacis*.* The follicle is pubescent, with a short thick style. The stem is erect, branching; the pedicels long, 2 to 3 flowered, rarely 7 flowered; bracts short, seldom as long as the pedicel; the spur larger than the calyx; the whole plant sub-pubescent. It will be seen that it presents characters separating it from both the other species. The long pedicels, the few flowers, with long spurs and the short bracts, bring it close to *D. Consolida*, while the pubscent follicle and the short thick style points to *D. ajacis*.

If this should be distinct from the other two British species, and I have in my own mind no doubt on the subject, I would venture to call it *Delphinium addendum*.

D. addendum, n. sp.; caule erecto, sub-pubescente, ramoso, floribus paucis, laxé racemosis, pedicellis bracteâ longioribus, capsulis pubescentibus.

The three British species would therefore stand thus:—

1. *D. ajacis*, Linn., DC.

Stem erect, about a foot high; branches spreading; leaves multifid; racemes 4–16 flowered; petals combined;

* Babington, Manual (5th edit), 1852, p. 12.

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calyx as long as the spur; pedicels short; bracts nearly as long as the pedicels; ovary abruptly narrowed into a short style; follicle downy; flowers blue, sometimes pink or white.

2. *D. addendum,* n. sp.

Stem erect, about a foot high; subpubescent, branches erect; leaves multifid; racemes 2–7 flowered; petals combined; spur longer than the calyx; pedicels longer than the bracts; ovary abruptly narrowed into a short style; follicle downy; flowers blue, pink, or white. Cambridgeshire.

3. *D. Consolida,* Linn., DC.

Stem erect, about a foot high; branches spreading; racemes few-flowered; petals combined; spur longer than the calyx; pedicels long; bracts minute; ovary narrowed into a long style; follicle glabrous; flowers blue.

1. Follicle pubescent, . . . 2.
   Follicle glabrous, . . . *D. Consolida.*
2. Racemes many-flowered; pedicels short; bracts nearly as long as pedicels, . . *D. ajacis.*
   Racemes few-flowered; pedicels long; bracts always shorter than the pedicels, . *D. addendum.*

We can easily account for the confusion which has occurred. Instead of there being only one species, as was until recently the opinion of British botanists, there are certainly two, perhaps three. How could we expect to get a description to embrace them all?

III. *Report on the Open-air Vegetation in the Royal Botanic Garden.* By Mr M'Nab.

Since the last meeting of the Botanical Society, March 12, vegetation has gone on at the same rapid pace as it had done previous to that date. The weather since then has been comparatively mild. With the exception of the 15th, 23d, 24th, and 25th, when the lowest morning temperatures indicated respectively 31°, 31°, 26°, 25°, all other mornings up to the present date (9th April) ranged from 34° to 53°.

Those herbaceous plants whose flowering I have been in the habit of recording up to the time of the April meeting,

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have all flowered during March, as well as numerous others which I have not been in the habit of noting, many of these plants being fully three weeks earlier than their average time of flowering during previous years.

Arboreous vegetation is also very far advanced, much more so than is generally seen at this period of the year. Many sycamores are in full leaf, as well as thorns, willows, larches, &c., and many others are coming rapidly forward, such as limes, birches, horse chestnuts, sorbus, &c. The snowy Mespilus is in full flower, as well as the *Pyrus nivalis*, elms, Norway maple, &c.

Many specimens of the *Ribes sanguineum*, which showed their first flowers this year on the 9th of March, are now past their best, while last year they only commenced flowering on the 3d of April.

The following table, which exhausts my usual annual list, will show the difference in the period of flowering this year as compared with last:—

Third List.	1868.		1867.	
Mandragora vernalis,............	March	18.	April	9.
Scilla bifolia rubra,..............	,,	18.	March	25.
Primula ciliata purpurata,.......	,,	20.	April	5.
Anemone nemorosa,...............	,,	20.	,,	15.
Narcissus moschatus,............	,,	20.	,,	3.
Fritillaria imperialis,............	,,	21.	,,	6.
Saxifraga virginica,...............	,,	21.		
Hyoscyamus orientalis,...........	,,	22.	,,	4.
physaloides,.........	,,	23.	,,	8.
Narcissus Pseudo-Narcissus,.....	,,	26.	,,	5.
Adonis vernalis,.................	,,	26.	,,	4.
Ornithogalum montanum,........	,,	28.	,,	10.

IV. *Miscellaneous Notices.*

Mr Robert Brown presented and made some remarks on various articles which he had brought from Vancouver's Island, Oregon, and other parts of North-west America, principally illustrative of the economic uses of coniferæ, &c.:—1. A large mat of the bark of *Thuja gigantea*, Nutt. 2. Raw material out of which it is wove. 3. The same stained to form ornamental borderings, &c. 4. The same

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teased out and used as gun-wadding, pads, &c. (All the above from Seshaaht Indians, V. I.) 5. Bottles covered with a woven sheathing of ornamental work, of the roots of some species of Cyperus (Fort Simpson, B. C.). 6. Indian spoons made of the wood of *Pinus monticola*, Dougl. (Queen Charlotte's Island). 7. Section of stem of *Philadelphus micropetalus* (Willamette River, Oregon). 8. Ground wokas (seeds of *Nuphar advena*, Ait.), used as food by the Indians near the Klamath lakes, Oregon, &c.

Mr Brown remarked that if we consider the varied uses to which *Thuja gigantea* is put, it might well be styled "the bamboo" of the North-western Indians. The bark is woven into mats embroidered into lozenge-shaped spaces and borders, with bark of a darker colour, stained by steeping it in a mixture of oil, charcoal, and water. These mats are used in a variety of aboriginal modes of existence, and the manufacture is a marked feature in their domestic economy. The bark teased out is woven into blankets and cloaks, and used for gun-wadding. The wood splits easily, and forms boards for their lodges, and the trunks are hollowed out into their beautiful canoes. The twigs are so tough as to be used as withes to sew together the detached pieces of the canoe, as well as to bind the boards of the lodges to the upright posts. The leaves are even smoked in times of tobacco famine. The bark is often used to roof temporary houses, and is a common material for canoe scoops. The wood is almost indestructible under ground, and it is extensively used in the construction of pickets or other works in which durability is required in the earth. It might be used much in railway sleepers, and, being very light, might be easily wrought, for window sashes, doors, &c. It is one of the most beautiful trees in North-west America, and ought to be extensively planted in England.

Mr Brown also exhibited and described a large series of drawings and photographs, illustrative of the forests and forest trees of the same region, including a number of views of *Sequoia* (Wellingtonia) *gigantea*, Lindley; *Thuja gigantea*, Nutt.; *Abies Menziesii*, Dougl.; *Abies Bridgesii*, Kell.; *Pinus contorta*, Dougl.; *Pinus Lambertiana*, Dougl.; *Abies Douglasii*, Lindley; *Arbutus Menziesii* (*procera*, Hook.); *Pinus monticola*, Dougl.; *Alnus Oregana*, Nutt.; *Juniperus*

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Henryana, R. Br. min.; *Cactus gigantea*, *Sequoia sempervirens*, &c.

Mr M'Nab exhibited a specimen of Bunch-grass (*Elymus condensatus*), which was three feet two inches in height on 1st April, and promises to be a free-growing productive grass for early cattle feeding.

Mr Gorrie exhibited specimens of *Narcissus Pseudo-Narcissus*, Lent-lily or common English Daffodil, from Mr W. Huggate, gardener, Buxstead Park, Sussex, which differ considerably from the plant in cultivation under that name. This, the true English Daffodil or Lent lily, is little known except in its native localities, and although one of the prettiest of a showy tribe, it is seldom or almost never subject to cultivation. If asked what is the *N. Pseudo-Narcissus* of Linnæus, most of our botanists will point to the large garden Daffodil, with its deep yellow flowers, and say there it is; an error for which they are in a great measure excusable, seeing that they have been led into it by different modern British floras, in none of which that we have looked into is it correctly described; but, on the contrary, the forementioned large Daffodil seems to be that to which these descriptions point. And we must go back to Johnson's edition of Gerarde's Herball, published in 1633, to ascertain clearly what the *N. Pseudo-Narcissus* really is; and there we will find it correctly figured as well as described under the name of "*Pseudo-Narcissus Anglicus*, the common yellow Daffodil or Duffodowndilly," which then, according to that author, grew almost everywhere throughout England—a much wider range of habitat than it now occupies. In the same work, the large garden Daffodil is named "*Pseudo-Narcissus Hispanicus*," is also figured, and of which it is recorded, "We have in our London gardens another sort, which naturally groweth in Spain, very like unto our best known Daffodil in shape and proportion, but altogether fairer, greater, and lasteth longer before the flowers doth fall or fade." The English Lent lily, so named from its period of flowering, is still common in some of the southern counties, it is only about half the size of the yellow garden Daffodil, and much lighter than it in colour —being only light lemon-yellow instead of approaching to orange-yellow, and is highly deserving of being generally

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introduced into gardens, and grassy ornamental woodlands.

Mr Alexander Craig-Christie exhibited a portable plant-case, which he had found serviceable in conveying living plants from a distance. It consisted of a box with two uprights, one at each end, from which canvas was stretched to the margins of the box, thus forming a sort of "Wardian case."

Mr Charles Howie noticed the occurrence of *Zygodon Stirtoni*, and *Polystichum angulare*, near Largo, Fife.

Mrs Ross, of Pitcalnie, sent a living specimen of *Buxbaumia indusiata*, which she had collected near that place.

Professor Archer exhibited the following:—1. Section of stem of *Abies excelsa*, from the district of Lower Tungoosk, 700 miles up the river Tungoosk, at the junction of the river Timour, near the Icy Sea, 70° N. It exhibited 300 annual rings of growth. 2. Section of *Pinus Cembra*, 302 years old, from the same place as the last. 3. Section of fir from the banks of the river Petchora, 66° 25′ N., age ninety-five years.

A specimen of *Palisota Barteri*, in flower, was exhibited from the Botanic Garden. It had been grown from West African seeds transmitted to the garden by Mr Hanbury.

Professor Balfour read a letter from Mr H. H. Calvert, Alexandria, announcing that he had despatched roots of *Biarum Alexandrinum*, *Iris Sisyrinchium*, and *Colchicum Steveni* for the Botanic Garden.

Dr Balfour announced that Mr Adam Matheson of Jedburgh had presented to the Museum a series of beautiful sections of fossil trees from the valley of the Tweed; that Messrs Cox Brothers of the Camperdown Linen Works, Dundee, had sent a series of specimens illustrating the manufacture of jute; and that Dr Parnell and Sir W. Trevelyan had lately presented to the Herbarium large collections of plants.

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14*th May* 1868.—CHARLES JENNER, Esq., President, in the Chair.

The following Gentlemen were elected Fellows of the Society:—

1. *As a Resident Fellow.*

THOMAS ALEXANDER GOLDIE BALFOUR, M.D.

2. *As an Associate.*

WILLIAM SHAW, Gunsgreen Hill, Berwickshire.

On the motion of Professor Balfour, a loyal address was voted to the Queen, expressing the Society's gratification at the deliverance of H.R.H. the Duke of Edinburgh from the hand of the assassin; and one to the Duke to a similar effect. Her Majesty is Patron of the Society, and his Royal Highness is an Honorary Fellow.

The following Communications were read:—

I. *On the Cultivation of Sumach* (Rhus Coriaria), *in the vicinity of Colli, near Palermo.* By Professor INZENGA.* Translated by Colonel H. YULE, C.B. Communicated by Dr CLEGHORN.

I propose shortly to describe the treatment of Sumach, as it is prosecuted in the vicinity of Colli, and I venture to hope that my work may be useful in some degree to those who have so courteously urged me to write on the subject.

Before going into a practical description of the cultivation, it seems indispensable to give some preliminary notice as to the soil and farming economy adapted to the

* Published in the "Annali di Agricoltura Siciliana, redatti per Istituzione del Principe Castelnuovo." Palermo, 1852.

Note by the Translator.

Professor Inzenga's paper is rather diffuse in expression, hence this is an abstract and paraphrase, not a literal translation; but I believe it conveys the sense of all the essential parts of the paper. The abstract was not originally written for the press, but only for the use of my friend Dr Cleghorn. As, however, he wishes to publish it, I have added a note at the end on some points of interest.—H. Y., *Palermo, Feb.* 20, 1868.

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profitable prosecution of this business, in order that every one may judge for himself of the localities where he wishes to introduce it, and anticipate what is likely to be the result of such an experiment.

1. *Soil.*—The soils best adapted to the sumach are those which, in our climate, are least suitable for the other crops forming the staples of our agriculture; I mean loose calcareous soils, which, in the absence of rain, become excessively dry, and are commonly called *warm* soils. *Rhus Coriaria* always flourishes best in dry places, and any excess of damp or stagnant moisture is destructive to its growth. It grows, indeed, in fertile clay soils; but though this fertility gives a luxuriant appearance to the plant, its produce will never be of the same quality as in drier tracts. The sumach grown in the dry calcareous soils is less luxuriant in aspect, and does, in fact, produce a smaller amount of foliage, yet this foliage always possesses those tanning virtues which render it an object of commerce. The essential principles which bestow these virtues are found in a less diluted state, and hence in the drying that takes place after gathering there is less loss of weight in relation to volume. For instance, take two equal volumes of fresh sumach leaves, one from a rich wheat soil, and the other from a poor and warm soil; after both have been dried, you will find that the latter will be much the heavier, will have the stronger odour of the peculiar tanning principle called by experts *Spirit of Sumach*, and hence will have the greater commercial value. Apparent luxuriance of foliage is, therefore, no test of value.

The soil best adapted to the sumach is one eminently dry, and which does not long retain moisture after a fall of rain; hence it is no wonder that it thrives especially in hilly lands with gentle slopes, where the waters drain off rapidly. The sumach leaf is a bulky article, and therefore, in view to profitable cultivation, there should be ready and economical means of transport to its market. These facilities of transport exist in our old sumach localities, which are generally in the neighbourhood of the seaboard, and especially lie round our commercial centres. It is questionable if the culture would pay beyond the reach of carriage roads.

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2. *Propagation.*—The sumach is propagated by suckers which spring up round the adult plants. These suckers are procured at the first digging bestowed on the adult plants; for in that operation it is usual, besides shifting the soil (which is its special object), to include the removal of all the suckers which have grown up round the parent plant; and as this operation takes place in December and January, the season coincides exactly with that proper for planting.

The best suckers will be got from those lands in which the sumach flourishes best, and from the plantations that are still in the vigour of their growth; from old plantations, tending to decay, you will never get vigorous suckers. The price of these suckers varies generally with the price of the produce in the market; and I find, on inquiry, that when the sumach leaves are selling, say at three ducats a quintal,* the suckers will sell at two ducats a thousand. This is, of course, merely a general approximation, and liable occasionally to wide exceptions.

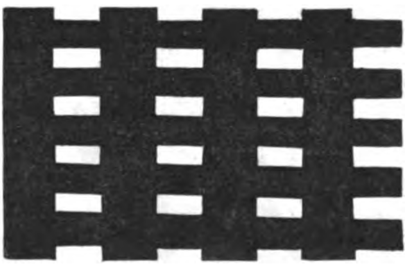

Fig. 1.

3. *Planting.*—The sumach plants are set in lines at intervals of about 2 feet. In calculating the number of plants for a given acreage, a considerable surplus should be allowed, in order to replace withered, dry, or sickly suckers, or those unprovided with capillary filaments or radicles. The holes for the suckers are to be made at intervals of 2 feet, rectangular in shape, 2 feet long by 8 inches wide, and 8 inches deep, using the pick to deepen if you meet the rocky sur-

* A trifle over 10s. for 175 lbs.

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face. At each end of each hole* put in a sucker in contact with the extremity of the hole, then cover them

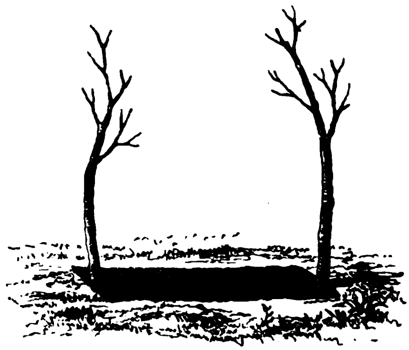

Fig. 2.

in and tread down the earth. But I repeat, that great care must be taken to eliminate weak, beardless, and unpromising suckers.

4. *Culture of first year.*—After the suckers have been

Fig. 3.

planted and well trodden round, you dig deeply and carefully the earth from the intervals between the holes, throwing it up in parallel ridges. After this is done, the suckers must be cut or pruned to a height of 8 inches with the *ron-*

* See fig. 1. The white spaces represent the holes.

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cone or pruning-hook, and in doing this, care must be taken not to tear up the suckers which have not yet taken root. For this purpose, it is usual for the labourer to plant his left foot firmly against the neck of the sucker, and then to cut towards the right, so that the foot keeps the sucker in place.

The intelligent cultivator spares no pains in the first year to secure the prosperity of the young plants, digging the field continually, whenever the induration of the ground or the growth of weeds renders it necessary. So, after the first operation (which we have described as throwing up the earth in parallel ridges), you follow with a second and similar operation in the transverse direction. The third operation consists in levelling the ridges again, and this is usually done in May. Between May and August, the surface should be twice dug over to remove weeds. Exact times cannot be laid down for these operations, as so much depends on the weather. It is enough to remark, that the soil must be kept loose and free from weeds, which are especially troublesome the first year, because the ground has probably been previously occupied by natural pasture.

5. *First year's gathering.*—In September the leaves are stripped, leaving only those at the very extremity of the branches which are not yet mature, and are the last to de-

Fig. 4.

velope. The leaves are put into baskets and carried to a central point to be dried. This is called the *aja* or *aria* of the plantation ("threshing floor"). In October the

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leaves upon the ends of the branches will be mature, and should be gathered. This is done by breaking the distal twigs, but without entirely separating them, leaving them attached by a strip of bark, and hanging clear of the soil. After a few days of dry weather, these will be sufficiently dry, and can be nipped off.

6. *The aja or threshing-floor.*—This requires different conditions from that of a threshing-floor for cereals. The last, as all know, is formed on the higher points of the farm, exposed to prevailing winds. But in threshing the sumach an opposite condition is required (*i.e.*, a position protected from the dominant winds); for the dry, broken, and partially pulverised sumach leaves are easily blown away and lost. Indeed, the operation of threshing requires calm weather, and if the wind rises it must be suspended, whilst the leaves are covered up with cloths, and weighted with pitch-forks, branches, &c., to preserve them from dispersion. The floor ought, however, to be open to the sun's rays; for in order to the effectual separation of the leaves from stalks and branches, the highest degree of dryness is required, and for this reason the operation is generally performed in the middle of the day.

7. *First year's pruning.*—In December the branches are removed. In doing this, take care not to cut into the main stem, but clear the last crown of buds at the point of demarcation between stem and branches. Usually care is taken to make the cut parallel to the stem, so as to leave a clear circular section, and not obliquely, leaving a wedge-like stump; for this stump (it is found), ceasing to derive vegetative vitality from the shrub, is apt to slough, and this spreading, abridges the life of the plant.

Fig. 5.

The pruning-hook is represented in fig. 5. The uncouth shape is essential to the work, for it has another use beside that of pruning. In cutting the sumach, besides the branches above ground, we find others springing from the neck of the plant, which are often covered with soil, and these ought also to be cut close to the stem. To do this without injuring the edge of the knife, you use the elbow of the blade to dig away the earth from the neck, and then applying the edge you cut the branch with facility. The blade of the pruning-knife is about 5 inches long from the insertion to the angle, and about 8½ inches from the angle to the point.

8. *Second year's cultivation.*—Immediately after pruning, you dig about the sumach, raising the earth in cones round the plant, and leaving the stem well exposed and surrounded by these cones, generally in the middle of four such. In March is the second operation, which consists in shifting and again levelling the soil. This month is chosen, because in this district (near the sea) we have no longer reason to dread heavy rains, such as would be followed by inundation of the soil, and the development of weeds, which are specially injurious to the sumach. In May you perform the third and last operation, by lightly digging the surface, so as to render it porous and friable, and by destroying any remaining weeds. Care must be taken to avoid hurting the tender suckers springing from the roots round the parent plant, as these will be required for propagating. But if any of these are found *close* to the parent plant and springing from the main stem, they should be destroyed with the spade; however, as yet there will be no great growth of suckers. This third operation is often neglected; but it is highly desirable, for it produces not only a sensible effect on the organic increment of the leaves, but contributes also mechanically to augment their weight in the following way:—The sumach leaves, owing to that sensible transpiration which characterises them, and which condenses on their epidermis to such a degree that they are always somewhat unctuous to the touch, readily attract dust, and the process of digging the dry soil in May, when the leaves are fully developed, raises a quantity of fine dust. This accumulates on the unctuous epidermis, and thus adds positively to the weight and produce of the plant.

9. *Renewal of plants in the second year.*—In the second year of culture some suckers will be found dead, and these plants should be replaced at the time prescribed in paragraph 2, before giving the first digging of the new agricultural year.

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If the replaced plants should die also, you may conclude that there is some local mischief in the soil, injurious to the life of the plant, and it is not worth while to repeat the process. Hence, after the second year, such renewals are seldom practised.*

10. *Second year's gathering.*—This usually occurs in the month of July, and with it is combined the pruning of the plants. On this occasion the entire branches are cut from the trunk with the leaves attached. The operation is to be performed as described in paragraph 7, *i.e.*, at the insertion of the branches, without wounding the main stem or injuring the buds below, which are the most important accessory organs of the plant.

The proper period for gathering has always relation to the maturity of the foliage, and the vegetative condition of the sumach. When all further development ceases in the flowers, or in the leaves at the extremities of the branches, then is the time to gather, as the leaf has attained a maximum of weight. Delay would tend to deterioration in quality and weight. The commencement of deterioration is shown by little black specks appearing on the leaf, which turns yellow and diminishes considerably in weight, so that there is positive loss both of quality and quantity. The exact time of gathering is thus one which an intelligent planter will watch with great care. July is the usual time for gathering, but it has sometimes occurred as early as the middle of June. The pruner will leave every stem cleared of all branches, using his hook as already described (paragraph 7). He accumulates the branches under his left arm till he has got a sufficient load, and then spreads them on the ground, treading the leaves together with his feet, so that they may be as much compressed and as much covered from wind as possible during the drying process, and also present a small surface to the sun's rays, which act detrimentally on the leaves they strike directly. Over the bundle of twigs which the man has spread out and trodden, a second pruner spreads his bundle, and likewise treads it down. Two

* At Colli, such cases are generally due to more than usually impervious hollows in the subjacent *tufa* retaining moisture. The greater part of the valley of Palermo is underlaid by a coarse sandy tufa, which in many places comes very near the surface, and in some is absolutely naked.

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such bundles form the *sheaf* of sumach spread to dry. In laying down the twigs, it is best to place the lower part towards the prevailing wind quarter, as in that position the leaves are less liable to be detached and dispersed.

After the gathering has been completed, there remain here and there about the parent plants a number of suckers springing from the roots. These being of later growth, and also shaded by the main branches, do not afford leaves fully matured at the time of gathering. But some twenty days later these leaves will be mature, and should be stripped, care being taken, however, not to lop or injure the extremity, as these suckers will be wanted at the beginning of the next season for propagation. The leaves of the sumach plants, on the lower parts of the stem and branches, come to maturity sometime before the season that has been indicated for the harvest, and if they be not gathered specially they wither and fall. Though the amount so lost is not considerable, it is worth while, when the culture is on a small scale, or when prices are running high, to make a preliminary gathering of these leaves. But this will scarcely pay when hired labourers are employed, and is usually done by the family of the cultivator. All the sumach gathering is generally intrusted to boys.

11. *Transport to the threshing-floor.*—This is one of the most fatiguing labours of our husbandry. After the branches have been dried on the field they are heaped upon a canvas cloth of some 6 or 7 feet square. Three corners of this cloth are furnished with wooden rings, and the fourth with a cord 9 feet long. After putting on the cloth as great a heap of twigs as it will hold, usually about 80 rotoli (140 lbs.), the cloth is laced together by the cord and the three rings, and is then hoisted by a single man's strength and dexterity on to his own shoulders. He goes off with it to the floor, and returns for a new load, continuing this heavy labour throughout the day. The average strength of the peasants is not sufficient to endure such toil, and to continue it for days, hence this business is the employment of the local athletes. Each man employed on this fatiguing work receives 6 tari * (2s. 1½d.) daily, and in a season

* The paper was written seventeen years ago. In Palermo, as in most places, wages have since risen considerably.

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they gain a good deal more than the common labourers; but, after the harvest is over, they need some days' rest to heal the scars inflicted on the neck and shoulders. It is a degrading and unnecessary practice, as there is no reason why the sumach should not be carried on animals. If there is loss in carrying so much dry sumach in that way, then it should be taken green direct to the threshing-floor and dried there.

12. *Cultivation and harvest after the second year.*—The practice is the same as in the second year. When, in course of years, the plants lose their luxuriance, it has been found very beneficial, in reviving their vigour from time to time, to dung and sow the ground with beans.* The sumach so treated acquires new strength, and the expense of this manuring process is always paid with usury.

In the Palermo district the sumach is not so long-lived as in some other parts of Sicily. Its duration never exceeds fifteen years, and before becoming extinct it drops off here and there, leaving vacancies which cannot be filled; this being, in fact, a law that generally regulates the extinction of a generation of plants of many species. When these spaces become considerable, the farmer turns the soil to account by growing on it beans in manure,* alternated with barley, the cereal that suits our soil best. After the total extinction of the plantation, the soil may revert to the ordinary crops of the country; but at first it will require ample manuring, as the sumach is an exhausting crop. General experience shows that the sumach does not readily admit of the close vicinity of other cultivated plants, and in a mixed plantation it will neither thrive nor let thrive. It is particularly bad husbandry to plant sumach with olives. I cannot say accurately how long an interval should elapse before a soil which has borne a sumach plantation could be profitably employed again for the same kind of produce; but, approximately stated from experience, it should not be less than ten years.

13. *Threshing the Sumach.*—This is done at the hottest

* The expression is "*vi accopiano a quando a quando una seminazione concimata di fave.*" Though this is a little obscure, I have little doubt it refers to a practice which seems to be common in Sicily of mixing the seeds of beans and lupins with manure, and, when the plants are green, digging them into the soil. Such an application appears to be called in Italy *soverscio.*—H. Y.

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time of day, as the leaves are then driest and detach most easily. The sumach is threshed with the flail, which is called by our country people "*bovillo,*" or "the little ox."* The handle is of beech, 6 feet long, and the smiting

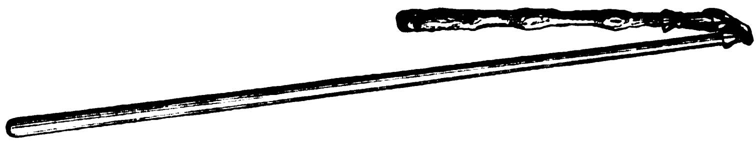

Fig. 6.

part is a knotty stick about 2½ feet long, thicker at the loose end, like a club. The sumach is strewed over the floor, and the threshers stand in two lines opposite to one another, using the flail with a rhythmical alternation. One line advances across the floor while the other retreats; and when the whole floor has been crossed, the first line retreats in turn and the second advances, and so on until the whole length and breadth of the floor has been equally and thoroughly threshed. One or more labourers, armed with wooden forks, pass about the floor removing the twigs already stripped, the leaves only with their stalks and mid-ribs remaining. After the threshing is finished, these are gathered into a heap, the stalks being removed with the hand as far as possible to bring the sumach into a marketable condition, and in this state the threshed leaves are stuffed into long hempen sacks, weighed, and either stored away or transferred on the spot to the purchaser.

14. *Qualities of Sumach from the threshing.*—The sumach thus threshed in the highest state of desiccation, under the noontide heat, comes out in a state of great trituration, and is sold only to be ground to powder in the mill. But if sumach in leaf is required, it must be as little broken as possible, and hence the mode of threshing must be modified. The sumach, in such case, is brought to the floor before it is perfectly dried, and it is threshed in the morning, instead of at midday. In this way the leaves remain entire, and only separated from the stalks, some small por-

* Of course, from its performing the duty of the ox in "treading out the corn."

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tions adhering to the twigs. After the sumach for bales has, in this condition, been gathered, the twigs, with such leaves as adhere to them, are well dried and threshed a second time in full noontide heat, producing a second supply of triturated leaves for the mill. The sumach obtained from suckers and from the first year's plant is always threshed for the mill. It is of inferior quality, and fetches a lower price than that of the pruned plants of full growth. It is easily known by its colour and lightness. The sumach from the October nippings of the first year is also threshed for the mill. This is the lowest quality of all, and distinguishable by its whitish colour, its extreme lightness, and the absence of the special aroma of the tanning principle. As this nipping takes place in October, when the air is already cold and rain begins to fall, the threshing is sometimes deferred till the following summer, the produce being stored meanwhile in a dry and airy place.

15. *Relative value of the different qualities of Sumach.*—This can only be given approximately, but I have taken pains to get the information as accurately as is practicable. I will suppose that sumach in leaf (which is the highest quality) sells at 1 ounce the quintal,* and on this standard I calculate the value also of the inferior qualities as follows:—

Sumach in leaf, for bales, . . .	10s. per 175 lbs.
To grind, ...	9s. 4d. „
From the first year's strippings, .	6s. „
The first year's October nippings, .	4s. „

16. *Produce of a Sumach plantation.*—Such a plantation, well cultivated and in the height of its vigour, usually produces with us 2 *quintals*, 35 *rotoli*, to every legal *tumolo* of surface (409 lbs. to 0·27 of an acre, or 15·15 lbs. to an acre nearly). Generally speaking, the produce goes on increasing from the first to the seventh year of the plantation; it then begins to decline, and continues to do so till the exhaustion of the plants, about the fifteenth year.

17. *Miscellaneous minor products of the plant.*—Besides the leaves, the farmer gets some positive profit by the

* About ten shillings per 175 lbs. The ounce is a very small fraction more than ten shillings in value.

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various *rejectanea* of the threshing-floor—first, from the twigs which are tied in bundles on the spot; secondly, from the leaf-stalks. Both are sold for burning,* chiefly to bakers. The earth detached by the flail on the threshing-floor, and which, from its greater weight, lies below the threshed leaves, is reckoned one of the sources of profit, and is mixed with the threshed sumach. This is a custom of the business, and cannot be objected to by the buyer; and though it is chiefly earth, no doubt there is some sumach powder mixed with it which cannot be separated.

The grinding and packing of sumach forms no part of the farmer's business, nor of my subject. I may state, however, that the grinding is performed under vertical millstones, similar to those common in Sicily for bruising olives. In this process all is ground to powder, except the small midribs, which are removed by the hand during the grinding. These are subjected to a greater force, and reduced completely to powder in the ordinary horizontal water mills, and then added to the produce of the ground leaves.

18. *Prices current of Sumach in Palermo.*—I have collected with much pains from commercial lists, newspapers, and the private books of merchants, the mean prices during the last twenty years, confining myself to the price of sumach in leaf (or in bale), from which the price of the other qualities can be deduced by the ratio already given. [It does not seem useful to give the table in question. The lowest price obtained in 1841 is 25 taris = 8s. 5d., and the highest in 1849, 1 oz. 14 taris = 14s. 10½d.]

19. The foregoing is a true account of the sumach culture as practised at Colli. Much more might be said regarding the influences of weather, such as frost-bite on the leaves, or the summer north-west wind, or the attacks of insects, which in some years cause great havoc among the plants, or the relative duration of the plant in different soils; but these investigations require much time and study.

Translator's Note.—I extracted the statistics of the export of sumach, at the various ports of Sicily, during the years 1857–66, from tabular statements preserved in the Consul's office at Palermo, in view to appending them to this

* The leafstalks are much used for kindling fires in the hotels of Sicily. —H. C.

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paper. On examination, however, I find these statistics appear on the surface to deserve so little confidence that I omit them. The price of sumach has greatly risen of late years, being now from two to three times what it was when Professor Inzenga wrote, and this rise is said latterly to have restricted the export. It is said that adulteration has also greatly increased. It may be worth while to add that the sumach is described by Theophrastus (Bk. iii. ch. 18) under the name of *Rhus* (ῥους); his description of the plant appears to be good, so far as I can understand it, and he mentions the use of the leaves by leather-dressers. So also does Galen, as quoted by Budæus in his note on Theophrastus (ed. Amsterdam, 1844, p. 272). Pliny also says the shrub *Rhus* is called *Coriarius*, and its dried leaves used, like the pomegranate rind, in tanning skins (xxiv. 54).

I have not found, in a short search, anything on the antiquity of the Sicilian trade in this article. *Somacho* appears in a list of duties at Florence and Pisa, contained in the Commercial Hand-book of Giov. da Uzzano, 1442 (*see* Della Decima, &c. iv. pp. 24 and 59), and this is the oldest mention I have met with of the modern name of the plant. It is borrowed from the Arabic *summáq* or *samáqíl*. H. Y.

P.S.—Since writing the above, I have received, by the courtesy of a merchant in Palermo, a return from the custom-house, showing the export of sumach on which duty was paid in 1867. My informant adds that a large allowance must be made for contraband export beyond this return.

Sumach in leaf, . .	kilos,	2,323,130
	Or say tons,	2282
Ground, . .	kilos,	15,692,699
	Or say tons,	15,413

There is nothing peculiar in the process of pulverising sumach except the very extraordinary atmosphere produced in the mill. The interior is dark as the most intense London fog, and one comes out saturated with fine powder. The odour is not unpleasant, something between snuff and chamomile. The workmen all wear a handkerchief over nose and mouth, but it is said to be rather wholesome than

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otherwise. The machinery consists merely of pairs of vertical stones grinding in a basin, just like a cement mill. An engine of 25-horse power turns four pairs; 100 lbs. of leaves produces about 84 lbs. of ground sumach; and the cost of grinding and bags is about 1s. 6d. per 100 lbs. This season (1868) the price of leaves varies from 10s. to 17s. per 100 lbs. H. Y.

II. *Notes of Mosses and Hepaticæ, collected by* ROBERT BROWN, Esq., *on the North-West Coast of America.* By GEORGE DICKIE, M.D., F.L.S., Professor of Botany, University of Aberdeen.

It will be necessary to state the circumstances under which the collections were made; this I may do by quoting from Mr Brown's letter, which he sent along with the specimens.

"The Mosses and Hepaticæ were collected during occasional shore-goings of a voyage to the Queen Charlotte Islands (lying off the north-west coast of British Columbia), on board a small trading sloop, in March and April 1866. The collection was made when occupied with other pursuits, and in localities chiefly on the seaboard, and from places never before examined botanically. Being very early in the year, many of the places visited were yet under snow, and as travelling a few miles off the shore, or even in the woods close to the sea, was very difficult, I did not burden myself with many duplicates. The islands on which these materials were gathered are in general low, rocky, and densely covered with forest of various species of coniferæ (principally *Abies Douglasii*, Lindl., *Thuja gigantea*, Nutt.; and farther north, *Abies Menziesii*, Dougl., and *Abies Bridgesii*, Kell.) Fallen trunks of these trees, boggy soil, or dead pine leaves, were the principal habitats. The localities were the following:—

"1. *Mayne's Island*, in the Haro Archipelago, between British Columbia and Vancouver Island, mostly wooded, with a swampy prairie in the centre, lat. 48° 50′ N., long. 123° 16′ W. (approx.)

"2. *Moresby Island*, one of the three main islands of the Queen Charlotte group; in Skedegate Bay, lying at the

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nearest points about 40 miles from the mainland, lat. 53° 32′ N., long. 131° 50′ W. (approx.)

" 3. *Pitt's Island*, off the coast of British Columbia, lat. 53° 45′ N., long. 130° 20′ W. (approx.)

" 4. *Hope's Island*, off the northern shores of Vancouver Island, lat. 40° 54′ 47″ N., long. 127° 56′ 03″ W. (Bull Harbour.)

" 5. *Valdez Island*, near the Nuchultaw (vulgo " Eucultaw") Indians' village, in Discovery Passage, lat. 50° 02 42″ N. long. 125° 14′ 38″ W.

"The very recent publication of Mr Mitten's account of the Mosses of the N.W. Boundary Commission will doubtless leave no species new to science to be described; but, as the localities are most of them widely different from Dr Lyall's, possibly an account of the species might not be without interest."

Although repetition of names is not desirable, I think it best to give a list of species from each locality mentioned.

HOPE ISLAND.

Mnium punctatum, *Hedw.* (var.)	Lepidozia reptans, *L.*
Hypnum Oreganum,* *Sulliv.*	Mastigobryum ambiguum, *Ldgb.?*
Jungermannia bicuspidata, *L.*	

VALDEZ ISLAND.

Hypnum triquetrum, *L.*	Hypnum Oreganum, *Sulliv.*
stoloniferum, *Hook.*	

PITT'S ISLAND.

Mnium Menziesii, *Hook.*	Hypnum splendens, *Hedw.*
Bryum nutans, *Schreb.* (var.)	stoloniferum, *Hook.*
Wahlenbergii, *Schw.* (var.)	crispifolium, *Hook.*
Polytrichum juniperinum, *Hedw.*	hamulosum, *Bry. Eur.* (var.)
Ceratodon purpureus, *Brid.*	Scapania nemorosa, *N. ab E.*
Hypnum loreum, *Dill.*	Fegatella conica, *Oorda.*

MAYNE'S ISLAND.

Dicranum scoparium, *Hedw.* (var.)	Mnium affine, *Bland.*
Weissia crispula, *Hedw.*	Hypnum Oreganum, *Sulliv.*
Polytrichum juniperinum, *Hedw.*	triquetrum, *L.*
Aulacomnion androgynum, *Schwarz.*	splendens, *Hedw.*
	stoloniferum, *Hook.*
	Madotheca navicularis, *N. ab E.*

* This is *H. Douglasii*, Hook. MSS.

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MORESBY ISLAND.

Sphagnum acutifolium, *Ehrh.*
Splachnum purpurascens,* *H. fil. et Wils.*
Pottia Pöppigiana,† *Hampe.*
Mnium Menziesii, *Hook.*
punctatum, *Hedw.*
Aulacomnion androgynum, *Schwarz.*
Polytrichum juniperinum, *Hedw.*
Polytrichum semipellucidum,‡ *Hampe.*
Polytrichadelphus Lyallii, *Mitten.*
Bryum nutans, *Schreb.*
crudum,§ *Schreb.*
Bartramia pomiformis, *Hedw.*
Dicranum scoparium *Hedw.*(var.)
Dicranum fuscescens, *Turn* (var).
Ceratodon purpureus, *Brid.*
Orthotrichum Columbicum,‖ *Mitten.*
Hookeria lucens, *Sm.*
Hypnum Œdipodium,¶ *Mitten?*
stoloniferum. *Hook.*
Oreganum, *Sulliv.*
squarrosum, *Linn*
splendens, *Dill.*
loreum, *Dill.*
plumifer,** *Mitten.*
circinale, *Hook.*
heteropterum,†† *Bruch.*
undulatum, *Dill.*

HEPATICAE.

Scapania nemorosa, *Linn.*
Plagiochila asplenioides *N. ab E.*
Frullania Tamarisci, *Linn.*
Sendtnera adunca, *Dicks.*
Metzgeria pubescens, *Schrank.*
Marchantia polymorpha, *Linn.*

In addition, the collection contained a few from Vancouver's Island:—

Tortula laevipila, Brid. Brown's River.

Mnium insigne, Mitten. In wet ground; Grappler Creek. A few stems without fruit.

Polytrichum juniperinum, and *Ceratodon purpureus.* At the base of Mount Anderson-Henry and at Brown's River.

Jungermannia barbata, Schreb. At Sproat's Lake.

The entire number of mosses in Mr Brown's collection amounts to thirty-five species. Of these, twenty-two are well-known European species; of the remaining thirteen,

* This is *Dissodon purpurascens*, C. Müll.

† Having some difficulty with this, Mr Wilson, on reference, stated it to be the above species. It is one of the same category with *Gymnostomum rufescens*, Hook.—mosses which, with habit and structure of Barbula, want the peristome, but have a large annulus.

‡ I have only two specimens of this, without operculum or calyptra, nevertheless I think the moss must be so named.

§ The first of these, a single tuft, with *very immature* fruit; the second, a mere scrap without fruit; still I think they must be so named.

‖ A single tuft, I think, to be referred to the above.

¶ A solitary tuft without fruit, doubtfully referred to above species.

** Specimens without fruit.

†† A very few specimens, no fruit, mixed with *Dicranum fuscescens.*

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ten are also recorded in Mr Mitten's paper on the "Bryologia of the survey of the 49th parallel of lat.," in 8th vol. of *Linnean Journal;* the remaining three are *Pottia Pöppigiana*, found in Eastern Chili by Pöppig.; *Polytrichum semi-pellucidum*, found by Humboldt and Bonpland near "La Garita del Paramo de Quindiu," Andes; and, finally, *Splachnum purpurascens*, found in Auckland and Campbell Islands, and, therefore, I believe, an addition to the muscologia of the American continent, and, it may be worthy of remark, in nearly the same latitude both north and south.

The Hepaticæ are twelve in number, ten of which are well-known European forms. Eleven are already recorded by Mr Mitten (*loc. cit.*), the only addition being *Sendtnera adunca*, long known under the name *Jungermannia juniperina.*

With better opportunities, and at a more favourable period of the year, Mr Brown's collections at the Queen Charlotte group would doubtless have been more extensive.

III. *A Monograph of the Coniferous Genus* Thuja, *Linn.*, *and of the North American species of the Genus* Libocedrus, *Endl.* By Robert Brown, Esq., F.R.G.S.

The genus *Thuja* was nominally indicated in 1700 by Tournefort, in his "Institutiones Rei Herbariæ," p. 358, but Linné in 1753 reserved the name in his "Species Plantarum" for a genus of Monœcia Monadelphia, embracing certain Eastern and American forms; but as the genus is now defined, all of these, with the exception of *Thuja occidentalis* are transferred to Don's genus *Biota*, distinguished from Thuja* by its wingless seeds.† To this restricted genus Nuttall, in his "Rocky Mountain Plants," p. 52, added the finest species yet discovered under the

* Defined in the "Genera Plantarum," (Ed. 1764), as "*Masculus Flos.*—Cal. *Amentum* ovatum, constans rachi communi, cui flores oppositi, triplici oppositione apponuntur. *Singulus flos* pro basi agnoscit *Squamam* subovatam, concavam, obtusam. Cor. nulla. Stam. *Filamenta* (in singulo flosculo) quatuor, vix manifesta, Antheræ totidem, basi squamæ calycinæ adnatæ.—*Femineus flos* in eadem planta. Cal. Strobilus communis subovatus, flosculis oppositis compositus: constans *squamis* bifloris, ovatis, convexis, longitudinaliter conniventibus. Cor. nulla. Pist. *Germen* minimum, *Stylus* subulatus, *Stigma* simplex. Per. *Strobilus* ovato-oblongus, obtusus, longitudinaliter dehiscens: squamis oblongis, fere æqualibus, extrorsum convexis, obtusis. Sem. oblonga, longitudinaliter cincta ala membranacea, emarginata. Obs. *Cupresso maxime adfinis*."

† Don, in. Lambert's *Pinetum*, Ed. 2, ii. 129. *Platycladus*, Spach. *Hist. Nat. Veget. Phaner*. xi. 338, excl. spec.

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name of *Thuja gigantea*—a tree found on the Pacific slope of the Rocky Mountains, where Douglas had already, in 1839, discovered it independently, and, apparently ignorant of Nuttall's prior description, had indicated it under the MS. name of *Thuja Menziesii*, in honour of the veteran Menzies. Prior to this, however, Menzies had discovered a form of this species on the western shores of Vancouver Island, which James Don described in the 6th edition of "Hortus Cantabrigiensis," p. 249, as *Thuja plicata*. In 1847, Endlicher further subdivided the groups, forming in his "Synopsis,"* p. 42, the genus *Libocedrus*, distinguished from Biota and Thuja by the strobilus being quadrivalvate, monospermous, and the seeds unequally winged. To this new genus he referred two South American species (*Thuja tetragona*, Hook.), and (*T. Chilensis*, Hook.), and one New Zealand species (*Thuja Doniana*, Hook.) In 1850 Torrey described, in his *Plantæ Fremontianæ* ("Smithsonian Contributions to Knowledge," vol. vi. pp. 7, 8), another fine North American species of the genus under the name *Libocedrus decurrens*, Torr. The paper descriptive of his plant was read in abstract to the "American Association for the Advancement of Science," in August 1850, and accepted for publication by the Smithsonian Institute in September of the same year; but the volume containing the contribution was not published until 1854, and it is just possible did not reach this country until that year. The question of priority is not, however, affected by this; for it was not until the end of that year that the Oregon Botanical Committee, in their printed account of some Coniferæ collected by Mr John Jeffrey in North-West America, described, under the name of *Thuja Craigana*, specimens procured by that ill-fated collector from Scott's River in Upper California (October 29, 1855). This tree had already been described by Torrey from specimens found by Dr G. Ed. Hulse; though so far back as 1843 the botanists of the United States Exploring Expedition had brought home fruitless branches. Under this name plants will be found very generally distributed throughout the country coupled with an idea that it is the same as Nuttall's *Thuja*

* "Synopsis Coniferarum; auctore Stephano Endlicher; Sangalli," 1847 "Genera Plantarum," iv. pars. 2. No. 1794.

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gigantea, though (independently of the species having no affinity, except in the general *tout ensemble* of the tree) Torrey expressly states that the species "has probably been confounded by some botanists with *Thuja gigantea* of Nuttall, from which, however, it can be distinguished by the foliage alone; the long decurrent bases of the leaves being characteristic of the Libocedrus." The way this idea originated is, that Carrière, in his "Traité Général des Conifères,"* apparently totally unacquainted with Nuttall's plant, and only knowing Torrey's from a description in the "Gardener's Chronicle," settles them in his work as the same species, and states that the plant described by Hooker† as *Thuja gigantea*, Nutt., is not that plant, but what Douglas formerly described as *Thuja Menziesii*—a plant which I have already shown, and which Douglas himself acknowledged, to be *Thuja gigantea*, Nutt. Still further was this statement circulated, when, in 1858, Gordon published his "Pinetum,"‡ and copied Carrière's statement without any correction, apparently equally ignorant of Nuttall's and Torrey's plants. Now, one would think that this was enough of entanglement for the synonymy of such a simple matter; but it was fated to be still worse confused. And now I come a little nearer home. In 1864, trusting to the works of Carrière and Gordon, and having, indeed, no other method of arriving at the truth, in the midst of a north-western forest, I sent home a quantity of seeds of *Thuja gigantea*, Nutt., under the name of *Thuja Craigana*, supposing them to be synonyms, and not being able to arrive at a conclusion regarding the priority, I refer to them as such in my various printed and MS. catalogues and letters. Subsequently, in 1865 a much larger quantity of seeds of the same tree reached this country, which I again styled (on the same principle), *Thuja Craigana*, Oreg. Com., and under this name the plant has been extensively

* Traité Général des Conifères ou description de toutes les espèces et variétés aujourd'hui connues, &c., par Elie-Abel Carrière, Chef des Pepinière du Museum d'Histoire Naturelle de Paris; 1855.

† Flora Boreali-Americana, ii. 165.

‡ The "Pinetum," being a synopsis of all the coniferous plants at present known, with descriptions, history, and synonyms, &c., by George Gordon, A.L.S., formerly superintendent of the Horticultural Gardens, Chiswick, assisted by Robert Glendinning, F.H.S., of the Chiswick Nursery, near London. London, 1858.

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distributed all over England. About the spring of 1865 I received authentic specimens of Nuttall and Torrey's plants from the Californian botanists, and I then discovered my error, and that of the authors mentioned. I immediately corrected the error in a MS. catalogue, which I sent in May 1865, and subsequently in my printed catalogues ("Farmer," &c.) I have been very particular to keep up this corrected nomenclature. However, on coming home, I find that many of my plants are distributed under the names of *Thuja Craigana*, *Libocedrus Craigana*, *Thuja Menziesii*, &c., and that yet there seems to be the most wonderful confusion in regard to their nomenclature. It is therefore not only with a view to endeavour to unravel this tangled web, but as an offender myself—innocent, no doubt, as only following recognised authorities according to my lights,—that I desire to enter on record this synopsis, in order to correct the mistakes into which some writers on Coniferæ, and cultivators depending on them, have allowed themselves to drop, and to make the *amende honorable* for misleading, for the time being, though unintentionally, as the making of this confession abundantly testifies. During my different journeys in North-West America I had many opportunities of observing the trees of these genera in their native state, and of examining subsequently authentic specimens from the authors who have described them from dried specimens. I had also many chances of observing the variation of the trees according to situation and climate, and therefore of understanding how far the characters which have been employed to separate the species hold good in nature. These observations I have incorporated in the present notes. The synonymy, geographical distribution, and economic and æsthetic aspects of the trees, I have illustrated almost solely from my own researches and observations. All the characters employed to distinguish the plants, specific and generic, I have tested on a large series of specimens, and being originally described by very eminent botanists, I have not been able to do much more than confirm their descriptions. I have therefore, wherever necessary, employed their specific distinctions, rather than run the risk, for the sake of a dubious quasi-originality, of substituting, as has been done, very much inferior ones.

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The following diagnosis of the genera, and of the divisions to which they belong, sufficiently expresses the distinctions by which they are separated from other allied genera:—

CONIFERÆ.

§ ACTINOSTROBEÆ.—*Strobili, with valvate scales, leaves alternate, opposite or ternate.*

Widdringtonia.—Strobilus, 4 scales, scales equal, 5–10 *spermous*, seeds two-winged, leaves alternate.

Frenela.—Strobilus, 6 scales, scales small and alternate, *polyspermous*, seeds 2-winged, leaves ternate.

Actinostrobus.—Strobilus, 6 scales, scales equal, *monospermous, seeds 3-winged*, leaves ternate.

Libocedrus.—Strobilus, 4 scales, scales small and alternate, *monospermous, seeds unequally winged*, leaves opposite.

Callitris.—Strobilus 4 scales, scales alternate, small, *di-monospermous, seeds 2-winged*, leaves opposite.

§ THUIOPSIDÆ.—*Strobilus with imbricated scales*, not valvate as in Actinostrobeæ, *leaves opposite.*

Biota.—Strobilus, with leathery scales, dispermous, *seeds wingless.*

Thuja.—Strobilus, with leathery scales, dispermous, *seeds* 2-*winged.*

Thuiopsis.—Strobilus, *ligneous scales, pentaspermous*, seeds 2-winged.

The diagnoses of *Libocedrus* and *Thuja* are further given in parallel columns, in order to show more clearly the distinctions, as well as the characteristics, of the two genera:—

THUJA, LINN.*

Flowers monœcious on different branches. *Staminiferous aments*, ovoid, very small, terminal on the lateral twigs. *Stamens*, oppositely decussate imbricated in four rows;

LIBOCEDRUS, ENDL.

Flowers monœcious on different branches. *Staminiferous aments*, terminal on the lateral twigs, sub-cylindrical. *Stamens*, 6-7 inserted *filaments* very short, the

* Though the genus was described nominally by Tournefort, I have yet given Linné as the authority, it being a mere useless piece of pedantry to go further back for generic authority than the revival of Botany on the publication of the "Species Plantarum," merely because some of Linné's predecessors happened to have applied a similar name, though that name conveys a totally different meaning from what we now-a-days understand by the word. For instance, we would not give Theophrastus as the founder of the genus *Cedrus*, his Κέδρος being a species of *Juniperus*. Equally might we give Theophrastus, or even Homer, the credit of founding *Thuja*, the latter (Odyssey ii. 6) talking of a Θυιον, and the former of Θυιον and Θυια, both being, probably, a Callitris. However, from this incense wood used in sacrifices, the modern name *Thuja* is taken. It is sometimes written Thuia and Thuya, which latter spelling Linné gives in the index to his "Genera Plantarum," though the more common one (Thuja) is adopted in the body of the work.

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produced in a deltoid or sub-orbicular excentrically peltate scale, and bearing on its under surface about 4 oblong anther cells opening longitudinally. *Seminiferous aments*, terminal solitary on the twigs. *Gemmuliferous scales* 4, mucronate under the apex, verticillate, two smaller. *Ovules* at the base of the scales, collateral erect, atrophied, the micropyle prolonged into a short bottle-shaped neck. *Cone* ovate, four-valved, valves ligneous or sub-coriaceous, with the back below the apex mucronate, in the form of a well-developed spine or a minute tubercle, within plain or concave, alternate scales smallest, sterile or monospermous. Seeds solitary at the base of the scales, erect, lenticularly compressed, with a tough integument, prolonged on either side into a membranaceous wing, the one wing small, the other large, spreading out above, and equally the scale in size. *Embryo*, antitropal. *Cotyledons* 2. *Radical*, cylindrical superior. *Leaves*, scales oppositely decussate, all equal, or navicular, plane, sometimes with a gland. *Cone*, mature yearly. *Tree*, evergreen. *Range*, North and South America and New Zealand.

connective excentric, peltate, blunt, orbicular, *loculi* 4 horizontal, longitudinally dehiscent. *Seminiferous aments*, solitary terminal on the lateral twigs. *Gemmuliferous scales*, 8–10 oppositely decussate, sessile with a broad base, mucronate under the apex, at first spreading, afterwards adpressed and imbricate, outside one 2-seeded at the base, inside ones sterile; *Ovules* at the base of the scales 2, collaterals erect, atrophied, with the micropyle shortly prolonged in a bottle-shaped form. The *cone*, composed of scales imbricated in four rows, subcoriaceous, oval, or oblong, plain or subconvolute, obtuse with the apex hardly thickened, the back pointless or mucronate, inside ones smallest and sterile. *Seeds* at the base of the scale 2 collateral, and sometimes solitary and abortive, erect, lenticularly compressed with the integument, tough, and hollowed out into resin-bearing foveolæ, expanded on either side into a membranaceous wing, emarginate at the base and apex. *Embryo*, antitropal. *Cotyledons*, 2-5. *Radical*, cylindrical, superior. *Leaves*, navicular, adnate, persistent, oppositely decussate, imbricated in four rows, cones mature yearly. *Tree*, evergreen. *Range*, North America.

tr. these parallel -umns.

Genus THUJA.

Thuja occidentalis, Linn.

Cedrus Lyciæ.—Clusius, Ic. Stirp. 11; t. 224.

Arborvitæ.—Clus. Hist. Rarior. (1601) 1, 36; Dodonæus, Pempt. Stirp. 630 (1616); Houttyn Lin. Pl. Syst. 2, p. 372 (1777–1788).

Thuja Theophrasti.—Bauhin's Pinax, 488 (1671).

Thuja strobilis lævibus, squamis obtusis, Linn.; Hort. Cliff. 449 (1737); Hort. Upsal., 289 (1748); Royen, Prod. Fl. Leidensis., 87 (1739); Kalm. It. Am., 3 pp. 389 (1753); Miller's Gardeners' Dict., n. 1 (1760); Du Roi Harbk., 2 p. 455 (1767–1772, *fide* Willdenow); Kruph. Bot. in Orig. Cent., 1, n. 91 (1750–1772); Blackwell, Herb., 210 (1737); Wangenham, Americ. 7, t. 2, f. 3 (1787, *fide* Willd.); Willd. Arb., 385 (*fid* Sp. Pl.)

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Thuja occidentalis.—Linn. Spec. Plant, 1422 (1753); Beckmann, Ed. Linn. Syst. Nat., sp. 1078, ii. 304 (1772); Willdenow, Sp. Plant, iv. 508 (1806); Sprengel, Spec. Plant, iii. 888 (1826); Pursh Fl. Am. Sep., 2, p. 646; Smith, in Rees' Encyc., No. 1; Michaux Hist. Arb. F., iii. 29, pl. 3 [good]; Nouv. Duhamel, 3, p. 12; Richard, Mem. sur le Conif. 43, t. 7, f. 1; Nees, Jun. Pl. Fl. German, t. 11, f. 7, 17; Sckuhr. Hand. iii. 287, t. 309 (*fide* Carr.); Desf. Hist. Arb. ii. 575; Loudon, Arboretum, iv. p. 2454, figs. 2312–2313; Endl. Syn. Conif. 51; Lindl. and Gord. Journ. Hort. Soc. v. 206; Knight Syn. Conif., 16; Revue Hort. 1854, p. 224 (*fide* Carr.); Lawson's List. Pl. Fir. Tribe (1851) 57; Carrière, Traité, 103; Gordon, Pinetum, 323; Emerson, Trees and Shr. Massach. p. 96; A. Gray Fl. N. States, 424; Beck, Bot. N. and Middle States, 58.

Thuja obtusa.—Mœnch. Meth., 69.

Cupressus arborvitæ.—Targ. Tozz. Osserv. ii. 51.

Popular Synom.—Engl: Arborvitæ, American arborvitæ. Americ.: white cedar; arborvitæ. French: cedre Americain, cedre blanc, arbre de vie. German: Gemeiner Lebensbaum. Italian: Arbero de vita.

Sp. char.—Ramulis ancipitibus strictis, foliis quadrifariam imbricatis late ovatis obtusis in utraque ramuli facie lucidis, marginalibus navicularibus, facialibus planis carinatis, dorso glandula tuberculiformi ovali, strobilis nutantibus, *squamis terminalibis truncatis, infra apicem gibbosis.*

Leaves appressed, very small, imbricated in four rows on two-edged branchlets; branchlets very much flattened. Strobili obovate, scales of cone generally 6, truncated, gibbous below the summit, smallest of all the species, seeds broad-winged all around.

It flowers in May, and the cones ripen in the following autumn. It tapers from a small base to a very slender summit. The branches spread out from the stem horizontally, and at irregular intervals; the smaller one curling downward, forming a regular, though not very graceful tree. It branches at about four-fifths of its height. The tree reaches a height of from 20 to 50 feet, and generally grows in thickets, though never forming anything approaching to a forest or wood. It is distinguished from its Pacific representative, not only by its small size and locality, but by its very minute cones, without points. Its geographical range is from about 45° to 32° North latitude. From Canada and New England, where it keeps chiefly northwards, and forms the cedar swamps, it ranges south along the Alleghanies, its southern limits being Virginia and Carolina, where it is rare.* It affects

* I have given these limits, as I am not sure of the specific identity of the "*Thuja occidentalis*" found by M. Borgeau on the Rocky Mountains.—*Blue Book of the Expedition under Captain Palliser*, 1863, p. 260.

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swamps, damp soil, and cool, rocky banks of streams, or islands in rivers. It is (like all the species of the genus) confined to North America, and principally to the eastern portion of the continent. Linné no doubt says (Sp. Plant, 1421), "Habitat in Canadæ et Sibiriæ subhumidis;" but the species, which Gmelin put in his "Flora Sibirica," vol. v. p. 182 (1747–1769) as *T. occidentalis* is undoubtedly not this species, but probably *Thuja orientalis* (Linn. Spec. Plant, 1422), a species of Biota (*B. orientalis* (L.) Endl.), found in Japan and China under cultivation, but growing wild in the mountains of some of the Japanese Islands.

As a timber tree it is of no great value, never attaining a dimension sufficient for that purpose; but it is still used all over Canada and the Northern States for various purposes. It is light and fine grained, with a pungent aromatic odour, and, like all the genus, is exceedingly durable. (*See* Michaux, Hist. Arb. iii. 29, and Emerson, "Trees and Shrubs of Massachusetts," p. 96, for particulars regarding its economic value).

VARIETIES.

Horticultural.—It was introduced into England in 1596, and is now generally found all over Europe under cultivation, thoroughly naturalised wherever it is planted. It has sported into a number of varieties, which, though mere foliage varieties, yet maintain the characters, and have received various names:—

(α.) var. *variegata.*—Weston, Universal Botanist and Nurseryman, &c., 1, 294 (1770); Stripe-leaved Arborvitæ, *Ibid.* 1, 294; Loudon Encycl. of Trees, 1068.

Thuja variegata.—Marsh Arbor., 243.

Some of the younger branches are of a pale yellow colour, and mixed with the ordinary green of the tree, giving a variegated appearance to the plant. This variety was originally described by Weston (*l. c.*), but he omits mentioning it in a subsequent work (*English Flora*) published in 1775.

(β.) var. *odorata.*—*Thuia occid. odorata*, West. *Ibid.* 1, 294; Sweet-scented Arborvitæ, *Ibid. loc. cit. Thuja odorata*, Marsh. arboretum (*fide* Gordon). The variety is occasionally distinguished by the character of being more odoriferous than ordinary—a varying character hardly worth mentioning.

(γ.) var. *argentea.*—*Thuia occidentalis argentea*, Carrière, *l. c.* p. 103. A variety with the young twigs of a silvery colour, and more delicate than the parent plant.

(δ) var. *compacta.*—*Thuia occidentalis compacta*, Carrière; *T. occidentalis densa*, Gord. Supp. Pin. 103; *Thuja compacta*, Hort, *l. c.* p. 104; *Caucasica*, Hort. A variety expressed by its name.

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(ε.) var. *robusta.*—*Thuja occidentalis robusta*, Carrière, *l. c.* 104; *Thuia Wareana*, Hort. (non Booth); *Thuia occidentalis asplenifolia*, Hort. This is probably the same as *Thuja dumosa*, Gordon, Supp. to Pinetum, p. 102, which he describes as a spreading little bush, densely clothed with numerous short, tufted, flat, fan-shaped branches, growing in all directions, and thickly set with short, forked, two-edged branchlets, of a glossy, light green above, but much paler below, and furnished on the back rib with an elevated transparent gland. "It forms a dense, dwarf, confused little bush, seldom growing more than two feet high," said to be found in the Antarctic regions. This last locality is very doubtful.

(ζ.) var. *pendula.*—*Thuja occidentalis pendula*, Gordon, Supp. 103. This variety is said by its describer to differ in having the principal branches along the main stem in a reverted position, and in the branchlets being more densely clustered or tufted towards the ends of the branches, and in a more declining position.

(η) var. *Vervæneana.*—*Thuja Vervæneana* "Van Geert." *Thuja occidentalis Vervæneana.* Hort. et Gordon, Supp. 103.—One of the variegated varieties, probably the same as var. (*a.*) *variegata.*

(θ.) var. *ericoides.*—*Thuja occidentalis ericoides;* Lawson, in "Illustrated Farmer and Gardener's Almanack," 1867, pp. 102, 103, fig.; M'Nab (Jas.) Trans. Bot. Soc. vol. ix. 61, fig.; "Tom Thumb Arborvitæ," of the American Horticulturists. This, the most recently cultivated variety, has a compact rounded habit, dwarfed, and with most of the leaves having a heath-like appearance.

Another variety is generally known in gardens under the names of *Tartarica, pyramidalis, australis,* &c., which Mr Gordon thinks is not a Biota, as generally stated, but a true Thuja, with cones identical with *T. occidentalis.* If so, *T. occidentalis* was found in Siberia as Gmelin has put it; but as far as I can learn, the variety under question was merely reared from the ordinary *Thuja occidentalis* from America, and has no connection with *Biota orientalis,* though Endlicher puts it, from a description of its general habit, and possibly name, among the varieties of that plant* (*tartarica* = *Thuia tartarica*, Hort. Pinet. Woburn. 197), and Mr Gordon finding that Endlicher has put a true Thuja among the varieties of a Biota, has accordingly come to the conclusion that Endlicher's *Biota orientalis* is a Thuja, a conclusion I can hardly bring myself to coincide in, though it is nearly allied to the

* *Thuja aurea*, Hort., is well known to be only a sport of *Biota orientalis*, and *Thuja Verschaffelti*, Hort., must come under the same category. Many of the plants labelled with the generic name of *Thuja*, with the superadded one of a specific MS. name derived from some trifling or supposed variation, are not *Thujas* at all, but are to be referred to other genera—in nearly every case *Biota*,—such as *Thuja uncinata*, *T. gracilis*, *T. Fortunii* (?), &c.

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genus Thuja. There is probably some confusion, which I have not yet been able to detect. Describing and cataloguing the synonyms of varieties is a most thankless task, fruitless of all results, either scientifically or horticulturally. While you are working, new varieties are forming, and old ones returning to the parent stock. Every cultivator has his own pet variety, which he catalogues under a different name, and will not acknowledge to be the same as that of his neighbour. The result is, that it is impossible to arrive even at an approximately correct nomenclature. Luckily, such is not required in science. These examples are given to show the natural bent of the plant, and the general course it seems to take in varying. The botanist has to do with natural varieties, of which there are none which can be classed under the heading of this species. Therefore, though I have endeavoured, for the reasons stated, to catalogue the principal varieties known to me, yet I by no means maintain that I have investigated the whole of them, or that errors will not be discovered in their synonymy.

THUJA GIGANTEA, Nutt.

Thuja gigantea, Nuttall, Rocky Mountain plants, 52; Smith's Ed. of Nuttall's "Sylva," p. 102; Gardener's Monthly and Hort. Advertiser (Philad.), June 1859 (with figures, good); Spach. Hist. Veg. Phan. xi. 342 (Excl. Syn. Dougl.); Endlicher Syn. Conif. 52; Lindl. and Gordon, Journ. Hort. Soc. v. 206 (excl. Synon. Douglas); Revue Hort., 1854, p. 224, fig. 12–14 (*fide* Carrière); Cooper, Nat. Hist. Wash. Terr., Bot. of Route, p. 21, and p. 265 (1860); Newberry, Trees of Oregon, in P. R. R. Surveys, vi. (Williamson's Report) pp. 56, 57, Bot. fig. 22 (good); Lyall, Journ. Linn. Soc. Bot. vii. No. 27 (1863), 144; Hittel, Resources of Cal. 1st ed. p. 97 (1863); Hook, Fl. Bor. Am. II., 165. Carrière Traité (*partim*) 105; Lawson, Cat. (1851) 57.

Thuja Menziesii, Dougl., MS.; Carrière *l. c.* (*partim*), 106; Gordon, Pinetum, 323; *T. Lobbii,* Hort.; *T. Lobbiana,* Hort.

"*Thuja Craigana et T. gigantea,*" R. Br. min. (*fide* Gordon et Carrière) in literis 1863–1865; postea "*T. gigantea,*" Sol.

Thuja Nuttaliana, "Dougl," *fide* Gordon, Supp. p. 102.

? *Abies microphylla,* Rafinesque, Atlantic Journal, 119.

Popular names.—Cedar, White Cedar (in Puget Sound). The name "White Cedar" is also sometimes applied in Oregon to "*Cupressus fragrans,*" Kell. (*C. Lawsoniana,* Murr. ?) which is, however, also known by the name of "Ginger Pine," "Port Orford Cedar, and the more indefinite one of "Oregon Cedar."

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Sp. Char.—Ramulis compressis erectis, foliis quadrifariam imbricatis ovatis acutis, marginalibus navicularibus, facialibus convexis. Strobilis magnis, arcte reflexis.

Leaves in alternate opposite pairs, densely imbricated, sometimes with a gland on the back. Leaves on the rami more distant, attenuated, and decurrent. Cones larger than in any other species, oval, tapering to both ends, but generally with the superior ends reflexed when ripe, swelled in middle. The branches come off from the stem irregularly, and take a downward sweep, describing towards the base an S shaped curve. The branches spread out in a dense, flat form, forming a hollow beneath, almost impenetrable to rain. It branches at a distance of some 30 feet from the base. The tree reaches a height of 250 feet, and a diameter of 40. I measured one in a rich river bottom which measured in circumference at the base 45 feet, or 15 feet in diameter. The bark is smooth, and when old, cracks longitudinally, but is very tough, and is not shed even in old trees. It is one of the most handsome trees in North West America; and being fast growing, and prospering well on damp sandy soil, might be introduced and grown much more extensively in this country than heretofore. As I have said, it seems to have been most strangely confounded with *Libocedrus decurrens*, with which it has no affinities, and with a supposed second species, *Thuja Menziesii*, of which it is only a synonym. Nuttall gave as one of the characters of his plant "foliis etuberculatis," but the dorsal gland is not constant, either on the species or on individual leaves of the same tree, so that the supposed distinction of *Thuja Menziesii*, founded on this (in itself no character), falls to the ground. Moreover, it cannot be distinguished by the paler upper or under side of the leaves; for in its native forests the same plant, in some of its branches, will be pale inferiorly, with stomata, and different on others, or in seedlings growing under its base. Neither can a supposed difference of habit serve to distinguish species allied to this; for this varies according to situation, soil, and climate; and if this was sufficient to form a species, the number might be increased almost indefinitely. Mr Gordon's description of *Thuja gigantea* is undoubtedly that of a Libocedrus, and apparently of *L. decurrens*, which he (having surely never seen Torrey's figure) puts down as a synonym of *T. gigantea*, Nutt.—a very different plant of another genus, as Torrey himself specially mentions. The tree itself might be passed at a little distance for *Thuja gigantea*, but *is in general* of a darker green. In the parts of the country where *T. gigantea* prevails *Libocedrus decurrens* is not found. *T. gigantea* has a range far north, reaching to Lynn Canal in 58° north latitude, and south into California. Its centre of distribution is, however, in the region adjoining Vancouver—the coast of British Columbia

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and Washington territory, to the Columbia River, on the western slope of the Cascade Mountains. To the southward, it is far from common, and in California it is a rare tree, while to the east of the Cascades it is only occasionally met with in a scrubby form in the damp dells and river bottoms, but far departed from its pristine glory on the damp banks of the Columbia or the Fraser. In Vancouver Island it is very abundant in such localities; but nowhere does it form a forest, being generally found in single trees, or at most in twos or threes scattered through the pine forests, and generally in poor soil. It is ~~not~~ found at a considerable height on the Pacific seaboard, and on the Cascade Mountains and towards the Rocky Mountains it rises to a good elevation, being found in Utah at a great altitude on that range. As a useful tree it stands pre-eminent before all other trees of North West America in the estimation of Indians and backwoodsmen. On a former occasion* I mentioned that the Indian made scoops of its bark, thatched his hunting-lodge with it, made from it ropes, blankets, cloaks, mats, "tow;"—that he smoked the leaves, dug his canoe out of the trunk (and nothing so thoroughly expresses the enormous size which some of these trees attain, than to see the large and beautiful war canoe which the Indians hollow out of a single trunk), and built his houses of its boards, sewed together with its tough twigs. The backwoodsman in a few hours will run himself up a temporary house with it; and many men are continually occupied in making "cedar shingles" out of its fissile and easily-wrought wood. It is not found in sufficient quantity anywhere to make it an article of commerce at the saw mills; but when it can be got, it is highly valued as a light, durable material for doors, window-sashes, &c. In the ground it is almost indestructible, but not in water. The Hudson's Bay Company, when they wish to build a fort, always endeavour, on account of this durable quality of the wood in the ground, to procure trees of it to form a picket or stockade round their trading post. "Cedar Hill" (Mount Douglas), near Victoria, was so called because the "cedar" trees to form the stockade of old Fort Victoria were taken from that place. Its lasting quality was brought forcibly before me on one occasion. I found the fallen trunk of a tree in the woods, quite decayed on the outside. Growing on the soil thus formed, with its roots now hid in the body of the decayed outside, was another tree. On cutting into I found it to be a cedar almost sound at heart. The tree growing on it was an *Abies Douglasii*, which could not have been less than twenty or thirty years old, and accordingly the tree must have lain dead in the forest for much more than that time. Dr Cooper (*l.c.*) related an instance very similar. In one of the damp, dark forests close to the coast, he saw trunks

* April 9, 1868.

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lying prostrate, with several spruces from 3 to 4 feet in diameter growing on them, having evidently taken root in the decaying bark, and, as in the tree seen by me, extending their roots into the ground adjoining, while the interior of the log was found still sound, though partially bored by insects. Judging of the age of spruces by the ordinary rules, this log must have lain hundreds of years exposed to the full action of one of the most moist of climates. On some of the tide meadows about Shoalwater Bay, dead trees of this species only are standing, sometimes in groves, whose age must be immense, though impossible to tell accurately. They evidently lived and grew when the surface was above high-water level—groves of this and other species still flourishing down to the very edge of inundation. But a gradual slow sinking of the land (which seems in many places to be still progressing, and is perhaps caused by the undermining of quicksands) has caused the overflow of the tides, and thus killed the forests, the only remains of which now left are these cedars. This wood is perfectly sound, and so well seasoned as to be the very best of its kind. Continued and careful examinations of such trees may afford important information as to the changes of level in these shores. That these have been numerous and great is further shown by alternating beds of marine shells, and of logs and stumps, often in their natural position, which form the cliffs about the bay to the height of 200 feet. But while these remains show that the changes took place in the latest periods of the pleistocene epoch, there is no evidence in the gigantic forests living on these cliffs, that any *sudden* or *violent* change has occurred since they began to grow, a period estimable by thousands rather than by hundreds of years.* The tree might, therefore, if extensively planted, soon become (as it is a quick growing species) of use as timber for railway sleepers and other work requiring great durability of wood under ground. Its bark has been recommended for paper-making, and is worth a trial on that account. On the whole, I know of no tree in all North West America more beautiful, more valuable, or more worthy of being introduced into cultivation in Europe. I may mention here that the tree which Mr Gordon, in a note in the Supplement to the Pinetum, p. 102, mentions on the authority of Sir E. Belcher's "Voyage of H.M.S. Sulphur," as being the tree called "Noo-wy-as" † by the Sitka Indians, is not the *Thuja gigantea* but *Thuiopis borealis*, Fischer (*Cupressus Nutkaensis*, Lamb). *Thuja gigantea*

* Cooper, *loc. cit.*

† It is amusing to see how loosely writers on Coniferæ talk of the "Oregon district," "the North West Coast," "California," and what "the North West and California Indians" call such and such a tree. The fact is, that there are more than forty languages and dialects spoken in that wide region, so familiarly spoken of, and that scarcely one little sept has the same name for any tree, and then even that name is often applied to all its congeners.

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will not take a fine polish, but the *Thuiopsis* will, and works beautifully. A good deal of the latter is sent down to Victoria on the Metlakathlah Mission schooner, and is eagerly bought by the cabinetmakers in Victoria. It is also valuable for boat-building. Sir Edward Belcher (I am informed by my friend Captain George, R.N., at that time one of the officers of the "Sulphur"), built a boat at Sitka of this wood, and Captain Verney, R.N., used it to repair his boats while in command of H.M.S. "Grappler." He presented a piece to the Museum of the Botanic Garden at Edinburgh in 1865.

VARIETIES.

(*A*) Natural Varieties.

(*α*) var. *plicata*—*Thuja plicata*, Don, Hort. Cantab. Ed. 6, p. 249; Lamb. Pinetum, Ed. 1, 11; 19 Ed. 2: Loddiges, Catal. (1836); Loud. Arb. iv., 2458; Endlich Synop. 51; Carrière, Traité, 102; Gordon, Pin. 51; Spach. Hist. Veg. Phan. xi. 342; Lindl. and Gord. Journ. Hort. Soc. v. 205; Knight, Syn. Conif. 16.

Thuja occidentalis plicata.—Loud. Encyc. Tr. p. 1110, f. 2108.
Thuja Warreana.—Booth, Cat. 1837.

*Specific Char.**—Ramulis complanatis patentibus, foliis quadrifariam imbricatis, in superiore ramulorum facie lucidis, in inferiore opacis, marginalibus navicularibus late ovatis acutis, facialibus rhombeis obtusiusculis planis carinatis, dorso glandula tuberculiformi orbiculari: strobilis nutantibus.

Loudon (*l. c.*) describes this tree as very branchy, light green, and spreading; the branches dense, often divided, pectinate, compressed; leaves rhomboid ovate, acute closely adpressed, imbricated in four rows, crowded together between the nodes, glabrous, quite entire, showing tuberculation in the middle; shining bright-green above and glaucous green below. Strobili scattered solitary, pendulous; oblong scales, elliptic obtuse, flat, obsoletely furrowed. Seeds compressed and winged all around, marginate at apex, obcordate oblong. This tree was said to have been discovered by Archibald Menzies in Nootka Sound, Vancouver's Island, in 1796, and has been long in cultivation in England under this general name. Most cultivators (even) are agreed that it is only a variety of *T. occidentalis*, and Loudon "has no doubt of it." It is even said that *Thuja occidentalis* will grow into it. And no better proof could be adduced of the frail claim it ever had to specific distinction than the fact that two cultivators, both authors of works on Coniferæ, disagree as to what are varieties of this and what are varieties of *T. occidentalis*.

* After Endlicher.

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For instance, Gordon classes the varieties, *compacta* (Knight), *asplenifolia* (Hort.), and *robusta* (Carr.) (which, following Carrière, I have put under the head of *T. occidentalis*), as varieties of *T. plicata*. Indeed, there is scarcely an author who agrees on what is *T. occidentalis* and what *T. plicata*. Even Carrière thinks that "Le *T. plicata* paraît voisin du *T. occidentalis*." The characters by which it is separated from *T. gigantea*, or *T. occidentalis* are, moreover, not sufficient to constitute a species; habit, darker or lighter green of the branch, being characters varying on the same tree in different situations, or on parts of the same individual exposed to different influences. I could find no tree in nature which I could pronounce to be *T. plicata,* although I sought for it constantly; but I did find, what I now put on the table, seedlings of *T. gigantea*, and branches of the same tree, bearing the characters of this *T. plicata,* as distinctly as the plant known by that name under cultivation. Dr Cooper, whose knowledge of North Western trees is second to none in America, writes, "A second species of Arborvitæ is said to be found on the islands north of the Straits of Fuca, and probably extends within the Territory. 'Cedars' on Whidby's, and other islands, resemble it in their smaller size and denser branching; but I attributed the variety to soil, and did not preserve specimens." I have also visited Whidby's Island, and various other islands in that vicinity, and found what Dr Cooper describes, but came to no other opinion than what he did, viz., that it was the exposed and dry soil of the prairies which made this trifling change in the habit and foliage. I have likewise visited Nootka Sound, where Menzies got his plant, but could find no trees there having the character. Since then, I am given to understand that the tree was not described from Menzies' plant, but from plants cultivated from seeds of a tree which he brought home. Doubtless this tree was only *T. gigantea*, which has sported into this character. And in confirmation of this, I may mention that I was told that some of the seeds which I took from *T. gigantea* trees have produced "*plicata* plants," and are so labelled in some collections. On the whole, I think no *botanist* can doubt for a moment but that this *T. plicata* is only a variety of *T. gigantea*. Those who have considered it as a variety, look upon it as a variety of *T. occidentalis*, because *T. gigantea* had not then been known: but I have shown that it equally agrees with *T. gigantea ;* and therefore, unless we are to affirm that *T. occidentalis* is nothing but a variety of *T. gigantea,* or *vice versa*, or that it is found on the Pacific slope of the Rocky Mountains (neither of which statements we have grounds for giving adherence to), we must consider *T. plicata* as a var. of the Pacific species *T. gigantea*, and as such I have considered it. Having been so long under cultivation, it has also sported into what are called "varieties of *T. plicata*," but it would

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be hard to say what is the variety and what the species. As, however, they are known as such, to avoid confusion, the only described one may be noted here—

(1.) Sub-var. *plicata variegata* var. *panachée*—Carrière Traité, 102. The variegated Nootka Sound Arborvitæ, Gordon, Supp. 103, 104.

Differs in having some of its leaves and twigs of a pale yellow colour dispersed over the plant in a variegated manner.*

(β.) *Microcarpa,* nov. var.—Thuja, *nov.* spec. No. 273, (*a*) R. Br. min., "Farmer," May 16, 1868.

This variety of *T. gigantea* is so distinct, by its small cones and regular pectinate branching, that I have thought proper to give it a distinct name. I found the tree on the Willamette, near Portland, Oregon, in May 1865, but not, of course, in seed. The tree struck me as curious, from its stunted branches, closely adpressed to the stem; the tree itself reaches a height of 170 feet, and a diameter of some 4 feet. I never visited that part of the country again, and so failed to procure seeds. All the specimens which I examined bore the same character as the one on the table.

Genus LIBOCEDRUS.

Libocedrus decurrens, Torr.

Libocedrus decurrens, Torrey, in "Plantæ Fremontianæ;" Smith. "Contrib. to Know." vol. vi. pp. 7, 8, plate 3 (good); Torrey, in "Rep. of Explor. and Surv. for a Railroad from Miss. River to Pacific Ocean," &c., vol. iv. 140 (Bot.); "Philad. Month. and Hort. Adv.," *l. c.* fig. (good); Bigelow, *Ibid.*, 24 (Bot.) Newberry, *lib. cit.* pp. 63–4.

Thuja Craigana, Oreg. Com. (Balf.) Description of Coniferæ collected by Mr Jeffrey (private distrib.) plate (good); Lindl. Gardener's Chr. 1854, p. 53.

Libocedrus Craigana, Hort. (Low).
gigantea, Hort. (Low).
glauca, Hort. (Laws.)?

Thuja gigantea, Carrière, *l. c.* 105 (*partim*).
Gordon, *l. c.* 321 et Supp. 102.

Cupressus, No 750. Jeffrey's MS.

Popular names.—"Red Cedar" in Oregon, and in places where *T. gigantea* is also found; "White Cedar" in California.

* In some collections a "*T. plicata,* var. *Llaveana,*" is found; but this, as well as "*T. Californica,*" Hort. aliq., "*T. flagelliformis,*" Hort., etc. differ in no appreciable manner from the normal types. To attempt to catalogue the endless MS. names in nurserymen's catalogues, in most cases made without any reference to previous descriptions, would be a worthless and unsatisfactory task. I only refer to widely known or described forms.

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*Spec. Char.**—*Ramulis* compressis sub-ancipitis: foliis late ovatis breviter acuminatis apice serratulis longe decurrentibus, lateralibus carinatis, facialibus planis: *strobilis* ovato-oblongis nutantibus. *Squamis* infra apicem spina tuberculiformi recurva auctis, superioribus multo majoribus: *seminalibus* bialatis, ala altera maxima.

Leaves, 4-ranked, as usual in the genus, very small and closely embricated; their bases prolonged downwards and contracted with strongly-marked longitudinal lines, where the two exterior overlap the two anterior ones. In the younger branchlets the decurrent bases are from two to three times longer than their diameter, and in the older ones about four times longer. None of the leaves are acerose. The two on the interior of each joint are marked on the face with a slight depression beneath, which is often a small obscure gland, though none appears externally. *The staminiferous aments* terminate the branchlets. They are ovoid oblong, and from two to three lines in length. The stamens are from 12 to 14, 4-ranked,—the connective produced in a sub-orbicular excentrically peltate scale, and bearing on its under surface about four oblong anther cells, which open longitudinally. The *seminiferous aments* (or strobili) are nearly an inch in length, ovate oblong, and consist of four scales, of which the two exterior are rounded externally, with the flattened septum-like axis prolonged between them, and equalling them in length; all of the scales are mucronate, with a short recurved point below the tip. Beneath each interior scales are two seeds. These are furnished with two very unequal wings. The tree resembles *Callitris quadrivalvis*, Venten., in its foliage, and is nearly related to *Thuja Chilensis* (Hook.)

As a tree, this does not come up to the standard of *Thuja gigantea*, neither reaching its girth nor height, nor approaching it in elegance of contour. It generally grows in groves, in shady valleys at a considerable elevation.

I have already, in the introduction to this paper, given the history of the synonyms of this species. The figures in Torrey's paper (*l. c.*), the Oregon Committee's brochure (*l. c.*), and the "Philadelphia Monthly and Horticultural Advertiser" (*l. c.*), are all very good; and none who has seen them could ever mistake the plant for any other. John Torrey's description of *Libocedrus decurrens*, as might be expected from the character of that eminent botanist, will scarcely admit of amendment; and in my diagnosis I have allowed it to speak for itself, with scarcely any change. Misled by unnaturally dried specimens, he has wrongly described the strobili as "erect." They are, as in nearly all the Coniferæ, pendent, though frequently, in Herbaria, they are found in the condition which Dr Torrey described them.

* After Torrey, but corrected in some particulars.

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In 1865, though I climbed, or cut down and examined upwards of one hundred trees, I did not get more than a dozen cones; though, from the remains found under the trees, they seem to have been abundantly produced the year previously.

Its geographical range is from about 44° to at least 38° N.L., and west to the Sierras and Cascade Mountains. It does not seem to go further east than these mountains. The tree is found at an elevation of from four or five thousand feet in the Sierra Nevada Mountains in California; but further north in Oregon, it grows at a much lower elevation. I did not find the tree north of Eugene in Oregon (Lat. 44° 2′ 44″ N.), and during my journey across the Cascades,* a little southward of this, I found it abundant here and there in the valleys, but very scarce on the eastern side of the mountains. Again, in the Rogue River valley I saw a few trees, and one or two in Josephine County, near Kerbyville, and southward, in the Siskiyou Mountains, it is quite common. Nowhere, where I saw it, did I see any *Thuja gigantea*; and, as I have already remarked, *Thuja gigantea* is a rare tree where this is common, or, indeed, begins to appear; and further north, in Northern Oregon, Washington Territory, Vancouver Island, and British Columbia, *Libocedrus* is entirely unknown. If anything could more distinctly show, than the description of them, the distinctness of the one tree from the other, it is their geographical range. In the county from whence Nuttall got his specimens there is no congener; and there *Libocedrus* is as unknown as in England; and (independently of any other considerations) suppose we knew no better, the only conclusion we could come to, knowing the range of the two species, is that Cooper, Lyall, and other Botanists who mention *Thuja gigantea*, could only mean Nuttall's plant, *Libocedrus decurrens* being an unknown tree in the tracts over which these travels extended. This tree has been introduced into cultivation, but can never, I think, produce any valuable timber, though pretty as a merely ornamental tree. Like nearly all of its allies (*Cupressus* and *Thuja*), it will last long if protected from the air by being underground or in water; if not, the opposite is true. An acquaintance of mine in Southern Oregon (Governor Briggs), told me that he put up a ring fence of this timber, but in two years it was so rotten that you could push it over. In the Calapooya Mountains, and some other places, in default of better timber, it is sawn, but does not make good lumber. It cannot, like *Thuja gigantea*, be easily split into planks, as it is apt to fly into "ribbons." The wood is, however, very light, of a dirty yellowish hue, and thought to be even more durable than redwood (*Sequoia sempervirens*), and I saw it used in some places in house joinery. It has no marked

* "Proc. Roy. Geog. Soc." vol. xi. p. 84 (1867).

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varieties in nature, nor has yet the art of the horticulturist produced any.*

Summary.

(1.) In this paper I have endeavoured to show that *T. gigantea*, Nutt., is totally different from *Libocedrus decurrens*, Torr.—a piece of almost unnecessary work, one would think, after seeing the two plants. They differ in everything that can constitute difference, and their geographical range is also markedly dissimilar; that Carrière's *Thuja gigantea* is partly Nuttall's (exclusive of the synonyms), and that Gordon's plant is really not a bad description of *Libocedrus decurrens*, is also tolerably evident; that Hooker's *T. gigantea* is likewise Nuttall's, and that Douglas's *T. Menziesii* is a synonym of *T. gigantea*, has also not been difficult to demonstrate.

(2.) Though the range of the genus *Thuja* is wide, and the range of the two species also considerable on either seaboard, yet it is limited to a great extent to regions lying within the influence of the two oceans—the Atlantic and the Pacific—and does not extend far into the interior. Though, *per se*, distinct enough, yet it appears that they are not so widely separated as might at first sight appear, and that forms such as *Thuja gigantea* var. *plicata* (*Thuja plicata*, *Auctorum*) form connecting links which render it difficult for the botanist to furnish specific characters constant in either species, or for the physical geographer to state their distribution satisfactorily. Between the range of the two species there lie between two and three thousand miles of longitude, with none of their co-genera. Their range in longitude on either side is about similar, though, from the warmer character of the Pacific coast, *T. gigantea* stretches further north on the western side of the country than does its representative species on the eastern. There lies something deeper behind it than we yet understand, and it really sometimes seems that a species may stretch to the outmost bounds of its range, cross over and take new characters to suit it to the new climate and physical circumstances it is subjected to, and here form a new race, in course of time to become the representative species of the original species, of whose family it was once an individual. The want of stragglers all the way over, I know, seems to militate against this theory; but still the great central regions of America, like the centre of all great continents, now too dry to be favourable for the prosperity, or even growth, of arborescent species, might not have been always so. Scarcely a prominent Atlantic species of conifer (or even of deciduous tree) but has its Pacific "representative"—

* *Thuja gigantea divaricata* ("J. Dickson & Sons," in Roy. Bot. Gard. Edin.) and *Thuja gigantea glauca* of the same collection, are only slight variations of *Libocedrus decurrens* produced by cultivation, but so slight as to require no further notice.

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Abies Mertensiana, ...	*Abies Canadensis,*
Pinus ponderosa, ...	*Pinus rigida,*
Pinus contorta, ...	*Pinus inops,*
Taxus brevifolia, ...	*Taxus Canadensis,*
Juniperus Henryana,* . . .	*Juniperus Virginiana.*

and many more could be cited, both herbaceous and arborescent species. Every now and then we are meeting trees and plants on the Pacific which are like, but yet are not the same as the Atlantic species, and yet the differences are not sufficient to separate them, though, for convenience' sake, we say that is different, though in our inmost souls we are diffident that it is really different; in other words, that it is the Pacific "representative species" of its Atlantic congener. In some cases we have to cross the rubicon, and really declare them the same. Students of Pacific dendrology are divided into two sects, each at daggers-drawn with the other. The one boldly asserts that no tree on the western slope of the Rocky Mountains is the same as on the eastern slope, but that the latter are the "representative species" of the former; the other that some are specifically the same. There are many connecting forms, no doubt. We may set up an archetype of a Pacific species, and work into this ideal type all the aberrant forms of that species, be it an Abies, a Pinus, or a Thuja; but still our self satisfaction is ever now and again rudely dashed to the ground by some of our aberrant forms meeting with some of the outposts of the "representative species" from the other side of the Rocky Mountains and claiming kindred. There is, I repeat, something deeper, in the phrase, "representative species," than the mere words express. To sum up all, the difference between some of the aberrant forms of *T. gigantea* and *T. occidentalis* are more of *degree* than of *kind.* Some of the sports are wider apart from the mother species than species which are acknowledged as distinct.

(3.) Foliage, I have shown, does not supply characters which can in the least be relied upon to separate species, any more than can the mere form of leaves in herbaceous plants; and the difference of colour, the want of stomata, &c., are due to physical circumstances, and often found on the same tree, parts of which are put under different physical circumstances. No doubt, as in other similar cases, an accidental variety of this nature can be propagated, and produce offspring bearing the features of its parent.

(4.) I have endeavoured finally to reduce the species to what they are in nature, rather than foist children upon her which she disowns. I have far from succeeded to my satisfaction—a feeling which must always be the case with any

* *R. Br. Min. MSS.*—It was sent home by me in 1864 under that name, and is now generally distributed over the country. It will be more fully described.

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one who attempts to cleanse the Augean stable of coniferous nomenclature and synonymy.

IV. *On the Vegetable Products, used by the North-West American Indians as Food and Medicine, in the Arts, and in Superstitious Rites.* By Robert Brown, Esq.

On ransacking my various journals and note-books, relating to North-West America, I find scattered through them many notices of the economic plants of the aborigines of these countries. Though these memoranda can be of but little use to civilised art or medicine, yet I have thrown them together, as a contribution to the economic history of plants, and the ethnology of a little known people. The country is however very extensive, and therefore much must be omitted, as there are numerous plants and vegetable products used by some of the tribes which I have never visited, and of which I know nothing except by uncertain hearsay. These notes, therefore, principally relate to my own observations, and chiefly to the Indians on the Pacific seaboard.

The Indians are not much of a phytophagous people. The tribes in the interior live by hunting, and those on the banks of great rivers, such as the Fraser and Columbia, chiefly by fishing, so that they only resort to vegetable diet as an addition to their ordinary food, or as a corrective to the unvarying meals of flesh and fish, chiefly venison and salmon. It is only the miserable Digger Indians—the *gens de pitie* of the voyageurs—who can be said to subsist to any great extent on vegetable food, varying it with grubs, snakes, lizards, and grasshoppers, the latter of which they devour as eagerly as do the Bedouins of the Eastern deserts. Nearly all of the tribes, from the coast to the Rocky Mountains, use as food more or less of the blue lily, the Gamass or *La Gamass* of the voyageurs (*Gamassia esculenta*, Lindl.*), which, in the spring, lends a characteristic aspect to the Western Pacific prairies and open grounds. In Vancouver Island this plant comes into flower about the middle or end of April, and remains in

* A good account of this plant will be found in "Hooker's London Journal of Botany," vol. v. (Geyer.)

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flower until June, when, just as it is fading, the roots are in a condition to be gathered. Until that time it is watery and unpalatable.

The gathering is nearly wholly done by women and children, who use a sharp-pointed stick for the purpose; and it is surprising to see the aptitude with which the root is dug out. A botanist, who has attempted the same feat with his spade, will appreciate their skill. About this period the Indians come from their permanent village, and encamp under the shade of trees in little brush camps. It is the time when, away from the filth of villages, Indian life appears in its most picturesque aspect; and the twinkling of the Gamass camp fires, as you pass along through the wood at night, have a very pleasing effect. To the Gamass gathering come sober-minded young hunters and salmon-fishers to select a partner; for the hard-working, skilful squaw is looked upon by an Indian of right constituted mind as a much more desirable acquisition than a mere gawky thing, gay in vermilion, brass wire, and hawk bells. In Oregon I have seen the bulbs roasted until they became black. They are then pounded up and preserved in cakes. In Vancouver Island, and generally throughout the country, the roots are roasted to convert the starch into sugar (though, of course, the Indian knows not the *rationale* of the process), and are preserved whole in bags for winter use.* They are sweet to the taste, and appear to be a nourishing, and far from unpalatable article of food.

The roots of the *Sagittaria sagittifolia*, Linn., were at one time very extensively eaten by the Indians, under the name of *Wappatoo;* and on the Columbia River there is an island called Wappatoo Island, from the abundance of this plant. Since the introduction of the potato the use of the roots of the *Sagittaria* has much declined, and the name is now transferred to the potato. In the vicinity of nearly every Indian village are small patches of potatoes, but the ground is merely scratched up, and the cultivation far from being properly attended to. Their innate laziness and hatred of any work out of the ordinary routine of their

* In some places they are buried in holes in the ground until fermentation sets in.

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life, will not allow of their either properly attending to these patches, or increasing their cultivation and material comforts thereby to the boundless extent which they might—the land costing nothing. However, since the introduction of this useful tuber, the Indians are much less subject to starvation and the uncertain privations of a savage life; and some of them excel in the cultivation of the plant, their potatoes bringing, even from the whites, a higher price than any other. On Queen Charlotte's Islands is held a sort of regular "potato fair" every year, when tribes from all parts come to buy in exchange for the products of their country and industry. Some of them have strange notions of the best method of cultivation. I once lived in an Indian village for some days, when regularly every morning, as the squaws were lighting the lodge fires, and preparing the morning meal, the old chief would solemnly stalk all through the village, shouting in a stentorian voice, "Eat the little potatoes, keep the big ones for seed; eat the little potatoes, keep the big ones for seed!"

The roots of *Lilium canadense*, L., *Brodiæa grandiflora*, Sm., and *Endosmia Gardneri*, H. & A. (S'hah-gok, Nisqually Inds.), are all eaten in the parts of the country where they are found. Everywhere in Vancouver Island, and the neighbouring country, the Indians gather the roots of the ordinary *Pteris aquilina*, L., and boil and eat them as food. They look upon them as a great luxury. The Thongeisth, near Victoria, call this "Slee-uk," and still use them, notwithstanding the advent of civilised luxury among them.

The root of *Peucedanum fœniculaceum*, Nutt., is also eaten, and by some the roots of *Aquilegia canadensis*, Linn.,* *Erythronium grandiflorum*, Pursh,† *Fritillaria lanceolata*, Pursh, *Allium canadense*, L., and *A. reticulatum*, Nutt., mixed with other food.

Douglas says that the roots of *Lupinus littoralis*, Dougl., are eaten by the Indians near the mouth of the Columbia

* Var. *formosa*, Fischer.

† I sent home this fine Erythronium in 1863, and it is figured in the *Curtis' Botanical Journal and Kew Miscellany*, May 1868, from specimens which have flowered in the Edin. Bot. Garden. Dr Hooker thinks it is the *E. giganteum*, Dougl.

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River (Chinooks). I never knew them do so, but I have seen the natives at the same place eat the roots of *Abronia arenaria*, Menz., which he might have mistaken for the former plant.* Some of the miserable tribes in California eat the roots of the *tule*† (*Scirpus lacustris*, L.), which chokes up the lakes and swampy land of some portions of Southern Oregon and California.

Among other plants eaten by the Kootanie, Colville, and other tribes in that part of British Columbia and Washington Territory, is the beautiful *Lewisia rediviva*, Pursh. The roots are gathered in great quantities, and boiled and eaten like *salep* or arrowroot. In this state they are not unpleasant to the taste, slightly bitter, and are highly valued by the Indians as a nutritive food for carrying on long journeys, two or three ounces a-day being sufficient for a man even under great fatigue (*Hooker*, *Flor. Bot.* Am. i., 223). These Indians call it Petlum-asd-ilse-ne-mare, and look upon it as one of the great gifts from the Supreme Master of Life. The white biscuit root, the *racine blanc* of the Voyageurs (*Eulophus ambiguus*, Nutt.), is dried, pulverised, and made into cakes baked in the sun. The roots of *Phaca aboriginorum*, Hook., a plant of the Eastern side of the Rocky Mountains, which, however, probably extends to the west of the range, are gathered by the Cree and Stone Indians in the spring as an article of food. The roots and young stems of *Heracleum lanatum*, Michx., are eaten by some of the coast tribes, and it is also used by the Crees of the eastern side of the Rocky Mountains as a pot herb.

The seeds of many plants are used as cereals. The seeds of various species of Pinus (*P. flexilis*, Torr., *P. Sabiniana*, Dougl., and *P. Lambertiana*, Dougl.,) are all eaten in the parts of the country where they prevail, and they are the nut pines of that part of the country, though the name is often thought to apply to *P. Sabiniana* alone. The Indian climbs the tree, and throws the cones down to the squaw beneath, who carefully secures them; otherwise the squirrels would make short work with them. The cones are then scorched, to open them and destroy the troublesome resin;

* *Vide* also Cooper's Nat. Hist. W. T. Bot., 55.

† *Tule*, *tula*, *tulare*, as variously pronounced, derived from the Mexican *tulitl*.

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so that the winter supply of pine seeds, which might have supplied a harvest to the botanist, is perfectly useless. When I visited Oregon in 1865, I found that in *P. Sabiniana*, as in nearly all other Conifers, the pine seed harvest had failed, and the Indians suffered much. One of these pines, *P. Lambertiana*, yields a sugar which is occasionally eaten, though it has cathartic properties. It is only found on scorched trees, and in very small quantities. I have, however, heard of a man who devoted himself for a few weeks to the business of collecting it, and obtained 150 lbs. It can scarcely be distinguished from the manna of the shops, except by a slight terebinthine flavour. In times of scarcity the Indians will eat the liber of *Pinus contorta*, Dougl. Along both sides of the trail in the passes of the Galton and Rocky Mountains, many of the young trees of this species are stripped of their bark from a foot or so above the ground to a height of six or seven feet. This is done by the Indians, during their annual buffalo hunting expeditions from the Kootanie and Kalispelm country to the plains east of the Rocky Mountains, for the sake of the inner bark, which they use as food, as well in its fresh state as when compressed into thick cakes, so as to render it portable (Lyall, *Linn. Journ.*, *Bot.* vii. 141). I am not aware of the coast Indians making any use of it for food. The seeds of *Vicia gigantea*, Hook., are also eaten. Many species of grass seeds are collected for food. They are ground in a mortar, and roasted or made into soup. The seeds of the wild rye (*Hordeum jubatum*, L.) is especially held in request among the Shoshones of Southern Oregon ; and a staple article of diet among the Klamaths, near the Klamath Lake, in Southern Oregon, are the seeds of *Nuphar advena*, Ait.—the yellow water lily of the lakes of that part of the world. I described its gathering and preparation in one of my letters.* "Chestnuts" (*Æsculus californica*, Nutt.) are usually made into a gruel or soup. After being ground in a mortar they are mixed with water, in a waterproof basket into which red hot stones are thrown, and then the soup is cooked. As the stones, when taken from the fire, have dirt and ashes adhering to them, the soup is not clean, and it often sets the teeth on edge. The

* "Farmer," Nov. 1865, &c.

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acorns of several species of oak (*Quercus*) are eaten with perhaps as much avidity as they were by the ancient Britons, only we are too familiar with the process as practised now-a-days by the digger to throw any shade of romance around it. The acorns of California are mostly large, and the trees in general produce abundantly, though in some years there is a great scarcity, and much misery ensues among the poor natives. They do not, however, contain, in proportion to the bulk, an equal amount of nutriment with cereals. The acorns are gathered by the squaws, and are preserved in various methods. The most common plan is to build a basket with twigs and rushes in an oak tree, and keep the acorns there. The acorns are prepared for eating by grinding them and boiling them with water into a thick paste, or by baking them into bread. The oven is a hole in the ground about eighteen inches cubic. Red-hot stones are placed in the bottom, a little dry sand or loam is placed over them, and next comes a layer of dry leaves. The dough or paste is poured into the hole until it is two inches or three inches deep. Then comes another layer of leaves, more sand, red-hot stones, and finally dirt. At the end of five or six hours the oven has cooled down, and the bread is taken out, an irregular mass, nearly black in colour, not at all agreeable to the eye or to the palate, and mixed with leaves and dirt. For grinding the acorns a stone pestal and mortar are used.*

The nuts of the hazel (*Corylus americana*, Walt.) are also extensively gathered as food in some parts of the country where they are found. The fruit of the crab apple (*Pyrulus rivularis*, Dougl.) is prepared for food by being wrapt in leaves and preserved in bags all winter. When the apples have become sweet, they are cooked by digging a hole in the ground, covering it over thickly with green leaves and a layer of earth or sand, and then kindling a fire above them. The fruit of *Cerasus mollis*, Dougl., is also eaten. All of the edible berries of the country are eagerly collected by the Indians, and either eaten fresh or preserved for winter use. Indeed, the "berry sun" is a great season with them, and all through the lovely summer

* "Hittel's California," 392. *Vide* also "Paul Kane's Journey," for some other methods of preparing acorns for food.

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weather of North-West America you ever and anon come upon parties of women and children in the woods, engaged in this agreeable pursuit. Equally so is it with the frontier white women and children, who go in parties of this nature for days and even weeks together into the mountains. I used often to come across these "berrying parties" in my wanderings, and some of the pleasantest remembrances I have of my wild North-Western life is the kindness I received from these little-polished, but good-hearted people—acts which I can never return, save by this general acknowledgment in a circle of my fellow-botanists; and I assure them that I gladly embrace the opportunity of so doing. Some of the berries, such as the strawberries (*Fragaria vesca*, Linn., *F. virginiana*, Ehr., and *F. chilensis*, Ehr.), will not admit of being dried, and are accordingly eaten fresh, or brought down to the frontier settlements and towns, and there sold to the whites. Nearly all of the others are dried and pressed into cakes for winter use. During the latter end of the summer and autumn all around Indian villages, but chiefly on platforms and on the flat roofs of the houses, vast quantities of these berries may be seen drying, and being superintended by some ancient hag, whose hands and arms are dyed pink with them. When required for use they are boiled, and form an agreeable dessert to salmon, beaver, or venison diet. The berries treated thus are various species of *Vaccinium*,* *Gaultheria Shallon*, Pursh,† *Amelanchier canadensis*, L.,‡ *Rubus nutkanus*, Moc.,§ *R. spectabilis*, Dougl.,|| *R. leucodermis*, Dougl., *Ribes divaricatum*, Dougl., *R. niveum*, Lindl., &c.; in fact, all the edible berries of the part of the country where the particular tribe lives. One of the Vacciniums (*V. ovalifolium*, Sm.) is well known to all North-Western travellers (at least those who have been much among the Northern Indians) as the *le brou* plant, being used to make a dainty of that name. The berries are gathered in the autumn, before they are quite ripe; and after being pressed into a cake, are dried and wrapped in bark, and laid by. When the cake is to be used, a quantity is put into a vessel among cold water, and then stirred rapidly round with the hand,

* "Huckleberry," &c. † "Salal." ‡ "Serviceberry."
§ "Thimbleberry." || "Salmonberry."

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which must be free from grease, until it assumes a paste-like form. More water is added, and more stirring applied, until it assumes a form not unlike soap-suds. In this frothy state it is supped with long wooden spoons (made of *Pinus monticola*). It is pleasant to the taste, with a slightly bitter flavour, and is often prepared in Hudson's Bay forts as an Indian dish which no traveller ought to leave the North-West without tasting. At their high feasts the Indians will sup of this until they are ready to burst, and then waddle to the water, drinking of which seems to allay the distention caused by the other. The Indians and the grizzly bears of Southern Oregon and California eat the berries of the *Manzanitta* (*Arctostaphylos glauca*, Dougl.); but I have never seen the northern tribes make the same use of the berries of the allied species *Arctostaphylos* (*Arbutus*) *tomentosa*, Pursh. The tender shoots of various plants are eaten in the spring, such as the shoots of *Rubus Nutkanus* (canoe-loads of which can be seen in the season on their way to Indian villages), *Rosa fraxinifolia*, Bork., the green stem of *Ligusticum scoticum*, Linn., and *Peucedanum leucocarpum*, Nutt., which are peeled and eaten, as well as the stem of *Erodium cicutarium*, L'Her., the *Alfilerilla*, or "pin-grass" of the Californians, and some other plants of that sort. They seem to make use of no species of lichen for food,* but make compressed cakes of a *Rhodymenia* for winter use. Grass and clover the Digger Indian (little elevated in his dietary above the lower animals) looks upon as great blessings, and eagerly eats them, and grows fat on them too. The California white clover is, however, very sweet, and I daresay to these poor people forms, either raw or boiled, a very agreeable salad to their grasshoppers. Beyond the potato, they have no cultivated plant. Some of the Indians in Oregon used to grow a little wild tobacco, but they now buy it from the whites. I have seen some of them, when tobacco was scarce, in order, as they thought, to get the full benefit of it, inhale in turns the smoke, gulping it down until it came out at the nostrils and ears. They would

* Captain Mayne, R.N. ("Four Years in British Columbia," p. 256), however, says that they boil and compress into cakes *Lichen jubatus*. Though I never saw them do so, the statement is probably correct. (See also Lauder Lindsay; Journ. Linn. Soc. Bot. vol. ix. p. 413-14.)

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repeat this once or twice, then hand the pipe to another, and lie down almost senseless to sleep off the stupor. I have often heard them say, in reference to the whites, "They waste the *food* by puffing it out; they do not use it properly." In times of scarcity they will smoke the twigs of *Thuja gigantea*, Nutt.; and the bark of *Cornus sericea*, L. (the *bois rouge* of the Canadian voyageurs), is usually mixed with tobacco, even in times of plenty—a habit which the fur-traders have learned from them. The leaves of *Arctostaphylos Uva-ursi*, L., are also extensively used among the Indians and fur-traders all over the American continent, either alone or (more usually) mixed with tobacco, under the Ojibway name of *kinikennick*. Luckily for them, though passionately fond of intoxicating liquors, they have not acquired the art of preparing any. *Acer macrophyllum*, Pursh, contains much juice, but the North-Western Indians have never attempted to make sugar from it, as in the case of *A. saccharinum*, L., in the eastern provinces. The Crees, however, make a sugar from *Negundo fraxinifolium*, Nutt., a plant which probably extends over the Rocky Mountains.

2. *In the Arts and Domestic Economy.*

In the first rank I place the tree I have so frequently spoken of before the Society, *Thuja gigantea*, of which the Indians make many articles for domestic use. I have referred to them before.* There is no birch in North-West America, of the bark of which they could make canoes. It is therefore chiefly of this tree that these elegant craft are manufactured. In some parts of the country they will make them of cottonwood (*Salix Scouleriana*, Hook.), and in Southern Oregon, and elsewhere, the rude "dug-outs" of the natives are made of the heavy trunk of *Pinus ponderosa*.

The bark of the white pine (*P. monticola*) is in like manner used for weaving blankets. The maple (*Acer macrophyllum*) is used for making paddles, hence it is called by the Cowichans *Kammalelep*, or paddle-wood. The vine maple (*Acer circinatum*, Pursh), in like manner, when it can be procured, is used for making bowls, and the

* Trans. Bot. Soc., April 1868.

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Pinus monticola for spoons. *Cupressus Nutkaensis*, Lam., *Thuiopsis borealis*, Fisch., is also used for that purpose among the Tsimpsheans, and for making boxes, the sides and bottoms of which are hollowed out of one piece. The roots of *Abies Menziesii*, Dougl., are used for making hats. I have seen a pack of cards ingeniously imitated on the bark of *Pinus monticola* and *Thuja gigantea*, for gambling purposes. The gambling disks and polished sticks used by many tribes are generally made of *Acer macrophyllum* or *Cupressus Nutkaensis*. Yew (*Taxus brevifolia*, Nutt. = *Lindleyana*, Murr.), is often called, in various languages, "fighting wood," being used to make bows. Much of this yew grows near Mount Shasta in California; and among the Oregon Indians a bow of "Shasta Yew" is as much prized as in Europe used to be a "coat of Milan steel," or a "Toledo blade." The arrows are made of cedar and various species of reeds; though in the North, the former is almost universally used. They have, I may mention, no arrow-poison; but I have known some of the Californian Indians get a rattle-snake (*Crotalus lucifer*, Baird), and irritate it until it had repeatedly struck into the liver of some animal, impregnating it with its virus. They would then dip their arrows into this poisoned mass. All wood is used as fuel, but principally *A. Douglasii*, the branches of which are (in common with other trees) put into a canoe when it is leaking, to keep the loads or paddlers from the water. At their great winter feasts bark is often used as fuel, as it gives out a greater heat.

Pinus contorta, Dougl., from being full of resin, is used as torches by the Indians in salmon-spearing at night, and at their feasts and dancing. The leaves of *Philadelphus Gordonianus*, L., and *P. Lewisii*, Pursh, are used by the natives as a substitute for soap. The *amole* (*Chlorogalum pomeridianum*, Kunth) or soap plant has a bulbous root, which, when rubbed in water, makes a lather like soap, and was much used for washing by the Indians and native Californians prior to the American possession of the country. It is also used for making saddle-mats, &c. Baskets are made of various species of roots, and the neat ornamental boxes sold to the whites are manufactured from some species of Cyperaceæ.

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In California the aborigines make hats and vessels from a grass generally known as the Wire-grass, and coarse mats of *Scirpus lacustris* and other rushes. Bottles are made of the bulbous stipes of *Macrocystis pyrifera*, Ag., the giant tangle of the North-West coast, and used to hold eualachon oil (*Osmerus pacificus*, Rich.), out of which a little is squeezed, every now and then, when required, as a painter squeezes his colours out of a tin-foil tube.* Excellent fishing lines are commonly made from the stipes of *Phyllophora Menziesii*, Ag. The textile plants of the Indians are few, the bark of *Thuja gigantea* supplying the place of most fibrous plants. They can extract a fibre from the stem of the native nettle (*Urtica gracilis*, Ait.), and I saw a fishing-net made of it which the owner valued at $100. Some of the Indians in the Columbia River used to make salmon fishing-nets of the twigs of *Cornus sericea*, L., and the more southern tribes still use the native flax (*Linum perenne*, L.) to make nets, twine, and ropes. Near the Klamath Lake, I saw it growing in such abundance as to suggest the idea of a cultivated field; and a friend has just sent me the following interesting extract from the San Francisco "Bulletin" on the subject of the wild "hemp," which doubtlessly refers to this or an allied plant:—

"A morning contemporary calls attention to the fact, recently verified, that large quantities of native hemp grow in the valley of the Humboldt River, in the State of Nevada, where it is gathered by the Indians, who strip off the bark from the dried wood and make from it very fine and strong nets. The fibre is said to be longer, finer, and stronger than common hemp; longer than flax, and more abundant in proportion to the wood, and more easily separated from the wood than either. It is said, 1000 tons of the stripped fibre can be collected in the Humboldt Valley this season, and its prospective value as a cheap substitute for cultivated hemp is suggested to our cotton and cordage factories. We may add to this interesting statement, a fact within our own observation, that a native hemp is found in many parts of California, especially in the moist bottoms of the Sacramento and San Joaquin Valleys. The early

* Brown in "Pharmaceutical Journal," June 1868.

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Spanish colonists mention that it grew about the Tulare lakes, and was used by the Indians, as on the Humboldt, to make their fishing nets. Its use for this purpose, however, has always been common to the Indians of every part of the State. Some years ago it was quite abundant along the Upper Sacramento. The fibre was long and fine, easily stripped with the fingers from the stalk as it dried in the earth, and very light-coloured. We have seen the Indians twist it into very fine and strong thread, with which they made not only small fish nets, but nets 20, 30, or 40 feet long and nearly as wide, with which they caught wild geese while feeding on the plains. Setting their stuffed geese skins as decoys, the nets are arranged flat behind them with wooden springs, and are sprung over the live geese, when they alight, by concealed Indians. As many as twenty geese were sometimes caught in this way at a single haul. As they struggled to get loose, the Indians rushed forward with sticks and knocked them senseless, when they poked their heads through the meshes. The nets required for this use were of course very strong. When a large net was to be made a number of Indians assembled to assist in its completion—the women being excluded from the sacred circle, though allowed to sit and gossip on the outside. It was enough for them that they were permitted to strip and dress the fibre, sometimes to pound the pinola (pine-seeds)and acorns,and to carry in conical baskets, steadied on their backs by straps bound about their brows, the burdens imposed by their lords and masters. All the work of thread and net-making was done with the fingers, assisted by sticks something like the modern crochet needles; and this does not seem at all strange, when it is remembered that the exquisite cotton fabrics of the Hindus are all made by manual appliances. In the same manner the Indians made from the native hemp some very fine small mats, in which they bound their thick massy hair behind, in a like manner, and with much the same effect, as the fashionable *chignon* of our own day. These hair-nets were variously coloured, ornamented with beads, and pierced with feathers or long sticks, covered with snake-skin. The despised Digger Indian of California may therefore fairly claim to be the inventor of that most astonishing

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article of head-gear now in use among civilised white women. But all this is a digression from the main object of these remarks, which is to suggest the propriety of a practical inquiry concerning the extent and value of the indigenous hemp growth of our State. We do not know if it is still to be found in its old abundance anywhere; perhaps not, since so large a portion of the bottom lands where it flourished so luxuriantly, but not exclusively, has been occupied for cultivation. If it can still be obtained in sufficient quantities, it would certainly be valuable for manufacturing purposes. The excellence of its fibre, for many inferior purposes at least, entitles this suggestion to consideration; and the fact that we have a native hemp of such fair quality, warrants the inference that the cultivated staple could be grown here to advantage. Possibly Indian labour on the valley reservations could be turned to profitable account in gathering and preparing the native production."*

3. *Medicine and Superstitious Rites.*

All medicine with the Indian is superstition, and all superstitions have a bearing more or less on medicine. Medicine is with them a mere piece of pagan empiricism. It is emphatically Napoleon's axiom—more trite than true—putting what we know little about into a body concerning which we know still less. I would have you to guard, however, against the notion that the "Medicine-men" are equivalent to the doctors—not so. They are mere "sorcerers;" and though practising medicine in so far as "legerdemain" and superstition goes, yet the healing art proper is in the hands of old women, who are supposed to be skilful in that way, and large fees are sometimes exacted from the patients. Surgery they know little or nothing about. I know a very celebrated (and also a very brave) chief who had rheumatism of the knee joint. He diagnosed it to be caused by dirt getting in, and accordingly he absolutely proceeded to bore a hole through the patella, in order that he might get a stream of water in to wash out

* Curiously enough, both Pursh (Fl. Am. Sept. 1, p. 210) and Douglas (Hooker, Fl. Bot. Am. 1, p. 106) expressly state, though erroneously, that it is never used by the Indians of North-West America for economical purposes.

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the foul joint. For fractures they use, as we do, splints. On one occasion I was travelling in the Mountains, my only companion an Indian boy, who, at a distance of several miles from the nearest abode of man, fell and snapped the femur. Luckily it was not displaced. With the aid of cedar bark used as paste-board splints, and tearing the boy's shirt into bandages, I managed to adjust the fracture, then raising the boy as well as I could on my back; in this manner the north-western surgeon and his patient took their way, through forests and through swamps, over fallen trees, and crawling along cliffs, and fording swollen mountain streams, until they reached an Indian village, when the patient was committed to more skilful nurses. Aided by a good constitution and wonderfully good luck, the boy recovered; and when last I visited that part of the country I found that he was perfectly well, and that my fame had grown very great in the land. The liber of *Abies Mertensiana* is used as sticking-plaster. Their knowledge of the virtues of plants are, as I have said, merely empirical; but, nevertheless, the plant is used sometimes in acts more honoured in the breach than in the observance. No crime is more common among Indian women than that of procuring abortion. They generally accomplish this by mechanical means, but some species of plants, such as a species of orchid, are also used. From the plant, root, leaves, and stem, is formed a decoction which is drunk by the woman several times a-day, until the effect is produced. It is said to be very effectual. The scrapings of a human skull are used in the same way, and some species of shells are also looked upon, as what old Master Pomet would have called "the sovereignest remedy on earth," for the same purpose. The infusion of the young cones of various pines is thought to be very useful in preventing women bearing children. The roots of a *Geranium* are also used among the Lilloets in British Columbia for the same purpose, and among the Pondéreille Indians the rattles of the rattlesnake are thought to ease labour.

I heard much from the Hudson Bay officers about the virtues of a species of *Valeriana*, called "Kunko" by the M'Leod Lake and other Takali tribes in British Columbia, in rheumatism. The berries of *Symphoricarpus*

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racemosus, Michx., are used about Lilloet for colds. *Berberis Aquifolium*, Pursh, the juice of the *Betula*, *Echinopanax horridum*, Sm., and an infusion of the leaves of *Abies Douglasii*, are all held in great estimation in venereal diseases.* A decoction of the roots of the *Berberis* has long been held in great esteem among the Indian tribes in the north-west, and is equally well-known and valued among the backwoodsmen and frontier miners, hunters, and others accustomed to mingle much among the native races. It is an excellent tonic, and there seems to be some good grounds for this universal appreciation of its properties against syphilitic and other venereal diseases, now becoming so common among the Indians.

I saw the roots of some species of Umbelliferæ (? *Archangelica peregrina*, Nutt.) applied as a poultice to inflammatory swellings with manifestly good effect. A decoction of *Achlys triphylla*, DC., is used as a remedy for pain in the breast; the leaves of *Psroralea physoides*, Dougl., are used as a poultice; the leaves of *Heuchera cylindrica*, Dougl., are bruised, and applied to boils by the Nisqually Indians; *Prunella vulgaris*, Linn., is mixed with grease, and applied to swellings; the roots of *Trillium ovatum*, Pursh, are used as a poultice; and an infusion of the roots of *Polypodium vulgare*, Linn., being sweet, is drunk with the decoction of *Berberis Aquifolium*, formerly referred as a remedy.

An infusion of *Conium maculatum*, L., is used in diarrhœa. One would think that this would be a dangerous drug to meddle with; but still the infusion is mild, and I never heard of any deaths ensuing from its use. They do not use the classical juice in any way. Like all superstitious people, they have "medicines" to produce mental effects, or to make them skilful in their employments. The notion is very old, and is not extinct in Europe yet; while in Africa and other savage countries it is one of the canons of superstition. Shakespeare referred to it in his day. Thus, in Henry IV. (Part 2), the following passage occurs:—

* The roots of *Aralia nudicaulis* are said to be used by the Crees in venereal diseases. They also apply the bruised bark to recent wounds. (Hook. *loc. cit.*; *fide* Richardson, i. 274.)

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"I am bewitched with the rogue's company. If the rascal had not given me medicine to make me love him. I'll be hanged; it could not be else. I have drunk medicines."

A belief in "love philtres" is very prevalent among the Indians. The Tsongeisth girls rub themselves with the roots of the orchid mentioned, to gain the affection of their sweethearts. The roots of the *Erythronium grandiflorum* and *Ranunculus* * are also used with a view to the same end. The roots of a species of Umbelliferæ (? *Conioselinum Fischeri*, Weem. & Grab.) are also used in this superstition by the Tsongeisth. The roots are dried, and then pounded or mixed with some others, put on the garments of the person on whom it is desired to operate, or kept in the mouth of the person who is employing this piece of witchcraft. They have even a plant which is used to make a man cry; but I could never learn what plant produced this lachrymo-poient medicine! They have a medicine to help them to be skilful in killing whales, and even one to simulate virginity!

I do not think the North-Western Indians know of any poisons; though I have heard of some individual who had a box burned near his lodge which contained medicines, with which he threatened to poison the whole family of an unwilling bride if she and they did not yield to the marriage. The infusion of the huge roots of *Megarhiza Oregana*, Torr. & Gray, put in little ponds in the wood, is said to be used to stupify deer which come down to drink, and thus fall an easier prey to the Indians. There used to be a scandal in San Francisco that it formed the principal ingredient in "Stoughton's bitters." Pine gum is continually chewed by the Northern Indian women, and to the use of it may be attributed their beautiful white teeth. The natives make no turpentine, but much is now manufactured in Oregon and California, and an experiment was made in Vancouver Island which promised success.

The Poison Oak (*Rhus Toxicodendron*, Linn.), grows abundantly in many parts of southern Oregon and California. There are several species, but the present one is the most common; and as the effects of all the others are similar, these may be considered under its description. It thrives

* Various species—*R. reptans*, L., *R. occidentalis*, Nutt., &c.

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best on a moist soil, and in the shade. In a thicket, with other bushes, it sends up many of its stalks eight or ten feet high, with large luxuriant leaves at the top. In the shade the leaves are green. In the open dry ground, exposed to the sun, and without support from other bushes, the Poison Oak is a low, poverty-stricken little shrub, with a few red leaves. If it can attach itself to an oak tree, it becomes a parasitic vine, and attains a thickness, though very rarely, of four inches in the trunk, and climbs to a height of forty feet.* It affects the skin of most people in a very painful manner, and the inflammation speedily spreads from one part of the body to another. Some people are so affected that their faces could not be recognised; others (like the writer of this paper) are not affected by it; but instances are not uncommon of persons who have long supposed themselves proof against the poison, but have at last been affected. After once being injured, they are ever afterwards very susceptible to the poison. Even passing to the leeward of a bush on a windy day, or through the smoke of a fire in which it is burning, will "bring the poison to the surface" again. In some parts of California cattle eat it, and are then affected by what is known as the "milk sickness." On breaking a stem of the *Rhus*, a milky fluid is exuded, which is exceedingly poisonous, and, if applied to the skin, will produce effects like that of nitrate of silver—a black welt is produced, which in a few hours becomes sore, destroys the cuticle, which sloughs off, and, upon healing, leaves a circular cicatrix. So poisonous is it, that it pollutes the air where it grows; children, and even grown-up people, who are gathering berries, or otherwise approaching its vicinity, are often badly poisoned. Their faces are frequently swelled until their eyes are shut; the neck, hands, and arms are covered with inflamed vesicles, the cuticle highly inflamed, and not unfrequently constitutional symptoms are observed, resembling those of "milk sickness." The nostrils of cattle grazing amongst it are often covered with pustules. Indeed, its effects upon some people are described as almost approaching to the fabled Upas tree, which that "Puck of Commentators," George Stevens, invented, and Erasmus Darwin handed down to fame in the

* Hittel's California, 103.

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stately verses of the "Botanic Garden." Though known for a long time (there is a paper on it in the "Philosophical Transactions" of last century), it has never been thoroughly investigated.* The Indians seem rarely to be troubled by it, and the native Californians look upon an infusion of *Grindelia hirsuta*, H. and A., a composite plant, as a cure for its noxious effects.†

There may be said to be no rattlesnakes west of the Cascade Mountains, at least north of the Columbia River,‡ though they are sufficiently abundant to the eastward of that range as far north as Fraser River, where I have known several Indians to be bit by them. Their usual plan is to brand the wound, having previously tied a ligature between the heart and the bite, or to push the wounded limb among mud immediately on receiving the poison. It is said that by this means the poison is washed off, and that the person often escapes death. The only effectual cure I have found is drinking immoderately of spirits. I know a gentlemen who was bit once by the well-known copperhead snake of the Western States (Missouri), and twice by rattlesnakes in Oregon, and recovered by this treatment. The country people have innumerable specifics for their bites, but I cannot learn that any of them are reliable. The Indians in Central America have several remedies derived from the vegetable world, and all the tribes north to British Columbia are said to possess some herb or other; but I have generally seen them adopt the treatment given above. In California the leaves of *Daucus pusillus*, Mich., the *Yerba de la vibora*, or "rattlesnake herb" of the Spaniards, are said to be a specific for the bite.

I will conclude these stray notes by an account of the extraordinary effects of the roots of *Clematis Douglasii*,

* *Vide* Dr Isaac Mendhall in the "Cincinnati (U.S.) Lancet and Observer," March 1861; Chase in *Ibid*, May 1861; article in the "Chicago Medical Journal," June and July 1861; Caulfield in "Edinburgh Botanical Society's Transactions," vol. vi. p. 377; "Bigelow's Medical Botany;" and "Farmer," August 1868.

† The frontier settlers, when "stung," apply the pulp of sour milk or a poultice of Indian corn meal to the injured place.

‡ Near Eugene in Oregon, and in various places in Marion County, they are quite abundant, and appear to be indigenous. The statement that they are not found anywhere west of the Cascade is not true. Floods occasionally bring them as low as the mouth of the Columbia, but they soon die in that moist climate.

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Hook., on exhausted horses. It was at a horse-racing of the Nez Percz Indians that it was witnessed. One horse was seen which had fallen down. The Indian put a piece of the root (the outer coat scraped off), into the nostrils of the animal. "The effect was surprising; the creature sprang up under convulsions, and was then brought to the river and bathed, and I found several which had been so treated afterwards grazing with the herd, apparently without having sustained any injury." *

What I said in the introduction to these stray notes, I may now say in conclusion, viz., that they are by no means complete, especially in the latter section. An Indian "sorcerer" or doctor will search for a whole day for the proper plant; and however ridiculous we may look upon their virtues, they think otherwise, and naturally are in no way willing to ventilate the secrets by which they earn large fees. I know one woman who got five blankets, worth about L.2, 10s. for allaying a very simple swelling. They may, however, serve as examples of the superstitions of a fast-dying off race.

V. *Report on the Open Air Vegetation at the Royal Botanic Garden.* By Mr M'Nab.

At the last meeting of the Botanical Society (9th April 1868), I stated that vegetation had gone on at the same rapid pace as it had done during the previous months, most plants being from three to four weeks in advance of ordinary seasons. The weather since last meeting has been comparatively mild, with the exception of the 10th, 11th, 12th, and 14th April, when the morning temperatures fell respectively to 30°, 27°, 31°, and 28°; also on the 6th of May, when the thermometer again indicated 28°, all other morning temperatures varying between 35° and 48°. This last frost has done considerable damage to the young growths of many of the Sikkim Rhododendrons, while the hybrid varieties are apparently untouched. During the past month the progress made by many of the trees and shrubs is remarkable, and, for my own part, I have never seen so many of them in flower during the month of April as have been observed

* Geyer; Hook, Journn. Bot. vi. 66.

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this year. Amongst them may be recorded lilacs, laburnums, thorns, particularly *Cratægus præcox* and *C. Oxyacanthoides* (the last being in full flower on the 22d April), also the perfumed cherry (*Prunus Mahaleb*), double flowering cherry, Gean, *Wistaria sinensis*, *Robinia Caragana*, numerous species of Cytisus, *Azalea pontica*, &c. Many herbaceous plants are also far advanced when compared with former years. The lily of the valley, for instance, which in this part of the country is rarely seen in flower in open borders before the end of May, was partially in bloom this year on the 1st of May. At the present date (14th May) the horse-chestnut, double, single, and scarlet thorns, bird cherry, service trees, *Rhododendron catawbiense* and *R. ponticum*, Ghent azaleas, with many others, are now in flower—kinds rarely seen in bloom before the end of May, and in this part of Scotland generally not sooner than the beginning of June. However, locust trees, deciduous magnolias, tulip trees, hop and common hornbeam, Catalpa tree, liquidamber, walnut, *Platanus occidentalis*, deciduous cypress, with many oaks, chiefly the American varieties, also ash, and some varieties of beech, are not much further advanced than during ordinary seasons. As a rule, it may be stated that most of the North American trees are generally the last of coming into leaf.

The strong and continued north-westerly gales during the month of April have done considerable damage to many of the forest and ornamental flowering trees, particularly those kinds where the foliage was early developed, the western side of many being nearly leafless, or with scanty foliage, while the eastern side is full of foliage, and of a rich green colour. This is particularly remarkable in limes, horse-chestnuts, birches, sycamores, geans, and larches. In the case of thorns, many of the trees, where much exposed, are perfectly brown on the western side, while the east side is green, and now flowering abundantly.

VI. *Miscellaneous Communications.*

Mr M'Nab stated that, since the formation of the new Arboretum on the ground recently added to the Royal Botanic Garden, the Coniferous section has received some

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large and important additions. Messrs P. Lawson & Son, with a liberality characteristic of their firm, have presented 130 coniferous plants, consisting of 32 specimens of the genus Abies, 22 of Cupressus, 22 of Biota, 10 of Picea, 10 of Juniperus, 10 of Taxus, 7 of Thuja, 7 of Pinus, 3 of Cedrus, 3 of Retinospora, 2 of Thujopsis, 1 of Cryptomeria, and 1 of Dacrydium. Messrs P. Robertson & Co. have likewise presented a collection of the genus Pinus, consisting of 18 species and varieties, all strong established plants. Messrs Rollison & Son, of the Tooting Nursery, Surrey, have sent 6 plants of their new upright *Juniperus excelsa;* and Mr Thomas Methven, of the Leith Walk Nurseries, has presented a plant of the variegated *Wellingtonia gigantea.*

Professor Balfour stated that, while lately on a visit at Monzie Castle, in Perthshire, he had taken the measurements of several old larch trees growing in the neighbourhood. One trunk measured, at 2 feet from the ground, 21 feet 4 inches in circumference, and at 4 feet, 17 feet 8 inches; diameter, 6 to 7 feet, and spread of branches from 40 to 50 feet. Another tree, measured at 4 feet from the ground, 13 feet 8 inches in circumference, and 4½ feet in diameter.

Rev. Mr Macmorland of Minto sent specimens of *Anemone ranunculoides,* which he had found growing in quantity in Minto woods. Dr Macdonald of St Andrews sent a fasciated branch of *Daphne Laureola* from Kilcarne House, County Meath.

R. H. Alcock, Esq., sent sections of stems of Bignoniaceous plants, which had been sent to Liverpool surrounding bales of cotton, from Paraiba, in the manner of ropes.

Dr Haynes presented specimens of Polyanthus, with the calyx developed as ordinary leaves.

Mr Curle, Melrose, presented specimens of *Veronica Buxbaumii,* collected in that district.

Mr J. F. Robinson presented specimens of rare British mosses.

Professor Parlatore of Florence presented to the Museum cones of *Pinus Mughus, P. Koraiensis, P. densiflora, Chamæcyparis obtusa, C. pisifera, Callitris quadrivalvis, Torreya nucifera,* &c.

Mr M'Nab placed on the table a collection of alpine

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plants, in flower, including *Tulipa persica* and *Narcissus dubius*, which have lately been presented to the Garden by Messrs P. Lawson & Son.

Mr Stark exhibited a growing plant of *Fritillaria Kamschatica*.

11*th June* 1868.—William Gorrie, Esq., Vice-President, in the Chair.

The Secretary laid on the table a letter from the Secretary of State, in reply to the loyal Address which the Society had forwarded to Her Majesty the Queen, and which she has been graciously pleased to accept.

Professor Balfour intimated the death of Mr William Ivory, who had long taken a warm interest in the Society, and at whose hospitable mansion of St Roque many of the members had met on several occasions to inspect the trees and shrubs which ornamented the grounds. Mr Ivory was an early supporter of the Caledonian Horticultural Society, and took much pleasure in cultivating rare plants. He was long a member of Council of the Botanical Society, and his loss will be severely felt.

The following Communications were read:—

I. *On the Reproduction and Cross Fertilisation of Passifloras.* By Mr Robertson Munro. Communicated by Mr Sadler.

It is well known that many species of Passiflora seldom produce fruit when impregnated with their own pollen, and yet they do so frequently when impregnated with pollen taken from another species or even distinct genera. Many self-impotent species are found capable of producing ovaries by merely dusting their anthers with pollen taken from such distinct genera as Disemma or Tacsonia, although when thus fertilised the ovaries either drop off prematurely or very rarely contain any seed. With a view of further illustrating such singular phenomena, I have, through the

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kindness of Professor Balfour, the honour to lay before the Society an account of various experiments performed by me during several years in the Royal Botanic Garden of Edinburgh, and in the Nurseries of Messrs P. Lawson & Son. My attention was first directed to the subject in consequence of a self-impotent species (*Passiflora alata*), being cultivated at Keith Hall for several years without showing the least sign of fertility, although grown under the best possible treatment. Hundreds of flowers have been impregnated from time to time on this plant, with its own pollen, but in no single instance has the gardener (Mr Donaldson) been able to induce it to "set" a single fruit. In the Botanic Garden of Edinburgh there is a plant in the same condition. Many experiments have been tried to induce this plant to produce fruit, but if self-impregnated, failure has been the invariable result. As a curious experiment, I got pollen of the Keith Hall self-impotent species, and impregnated a few flowers on the self-impotent plant at the Botanic Garden; the result was the production of three ovaries, one of which arrived at maturity, and contained a large number of perfect seeds. Seedling plants from this union flowered in the garden in 1864. I impregnated a considerable number of these flowers with their own pollen, every one of which proved abortive. But on impregnating eighteen flowers on the mother plant with pollen from her own self-impotent seedlings, I got eighteen fine plump ovaries full of seed! This remarkable fact has already been published by Mr Darwin, as well as some interesting facts communicated to me by Mr Donaldson, gardener at Keith Hall, showing the very singular circumstances by which *P. alata* was rendered self-fertile at Taymouth Castle by being grafted on another species. Seedling plants obtained from this grafted *P. alata* were found by Mr Donaldson to be irretrievably sterile, not only when fertilised with its own pollen, but also when impregnated with pollen of the self-impotent *P. alata* previously referred to.

In order to test the fertility of *P. alata*, as well as other species of Passiflora when crossed, I began by impregnating eight flowers of *P. alata* with pollen of *P. cærulea*, and had five fine ovaries full of seed, which germinated freely when

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sown. Six flowers of *P. alata*, impregnated with *P. racemosa*, proved abortive, but conversely nine flowers of *P. racemosa* impregnated with *P. alata* produced five ovaries full of seed. Eight flowers of *P. alata*, impregnated with *P. macrocarpa* (evidently a variety of *P. quadrangularis*, and like that species perfectly fertile when impregnated with its own pollen), yielded four fine ovaries full of excellent seed. Six flowers of *P. alata*, impregnated with *P. Kermesina*, proved abortive; but two flowers of *P. Kermesina*, impregnated with *P. alata*, produced two ovaries which contained no seed. I may here observe that many species, as well as hybrid Passiflora's, are often found destitute of pollen; but I have invariably found species thus rendered self-impotent from the imperfect development of their reproductive organs could easily be excited to produce seed when impregnated with good pollen. Eight flowers of *P. alata*, impregnated with *P. Loudoniana*, proved abortive; two flowers of *P. alata*, impregnated with *P. fulgens*, proved abortive; six flowers of *P. alata*, impregnated with *P. Belottii*, proved abortive; four flowers impregnated with *P. Newmanii*, yielded one ovary containing good seed; eight flowers of *P. alata*, impregnated with *P. palmata*, proved abortive; two flowers of *P. alata*, impregnated with *P. cardinalis*, produced no fertile ovaries. On *P. racemosa* I impregnated thirty-eight flowers with its own pollen, but failed to get a single fertile ovary. Nine flowers, *P. racemosa*, impregnated with *P. alata*, produced five ovaries full of seed; fifteen flowers of *P. racemosa*, impregnated with *Tacsonia pinnatistipula*, produced six ovaries, which dropped off before they arrived at maturity, and contained no seed; five flowers of *P. racemosa*, impregnated with *Tacsonia mollissima*, yielded two ovaries, which arrived at maturity, but contained no seed; sixteen flowers of *P. cærulea*, impregnated with their own pollen, proved abortive. A plant at Trinity Cottage, however, has frequently produced plenty of fruit, but on dissecting a great number of ovaries I found that they contained no seed, nothing but the seed walls being developed. Four flowers of *P. cærulea*, impregnated with *P. racemosa*, produced one ovary which arrived at maturity, but contained no seed; six flowers of *P. cærulea*, impregnated with *Tacsonia pinnatistipula*, proved abortive;

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ten flowers impregnated with *T. mollissima*, yielded eight ovaries, which dropped off at an early stage, and contained no seed. *Passiflora Belottii* proved abortive when impregnated with its own pollen, and also with the following species:—*P. alata*, *P. cœrulea*, *P. palmata*, *P. Kermesina*. I have tried this species at different hours of the day, but I have not yet been able to induce it to yield a single ovary. Six flowers of *Tacsonia pinnatistipula*, impregnated with its own pollen, produced six ovaries full of fine seed. Three flowers, impregnated with *T. mollissima*, produced one ovary which arrived at maturity. It contained a few apparently good seeds, none of which, however, germinated when sown. Sixteen flowers of *P. Kermesina*, impregnated with its own pollen, proved abortive. Two flowers, impregnated with *P. alata*, yielded two ovaries which contained no seed. Twenty-three flowers of *P. holosericea*, impregnated with its own pollen, proved abortive. Seventeen flowers, impregnated with *Tacsonia mollissima*, produced twelve ovaries, which arrived at maturity, but on dissection I found they contained no seed. On *Passiflora fulgens* I impregnated three flowers with its own pollen, but failed to get an ovary. Fifteen flowers of *P. cardinalis*, impregnated with *P. alata*, proved abortive. Three flowers, impregnated with *P. palmata*, proved also abortive. One flower, impregnated with *P. Loudoniana*, has produced an ovary which I fear will not contain seed.

On a hybrid passiflora between *P. alata* and *P. racemosa* (*P. alata* being the mother) I impregnated six flowers with *P. alata*. This union produced six ovaries, some of which dropped off in three weeks, but three remained until nearly mature; these, however, contained no seed. I tried the same plant with pollen of *P. cœrulea*, but failed to get an ovary.

Specimens of the following species and hybrids were laid on the table:—*Passiflora alata*, *P. cœrulea*, *P. Loudoniana*, *P. fulgens*, *P. cardinalis*, *P. Kermesina*, *P. racemosa*, *P. laurifolia*, *P. Houletii*, *P. macrocarpa*, *P. Newmanii*, *P. palmata*, *P. Belottii*, *P. edulis*, *P. alata* crossed with *P. cœrulea*, *P. alata* crossed with *P. racemosa*, *P. alata* crossed with *P. macrocarpa*, *P. alata* crossed with *P. Newmanii*, also *Tacsonia pinnatistipula* and *T. mollissima*.

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II. *On the Characters of the Akazga Plant, and the difference between the Structure of its Stem and that of* Strychnos Nux-vomica. By Thomas R. Fraser, M.D., F.R.S.E., M.R.C P.E., Assistant to the Professor of Materia Medica in the University of Edinburgh. (Plate VII.)

We have been indebted, within recent years, to several travellers in West Africa for interesting accounts of the properties of a poisonous plant called akazga, which is extensively used as a judicial ordeal. The chemical characters of this poison were examined, in 1862, by Messrs Attfield and Simmonds. The results obtained by these gentlemen were, however, unsatisfactory, as they had only a small quantity of akazga at their disposal; but they supposed that they obtained indications in it of the presence of strychnia. Its physiological action was investigated, in 1866, by MM. P cholier and Saintpierre, and found to be very similar to that of nux-vomica.*

Some specimens of akazga were lately sent to Scotland by the Rev. A. Bushnell, of Baraka, and these were given to me for examination by Mr Thomson, of Glasgow. I am also indebted to these gentlemen, and to Dr Nassau, of Bonita, for the very interesting and trustworthy information they have supplied regarding the employment of the ordeal; by which, principally, I am enabled to communicate the following particulars to this Society.

The poison is known among the various tribes who employ it as *akazga*, *boundou* (or *m'boundou*), *ikaja*, and *quai*. Akazga is probably derived from *nkazga*, which signifies pain or hurt. It is employed as an ordeal on the West Coast of Africa, in a district which extends for a considerable distance north and south of the equator and many miles inland, and also in the adjacent island of Corisco. Witchcraft is believed in almost universally over Africa as the cause of all deaths, of unexplainable misfortunes, and of many crimes; and to detect the sorcerer this poison is employed. The supposed sorcerer is obliged to drink a certain quantity of the infusion prepared from

* Comptes Rendus, 1866, p. 809.

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the bark, and to step over a number of akazga sticks placed parallel to one another at the distance of two feet. If this be done, the person tried is pronounced innocent; if guilty, difficulty is experienced in stepping over the sticks, they appear like large logs, to surmount which suitable efforts are made, and these are rendered more and more difficult by spasmodic muscular twitches, until the victim staggers and ultimately falls in tetanic convulsions. If the poison do not now immediately prove fatal, the knives and clubs of the onlookers quickly free the tribe of the supposed sorcerer. In those cases in which the trial is successfully undergone, a copious flow of urine is described as occurring, and by this means the poison is supposed to be removed.

The akazga was sent to me in bundles which consisted of long, slender, and crooked stems, having their roots generally attached to them, but sometimes their leaf-bearing branches only, and containing also a few complete plants, with roots, stem, and branches. I have also recently obtained a few seeds, the greater number of which, however, have germinated and possess radicles six or eight inches in length.

The plant is ususally about six feet in length; but some specimens were only four, and others as long as eight feet. They have generally a diameter of half-an-inch, and this varies from a quarter to one inch. The bark is of a yellowish orange colour, and in some parts light red; and over it a grey efflorescence is frequently found. A few of the stems are of a dark-brown colour, with numerous yellow tubercles. The bark adheres firmly to the stem, but it can be readily detached after exposure to a gentle heat for some days. Its internal surface is light brown.

The wood is dense and hard throughout, the plant being apparently of very slow growth.

The leaves are opposite, and oval-acuminate in form; the apex frequently consisting of a linear prolongation more than an inch in length. They have five parallel ribs, three of which are prominent. The leaves vary greatly in size. The majority are from three to six inches in length, and from one and a-half to two and a-half in greatest breadth. A few, selected at hazard, had the

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following dimensions in inches:—$5 \times 2\frac{1}{8}$, $6\frac{1}{2} \times 2\frac{1}{4}$, $5 \times 1\frac{3}{4}$, 5×2, $5\frac{1}{2} \times 1\frac{3}{4}$, $7 \times 2\frac{1}{8}$, $6\frac{3}{4} \times 2\frac{3}{4}$, $2\frac{3}{4} \times 1\frac{1}{2}$, $5\frac{5}{8} \times 3\frac{1}{2}$, $7 \times 2\frac{1}{2}$, $8\frac{1}{2} \times 4$, $6\frac{1}{4} \times 1\frac{7}{8}$, $3 \times 1\frac{3}{4}$, $4 \times 2\frac{1}{2}$, $3\frac{1}{2} \times 2$, $11 \times 4\frac{1}{2}$, $6 \times 1\frac{3}{4}$, 4×2, $12\frac{1}{2} \times 5\frac{1}{8}$, 5×2.

The characters of the seed cannot be accurately determined from the specimens in my possession, as the non-germinated ones appear to have been injured by exposure. It seems to have a globular form, with two somewhat flattened sides, and to vary in size from $\frac{5}{8}$ to $\frac{6}{8}$ of an inch in greatest diameter. Its external surface is covered with a downy layer of long hairs, but it does not present the velvety appearance that characterises the seed of nux-vomica. The albumen is easily split into two halves, between which the embryo is found furnished with two five-ribbed, oval-acuminate cotyledons.

The bark has a strongly bitter, faintly aromatic taste, and a distinct bitterness may also be perceived in the wood, leaves, and seed.

These general characters at once suggested that this plant is one of the Loganiaceæ; but with the materials in my possession, it was impossible to identify it. Professor Balfour kindly placed at my disposal a large collection of West African plants, and with his assistance and that of Professor Dickson these were compared with the akazga, but we found nothing that exactly corresponded with it. Professor Oliver, of Kew, who is intimately acquainted with the flora of West Africa, also examined some of my specimens, and considers that there is great reason to suppose that the plant is undescribed.

The results I have obtained by a chemical examination of this poison appears to support Professor Oliver's opinion; and, if it be proper to be guided by the nature of the physiological action of substances derived from a plant, I believe there can be little doubt that akazga will be found to be a new species of *Strychnos*. I have separated from it, by a process that has been elsewhere published,* a crystalline alkaloid which closely resembles strychnia, but which is readily distinguishable from it. For this alkaloid I have proposed the name *akazgia*, derived from akazga, apparently

* Proceedings of the Royal Society of Edinburgh, 1866-67, No. 73, p. 159; and "British and Foreign Medico-Chirurgical Review," July 1867.

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the most usual as it certainly is the most euphonious of the synonyms of this ordeal. Akazga is principally distinguished from strychnia by a difference in its equivalent, by being precipitated from solutions of its salts by the *bicarbonates* of sodium and potassium, and by the comparative difficulty of obtaining it in a crystalline form. It agrees with strychnia in possessing those colour reactions that have been hitherto regarded as characteristic of that alkaloid, and in producing the same physiological effects.

I have endeavoured still further to ascertain the differences between akazga and nux-vomica by examining the miscroscopic anatomy of their stems. The following descriptions indicate the principal characters of these:—

Akazga. (Plate VII. figs. 1 and 2.)

The *pith* consists of complete parenchyma. Its cells have, in transverse section, a more or less regularly hexagonal form, and, in longitudinal section, they present the appearance of four-sided parallelograms. Their transverse diameter varies from $\frac{1}{500}$th to $\frac{1}{1500}$th of an inch, being usually, however, about $\frac{1}{800}$th; while their longitudinal diameter is from $\frac{1}{400}$th to $\frac{1}{600}$th of an inch. The majority of the cells are indurated and marked by radiating canals. A few non-indurated cells occur irregularly throughout the pith, and these contain starch granules.

The *wood-cells* have pretty constantly a diameter of $\frac{1}{2000}$th of an inch, and are greatly indurated, the cavity being so much reduced in size as to appear, in cross-section, like a point. Such a section also shows that the wood-cells are divided into irregular four-sided groups; *firstly*, by numerous medullary rays, which vary greatly in thickness —some consisting of only one layer of cells, and others of three or four; and, *secondly*, by portions of concentric rings, which consist of plates of parenchyma placed at right angles to the medullary rays. The *dotted ducts* are almost invariably placed within these parenchymatous plates. They are nearly circular in form, though sometimes compressed radially, and, at others, concentrically; and they vary in diameter from $\frac{1}{300}$th to $\frac{1}{1000}$th of an inch, usually, however, being about $\frac{1}{500}$th. Longitudinal cylindrical tracts of delicate parenchyma surround the pith, and occur

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also in various portions of the wood. In the latter situations, these tracts vary from $\frac{1}{100}$th to $\frac{1}{160}$th, and, in the former, from $\frac{1}{30}$th to $\frac{1}{80}$th of an inch in diameter.*

The cells of the medullary rays and of the concentric plates of parenchyma are filled with starch granules of moderate size (about $\frac{1}{4000}$th of an inch in greatest diameter) and of irregular oval forms, which seem identical in appearance with the starch granules in the non-indurated pith cells.

The corky layer and cellular envelope of the *bark* are moderately developed. In the endophlœum the development of bast cells is very slight, only a few isolated bast cells being seen in cross-section. Immediately internal to these, however, there is a distinct layer, about $\frac{1}{400}$th of an inch thick, and three or four cells deep, of indurated parenchyma, the cells of which are small and of various shapes, and exhibit radiating canals.

Strychnos Nux-Vomica. (Plate VII. fig. 3).

The *pith* is only slightly indurated ; and, in the sections examined, its cells almost invariably contain starch granules—a very few nearly perfectly indurated cells are, however, present. These cells vary considerably in diameter, some being met with of $\frac{1}{2000}$th of an inch, and others of $\frac{1}{800}$th. The majority of the smaller cells occur at the circumference of the pith.

The *wood-cells* are of the same character as those of akazga. The cylindrical tracts of delicate parenchyma are, however, larger, and much more numerous than those in akazga.

The *dotted ducts* are also more numerous, and, in place of being arranged singly or in groups of two or three, they frequently occur in groups formed of radial lines of five or six. In consequence, apparently, of this great development in the number of the dotted ducts, the wood of nux-vomica is divided into much smaller masses than that of akazga.†

* Similar tracts of parenchyma have been observed by Professor Oliver in *Strychnos toxifera* (Oliver, "On the Stem of Dicotyledons;" *Nat. Hist. Review*, vol. ii. 1862, p. 317.)

† This structural character of nux-vomica is apparent on simple inspection of a cross-section.

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The general botanical characters of the akazga plant, the minute anatomy of its stem, the nature of its poisonous action, and the chemical and physiological properties of the alkaloid that it contains, are, therefore, sufficient to show that it is nearly allied to *Strychnos Nux-vomica;* but they are also sufficient to distinguish it from that plant. It will be interesting to see how far this opinion is confirmed when an opportunity is obtained for examining its floral structure, and thus ascertaining its affinities with certainty.

In the parcels of akazga I received there were a few leafless stems, which were found to contain an immense number of sparkling crystals beneath the bark. These stems also differ from the others in the exterior of the bark having a more smooth appearance. A microscopic examination of the stem revealed the following characters:—

The *wood* has the same general structure as that already described as belonging to akazga, the wood-cells being greatly indurated, and the medullary rays being arranged in the same manner. The cross-plates of parenchyma in connection with the dotted ducts are, however, shorter in cross-section, hardly extending beyond the immediate neighbourhood of the dotted ducts.

The *pith* contains very few indurated cells.

In the inner portion of the *bark*, and also in the longitudinal cylindrical tracts of delicate parenchyma traversing the wood, a number of prismatic crystals, terminated in domes, occur. These are arranged longitudinally to the stem. *There is no layer of indurated parenchyma in the bark.*

Guided by these characters, Professor Dickson—who had kindly interested himself in the subject—pronounced that these were not stems of akazga. I was at first unwilling to adopt this opinion, but a physiological and chemical examination has now convinced me of its correctness; for the bark of these stems is perfectly inert, and the alcoholic extract that is obtained from it does not possess the well-marked chemical reactions of that obtained from akazga.

Fig. 4 represents a cross-section of one of these stems, and, in the absence of any means of identifying the plant, I have, meanwhile, designated it *False Akazga.*

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Explanation of Plate VII.

Fig. 1. Transverse section of large stem of Akazga, showing a portion of the wood and the bark.

Fig. 2. Transverse section of small stem of Akazga, extending from pith to bark.

Fig. 3. Transverse section of stem of Strychnos Nux-vomica, extending from pith to bark.

Fig. 4. Transverse section of stem of "False Akazga," showing a portion of the wood and the bark.

The following lettering applies to all the figures:—*m*, pith; *m r*, medullary ray; *w*, woody tissue; *d*, dotted duct; *c pl*, cross-plate of parenchyma in wood; *l t*, longitudinal tract of delicate parenchyma; *b*, bark; *l*, liber-cell; *ind*, indurated layer of endophlœum.

III. *Notice of Poisoning of Goats by Rhododendrons.* By Mr P. S. Robertson.

The author remarked that on 25th April 1868 he had two goats in a yard, loose and in perfect health—one about four years old and in kid, the other two years old and not in kid. About six o'clock that afternoon, a large armful of branches which had been that day cut from plants of *Rhododendron ponticum, hybridum* (the common purple-flowered variety), grown for game cover in nurseries, was given to them. Both animals began freely to eat the leaves and softer parts of the branches, and by next morning the most of them were consumed. About ten o'clock the following forenoon, the old goat was observed to stagger, and when attempting to move fell backwards, as if all power had left the hinder parts. Towards evening, and for the next four days, the animal could not rise at all. It cried piteously, and a large discharge of greenish yellow matter flowed from the mouth. The lips were swollen, appeared whiter than usual, and were turned outwards from the jaws. The eyes, for the first three days, were very full, enlarged, and protruded, but after that they became dull and partially closed, and the animal lay with its feet stretched out as if dead. It seemed pleased when handled, especially when the belly was well rubbed. It was not seen to eat anything for four days. After that, about a pint of gruel, made with water and milk, was given to it from a bottle, and for four or six days this was continued, with the addition of a pint of

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Bass's bitter beer in the forenoon, and a glass of good whisky in the afternoon among the gruel. The effect of the stimulants was very decided. After the second dose the bowels were moved, and the poor creature began to lift its head, look back upon itself, and seemed to get relief. It was fourteen days before it could again stand or eat grass and ordinary food. It lost flesh very much, and parted with its kid (about three months grown) ten days afterwards. It ultimately got quite well. The other animal vomited freely from the very first, and did not entirely lose the use of its legs, but had the same ghastly look about the eyes and mouth as the other, and staggered much backwards when it tried to walk. It got well in six days after eating the rhododendrons, but lost flesh as much as the other.

Dr Cleghorn stated that the poisonous properties of the young leaves of *Andromeda ovalifolia* were well known to the shepherds of the north-west Himalaya, and the following note, contributed by him to the "Journal of the Agricultural and Horticultural Society of India," vol. xiv. 1867, is reprinted for information:—

On the Poisonous Properties of Certain Species of Andromeda.

"It is instructive to note every fact illustrating uniformity of action pervading a family of plants; it may, therefore, be useful to direct attention to the following passage in the "Gardeners' Chronicle" of 17th March 1866, page 256, describing the poisonous effects upon a flock of sheep of *Andromeda floribunda*, a shrub introduced into England:—'Mr Deacon of Mapledon has recently lost no fewer than eighteen sheep through their eating a poisonous shrub. It appears that a short time ago the gates leading into the pleasure grounds were left open, and thirty-eight sheep which were grazing in a field near strayed into the grounds, and while there they ate ravenously of *Andromeda floribunda*, a most poisonous shrub from North America. Mr Hewitt, the bailiff, at once treated the sheep, thirty-seven of whom showed symptoms of poison, and then called in Dr Gregory, and under their united treatment nineteen of them recovered.'

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"To those who have lived at any of our Himalayan stations, it is probably known that the young leaves of the *Andromeda ovalifolia* poison goats; the deleterious action was first alleged by Doctor Wallich, who figured this tree in the 'Asiatic Researches,' vol. xiii. p. 391, giving a communication from Dr Govan, then (1820) superintendent of the Botanic Garden at Saharunpore. 'Your *Andromeda ovalifolia* occurs first on the hills between Nahun and Sabhatoo, at an elevation of about 5000 to 8000 feet, after which it becomes rare and soon disappears entirely. It is called *Aiaar* or *Airee*, and grows to a tree of 20 to 40 feet in height; the bark of the stem and older branches is much cracked and rough, that of the former almost suberose. With regard to its use, the same opinion prevails here as in Sirinagur, an infusion of the bruised leaves in water being considered a specific against cutaneous complaints of a herpetic nature both in the human species and in cattle; its operation is said to be attended with considerable pain. Sheep and goats eat the leaves which, when young, produce soporific and deleterious effects on them. When used as litter, they are said to destroy insects in the stalls of the cattle.'

"The tradition of the poisonous character of the *Andromeda* prevails everywhere from Nepal to Khagan, and I have myself seen the stimulant and deleterious effects produced on sheep and goats both at Simla, where the tree is known as *Ayar*,* and at Dhurmsalla, where the vernacular name is *Eliyoon*. The tree is common along the whole outer range of North-West Himalaya, and is usually associated with *Rhododendron arboreum* and *Quercus incana;* the wood is used for the manufacture of charcoal. In the valley of Khagan, the local name is 'Ratankat,' which signifies 'blood killer.' At one of the hill sanitaria, a municipal commissioner proposed that all the trees of this species should be cut down, on account of the injurious effect upon sheep imported from the plains.

* In Nepal *Angier*, perhaps from the Sanscrit "*androgyukar*," causing sickness, the young leaves being very poisonous to sheep and goats. The honey is also considered very deleterious.—Madden in *Jo. As. Soc. Beng.*, vol. xvii. p. 365. *Andromeda ovalifolia*, Wall., is the *A. capricida* of Hamilton's MS., and *Pieris ovalifolia* of Don's. Gard. Dict. iii. p. 832.

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It is remarkable that the young shoots only are deleterious; the old leaves are not poisonous, and the sheep of the hills do not appear to suffer.

"In the Diary of Major Marshall, when passing through Sirmoor in the outer Himalaya, 1827, the following passage occurs:—'Our flock, but especially the goats, were affected with a violent vomiting, occasioned by their eating a shrub which grows about pointed out to us by the zemindars, who call it "Oowar." They gave them water, which cured some of them.'—*Calc. Jour. Nat. Hist.* vol. vii. p. 544.

"The Rhododendron tribe exhibit more or less of these deleterious properties. Thus *R. ponticum*, *maximum*, *ferrugineum*, *chrysanthemum*, are poisonous to cattle which feed upon them; *Ledum latifolium*, more stimulant, is used as tea (Labrador tea), but determines to the head; *Kalmia latifolia* is accounted poisonous, honey collected by bees feeding on it is of a deleterious nature, as is that of *Azalea pontica.*—Royle's Ill. p. 259. On referring to Dr Torrey's Flora of New York, which contains much useful information regarding the properties of North American plants, I find the following remarks upon species of this family:—

"*Andromeda mariana*, Kill Lamb, or stagger bush. It is supposed to be poisonous to lambs and calves, producing a disease called the staggers.

"*Kalmia angustifolia*, Sheep Laurel. This plant is believed to kill sheep and other animals. In some places it is called *Sheep poison* and *Lamb Laurel.*"

IV. *Miscellaneous Communications.*

Mr John Sim, Perth, sent an account of an excursion he had recently made to Derry Island, in the Tay, and enumerated the principal plants he met with.

Professor Balfour intimated that Charles Jenner, Esq., President of the Society, had offered the following prizes for collections of dried specimens of British plants:—

Prizes to Gardeners.—1st prize, L.5; 2d, copy of "Loudon's Encyclopædia of Gardening;" 3d, copy of "Balfour's Class Book of Botany." The collections to consist of flowering plants and ferns, and to contain not less than 400 correctly-named species. The plants must be gathered

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between 1st July 1868 and 30th September 1869, and within a radius of ten miles of the competitor's residence. The collections to be sent in on or about 1st October 1869. Further particulars regarding these prizes may be had on application to Mr Jenner, Easter Duddingston Lodge, or at the Royal Botanic Garden, Edinburgh.

Prizes to Students.—A gold medal and a silver medal for the best and approved collections of plants made in any little explored alpine district of Scotland, during the months of August and September 1868, to be accompanied by a report of the district visited.

Professor Balfour reported that the Maharajah of Jeypore had offered a prize of L.25 to the Botanical class for the best series of models illustrating any of the organs of plants. The models to become the property of the Maharajah, and to be deposited in the public museum at Jeypore.

Professor Balfour submitted a report by Dr Thomas Anderson, on the progress of Cinchona cultivation at Darjeeling in India; he also referred to a description and figure in the Botanical Magazine (tab. 5714) of *Erythronium giganteum*, taken from a plant which had recently flowered in the Edinburgh Botanic Garden.

Dr Fraser sent specimens of *Hypnum bambergeri*, a moss new to the British flora, which he had collected last autumn on Ben Lawers. Mr Wm. Shaw sent specimens of *Daltonia heteromallum*, collected in Berwickshire. Mr Allan Coldstream sent living plants of *Primula scotica* and *Scilla verna* from Sutherland. Mr William Ferguson of Colombo presented specimens of *Hymenophyllum exsertum* (Wall) from Ceylon.

Messrs J. G. Gilmer & Co., Leith, presented to the Museum sample of "Extrait pernod" (a new patent extract of madder for reds and purples), along with a framed card of specimens of calico-printing and dyes from it.

Dr Balfour laid on the table two of a series of monographs by M. Baillon, illustrating the natural orders of plants. He also noticed the publication of a work by Miss Fanny Sharsley on the Flora of Melbourne.

Mr M'Nab placed on the table a collection of alpine and other interesting plants in flower.

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9th July 1868.—Isaac Anderson-Henry, Esq., in the Chair.

The following Gentleman was duly elected a Resident Fellow of the Society:—

W. A. Anderson, Esq.

The following Communications were read:—

I. *Biographical Notice of the late Dr Walker-Arnott, Regius Professor of Botany in the University of Glasgow.* By Dr Hugh Cleghorn, F.L.S.

George Arnott Walker-Arnott was born at Edinburgh on the 6th February 1799, but his early years were chiefly spent at Edenshead and Arlary, on the borders of Fifeshire and Kinross. He attended the parochial school at Milnathort when at Arlary, and also received instruction from the tutor of the sons of Mr Cheape of Wellfield. He was not considered a quick boy, partly owing to his modest, retiring disposition, but he was a persevering student; and when the subject specially interested him, he sifted it to the bottom, an excellent memory enabling him to retain what he learned. His docile, kind disposition, and his earnestness in study, made him a great favourite with his teachers; but "he took little or no part," writes Dr Wight, "in the wilder school sports, and but little more in the quieter ones."

In the year 1807 he went to the High School of Edinburgh, where he was the pupil of Mr Ritchie and Mr Pillans. Among his contemporaries may be mentioned Professor Christison; Mr Mark Sprot of Garnkirk; Mr David Syme, Sheriff of Kinross; Dr Robert Wight, F.R.S.; and Dr Wm. Jameson, surgeon, Professor of Natural History at Quito. He was in the habit of carefully registering in a note-book the career of his school-fellows, in whose fortunes he cherished through after life a deep and abiding interest.

Mr Arnott entered the Arts Classes of the Edinburgh University in 1813, and obtained a distinguished place both in languages and in mathematics, attracting by his eminence in the latter study the special notice of Sir John Leslie and Professor Playfair. It may be mentioned, as a proof of his mathematic and algebraic attainments, that while a pupil of Sir John, he was in the habit of revising his works and calculations for the press; and that two

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papers written by Arnott on mathematical subjects, while he was still a student in arts, appeared in Tilloch's Philosophical Magazine. These are "Observations on the Solution of Exponential Equations," May 1817, and a "Comparison between the Chords of Arcs employed by Ptolemy and those now in use," Nov. 1818.*

With regard to his college life, Mr Isaac Bayley, W.S., his cousin, and one of his earliest friends, writes,—"Such as the boy was, the man became. At the High School and College the same persevering study characterised him, and he equally became the favourite of his teachers and professors, and avoided mixing much with his fellow-students. I well remember how difficult it was to get him to join any social or even family party."

He took the degree of A.M. in 1818, and after a further period of professional study for the bar, was admitted a member of the Faculty of Advocates in 1821. But law was an uninteresting subject to him, and he soon relinquished the legal profession. He had a dislike to public speaking, and only appeared in his advocate's gown three times. His father, Mr David Walker-Arnott, died in 1822, when the property of Arlary, near Kinross, fell to him.

His attendance on the lectures of Professor Jameson early imbued him with a love for the study of natural science, especially of mineralogy; but the attractions of botany, which, he remarked, deals with lighter and more portable materials, subsequently prevailed, and it speedily became his absorbing pursuit. The lectures of Mr John Stewart, an extra-academical lecturer in Edinburgh, developed his relish for this branch of study. He attended his course in 1817 and 1818, being associated in the latter year with Dr Greville in the Cryptogamic Class. Dr Wight writes,—"Here it was our friendship began, in a friendly rivalry in the formation of our herbaria." His love for botany was subsequently converted into a life-long passion by his visits to France in 1821 and 1825, and his intercourse with the great French botanists, whose lectures and herbaria he frequented, and whose botanical excursions he joined.

Lady Hooker gives the following account of his inter-

* Sir John Leslie, in speaking of young Arnott, was accustomed to say that botany had spoiled a first-rate natural philosopher.

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course with the late Sir W. Hooker:—"Dr Arnott first came to Dr (Sir Wm.) Hooker's house during the summer course of lectures in 1821, bringing a letter of introduction from Dr Greville, who had made our acquaintance in Suffolk about a year previously. Dr G. was then applying for the botanical chair in Glasgow, and told us so, being ignorant that Dr Hooker had been appointed (on Sir Joseph Banks' recommendation) only a few days before. The excursion of students to Loch Lomond was soon to take place, and Arnott joined it, and continued always to make one of the party to Ben Nevis, or Staffa, or the Grampians, for many subsequent years. His taste for science became so confirmed by his intercourse with Dr Hooker, that he more and more devoted himself to it, though his parents greatly regretted his abandonment of the legal profession, to which he had been brought up. But the possession of the herbarium commenced in Glasgow by the gift of many duplicates from Dr Hooker's collection, and to which constant additions were made during Dr A.'s visits (and he was seldom absent six months at a time), worked like a spell in binding him to botany. I used to sit by, and name the specimens to dictation, thus expediting the work." Many of the herbarium specimens bear Lady Hooker's handwriting.

In 1821, immediately after passing advocate, Mr Arnott went to France, and for two months worked hard in the late Baron Delessert's herbarium, then kept by Achille Richard and Guillemin, and also in the herbarium at the Jardin des Plantes. "When at Paris," he wrote, "I had the good fortune to make a botanical excursion with old Jussieu (author of the 'Genera Plantarum'), the last he ever made. His son, Adrien de Jussieu (now also dead), took the management of the class. It was to the Etang de St Gracieu we went, and we slept all night in the neighbourhood."

One of his earliest botanical papers, "On some Mosses from Rio Janeiro," written in French, appeared in a Paris journal in 1823. Soon afterwards, in conjunction with Dr Greville, he published in the Wernerian Society's Transactions, three excellent memoirs, "*Tentamen methodi muscorum;* or, a new arrangement of the genera of mosses, with characters, and observations on their distribution, history,

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and structure." This was followed in 1825 by the "*Nouvelle Disposition méthodique des espèces de mousses,*" contained in vol. ii. of "Mémoires de la Société d'Histoire Naturelle de Paris."

In 1825 he returned to Paris, when the kindness of Baron Delessert again gave him the opportunity of studying in his rich herbarium. Here he examined the collection of Palisot de Beauvois, and was enabled to make out many of his hitherto doubtful species of mosses. During this stay in Paris, he was requested by Mr Bentham to visit him at Montpellier, and his partiality for botanical science induced him to comply. They met at Avignon, in the house of M. Requien, Director of the Public Garden, with whom and M. Audibert they botanised in the south of France, and made a tour to the Pyrenees, the results of which are recorded in an interesting series of letters to Dr Jameson, published in the "Edinburgh New Philosophical Journal," 1826–29.

Dr A. relates the following incident:—"As to *Hedwigia aquatica,* few botanists would credit me should I say I gathered none of it, but fewer still will believe that I was at the pains to fill all my pockets and my hat as full as possible. While thus engaged, one of my companions came up, and assured me I had taken 'bien assez pour tous les botanistes en Europe.' 'Voilà donc pour l'Amérique,' was all I had time to answer, while I proceeded in my labours. There is certainly something very delightful in finding in quantities anything one has been long eager to lay hold of."

The friends next proceeded to Montpellier, and, in company with M. Delile, Professor of Botany, and M. Dunal, author of the monographs on the *Anonaceæ* and *Solanaceæ,* made excursions in the neighbourhood. The following curious fact is recorded in Dr Arnott's journal:—"Every year a great quantity of wool is brought from Africa. It is landed at Pont Juvenal (called also Port Juvenal, for vessels come up this length to unload), and is spread out here to be bleached. Not a few seeds of African plants remain attached to the wool, and are thus sown; and the following years, when the ground for the wool is changed, they spring up. M. Delile, by searching diligently every fortnight or three weeks, has been so fortunate as to meet with several plants

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naturalised nowhere else in Europe, and some of them scarcely at all known to the botanist."

In the notes of his tour he institutes an interesting comparison between the botanical gardens of England and the Continent. "In France there are, in addition to the several botanical institutions in Paris, many smaller ones, also under Government, scattered through the country. I may instance those of Lyons, Strasburg, Montpellier, Toulouse, and Perpignan. When any of these receive the root of a new or rare species from another country, or its seeds, the year following either seeds or roots are transmitted to the Jardin du Roi at Paris; and also, when any new plant arrives there, it is as soon as possible disseminated through the smaller establishments of the provinces. The care and attention paid to the naming of the plants at the Museum prevents almost the possibility of an error, and thus in the Government institutions in the country the species is found well determined." Prats de Mollo is mentioned as one of the best points for a botanist's residence in the East Pyrenees. In the herbarium of M. Xatard at this place, in that of M. Marchant at St Béat, and in that of M. La Peyrouse at Toulouse, they examined the types of most of La Peyrouse's plants, and comments on them are entered in Arnott's journal.

The party proceeded through North Spain as far as Barcelona. Mr A. then went to Geneva, and studied three months in De Candolle's herbarium, boarding with M. Seringe, who had charge of it. The narrative of the tour was brought to an abrupt conclusion, in consequence of Mr Bentham, who accompanied Mr Arnott, having published at Paris his "Catalogue des Plantes des Pyrenees et du Bas Languedoc," with a sketch of the whole journey.

In 1828 he visited Russia, and acquired during his residence there considerable knowledge of the Russian language. Mr Barclay, whose daughter he afterwards married, had been settled as a merchant in St Petersburg, and Mr Arnott was induced to accompany him on his return from a visit to Scotland. Mr A. had given up the bar, and had no desire at the time to settle at Arlary, but was eager to enlarge his knowledge of botany, and to make the acquaintance of Fischer, Ledebour, and other botanists. About

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this time he was elected member of the Imperial Society of Natural History at Moscow.

In 1831 he was married to Miss Mary Hay Barclay of Paris, in Perthshire, and resided at Arlary from 1831 till 1845, when he built additional rooms expressly for the accommodation of his now extensive library and herbarium. The friendship and intercourse with Sir W. Hooker continued during the whole period of that eminent botanist's residence in Glasgow. He often visited him (Sir William) there, and occasionally afterwards at Kew. The excellent article, *Botany*, in the 5th volume of the "Encyclopedia Britannica," 7th edit., appeared from his pen in 1831, and at the time of its publication was the best purely English exposition of the natural system of botany.

From 1830 to 1840 Mr Arnott was engaged, conjointly with Dr (Sir Wm.) Hooker, in publishing an account of the botanical collections of Captain Beechey's voyage to the Pacific and Behring's Straits. This work, executed with great care, furnishes interesting notices of countries then little known, such as the Sandwich and Loochoo Islands, California, &c.

"In the autumn of 1832," writes Dr Wight, "he most kindly and liberally volunteered to assist me in the preparation of my then contemplated 'Peninsular Flora of India,' an offer most thankfully accepted and acted upon." Dr Wight's furlough expired before the completion of the first volume, which Mr Arnott edited and published after his friend's return to India. The Prodromus, which is in the hands of every botanist, renders a detailed notice unnecessary. It is thus mentioned in Hooker and Thomson's Introduction to the Flora Indica:—"We have already characterised this work as the most valuable and able contribution to Indian botany which has ever appeared, and as one which has few rivals in the whole domain of botanical literature, whether we consider the accuracy of the diagnoses, the careful limitation of the species, or the many improvements in the definition and limitation of genera, and the higher groups of plants." One volume only was published, the progress of the work having been interrupted by Dr Wight's return to India in 1834. "After the publication of vol. i., so much poured in on Mr A. from India,

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that although he could have got out a second volume, it would have been necessary to publish a large supplement to the first; and, besides, there was not sufficient sale to pay expenses, so no more was printed, although a vast deal was prepared, and ready for the press."—(Dr Wight.)

The herbarium of Mr Arnott at Glasgow, being particularly rich in Indian plants, is especially valuable, as containing the materials from which the *Prodromus Floræ Peninsulæ Indiæ Orientalis* was elaborated. It proved afterwards a most material benefit to the authors of the *Flora Indica*, who often applied to it on doubtful points.

In 1837, King's College, Aberdeen, conferred on Mr Arnott the degree of LL.D. In 1839, he lectured in Glasgow for Sir W. Hooker, who was temporarily absent, on account of family affliction, and in 1845 he received the appointment of Professor of Botany in that University, when Dr Balfour was transferred to Edinburgh. From 1825 to 1855 he was continually occupied in elaborate researches, the results of which were embodied in the works already mentioned, and in numerous contributions to the Transactions of learned societies. At the end of this memoir is an enumeration of his botanical writings, which will serve to indicate the extraordinary industry of our lamented friend.

It is a remarkable feature in the scientific work of Dr Arnott, that so much of it was done in conjunction with others; his single-hearted devotion to science was conspicuous in his cordial co-operation with men of different nations and temperaments, such as Sir William Hooker, Drs Greville and Wight, Röper, and Nees Von Esenbeck.

The single-mindedness with which he gave up his time to any one desirous of information, was beyond all praise. He would spend hours of the night in elaborating the collections of foreign botanists, purely for the love of science. Indeed, any survey of what Dr Walker-Arnott has done for the progress of botany, would be incomplete if it was confined to the notice of his published works, numerous and important though they are. Account must be taken of the spirit in which he worked, of the extent of the researches which he carried out, of the correspondence which he kept up, and of the aid and encouragement which

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he was ready to give to botanists visiting him, or consulting his herbarium. As a botanist, his careful habits of observation, and minute accuracy of description, render his works peculiarly valuable; and his reputation in this respect is quite as great on the Continent as in this country.

Professor Decaisne of Paris writes,—"La mort inattendue du Dr Walker Arnott est une perte réelle pour la science, et, je puis ajouter, pour les nombreux amis qui, en Angleterre et en France, ont été a même d'apprécier ses excellentes qualités, comme homme et comme savant."

In 1846 Dr Arnott left Arlary, and took up his residence in Glasgow, where he entered upon the duties of the professorship to which he had been appointed the previous year. As a professor, he was much respected and esteemed by all the students who had any real interest in the work of the class; and he had the gratification of imbuing many youthful minds with a permanent love for his favourite study. Dr J. Lindsay Stewart, at present Conservator of Forests in the Punjab, was one of his distinguished students, and is now one of the most rising botanists in India.

In 1860, when editing and remodelling the eighth edition of the British Flora, he addressed two humorous letters in rhyme to Sir W. Hooker on Brambles and Hawkweeds, which are characteristic of his desire to keep down the number of doubtful species. In truth, his zeal for rigid specific distinction has been of great benefit to the student of botany.

Of late years he devoted himself specially to the study of diatoms, with which his capacity for minute investigation, and his unwearying patience of research, pre-eminently fitted him to deal. The diatomaceous collection fills three cabinets, and is the richest in Great Britain. Dr Arnott contributed numerous papers on diatoms within the last few years to the Microscopic Society's Journal and Transactions, but by far the greater portion of his observations were communicated in letters to his scientific friends in England, on the Continent, and in America. Amongst these may be mentioned Professor Dickie of Aberdeen; Mr Carruthers, British Museum; Messrs W. Wilson and T. G. Rylands, Warrington; S. Roper, London; G. Norman, Hull; F. Kitten, Norwich; and Dr Lewis of Philadelphia. In 1866 he visited several of his correspondents in England,

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and also went to France, where he spent about ten days with his friend, M. de Brebisson, at Falaise in Normandy, all the time being constantly at work on diatoms.

For twelve months prior to his decease Dr Arnott's general health had evidently declined, and he was unable to take his accustomed exercise. At the commencement of the summer session be made an effort to resume with wonted zeal the labours of his class; but it was obvious to all his friends that the effort was attended with great pain and much risk, and that the conscientious desire to discharge his duty was impelling him to overtask his strength. After a few days the writer, who had just returned from India, was requested to carry on the duties of the class, to which he gladly acceded. It was a pleasure to aid in time of need one from whom he had received valuable assistance in botanical research, and he was an inmate of Dr Arnott's house during the tedious and painful illness which proved fatal. Jaundice appeared in April, and remained prominent till his death on the 17th of June, in the seventieth year of his age. He was interred on the 20th at Sighthill Cemetery, near Glasgow, in the presence of a large number of friends, members of the senate, and students. Mrs Arnott, three sons, and five daughters survive this distinguished botanist.

One of the trustees appointed is Dr Hooker, F.R.S., and it may be mentioned that after inspecting the valuable herbarium and library left by Dr Arnott, it was resolved to offer them to the Glasgow University, and it is hoped that they may thus become available to the nation. Dr Hooker remarks as follows:—"During this inspection, I became strongly impressed with the great importance of the books and plants being kept together, as being portions of a whole, and the work of one mind devoted for half a century to one object—the promotion of botanical research. There is another point of view under which it appears to me to be a matter of great moment that the books and plants should not be dissociated, and this is, that both of them illustrate in a most remarkable manner the rise and progress of systematic and descriptive botany during the earlier part of the present century, during which period exotic botany first became a science properly so called. Under the latter

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point of view, these collections of books and plants possess a rare interest and value for a public and especially an educational institution, such as Glasgow University, to which the trustees are empowered to offer them at a fair valuation." *

A memorandum in Dr Arnott's handwriting gives the following dates:—

Entered at College of Edinburgh, Nov. 1813.
Took degree of A.M. 1818.
Was admitted to the Faculty of Advocates, 1821.
Got degree of LL.D. from King's College, Aberdeen, 1837.
Appointed Regius Professor of Botany, Glasgow, 1845.
Fellow of Royal Society of Edinburgh, 1822.
Membre de la Société d'Histoire Naturelle de Paris, 1822.
Member of Wernerian Society of Edinburgh, 1822.
Member of Botanical Society of Ratisbon, 1824.
Fellow of Linnean Society of London, 1825.
Member of the Imperial Society of Natural History of Moscow 1829.
Member of the Royal Physical Society of Edinburgh, 1830.
Member of the Acad. Cæsar Leopold Nat. Curiosorum, under the cognomen of "Sibbald," 1834.
Member of Botanical Society of Edinburgh, 1836.
Member of the Lyceum of New York, 1837.
Was appointed Deputy-Lieutenant of Kinross-shire in 1825.

Dr Arnott was also Vice-President of the Royal Caledonian Curling Club, and was lately acting Depute Grand Master of the Royal Order of Masons of Scotland.

Botanical Writings.

1. Tentamen Methodi Muscorum (Arnott and Greville). Wern. Soc. Mem. IV. V. 1822–24.
2. Sur quelques Mousses de Rio Janeiro. Paris, Mem. Soc. Hist. Nat. I. 1823.
3. Notice of a Journal of a Voyage from Rio de Janeiro to the Coast of Peru, by W. Jameson; the Plants described by Dr Arnott. Wern. Soc. Mem. V. 1823–24.
4. Nouvelle Disposition Méthodique des especes de Mousses exactement connues. Paris, Mem. Soc. Hist. Nat. Vol. II. 1825.
5. A Tour to the South of France and the Pyrenees in the year 1825. Ed. N. Phil. Journal. Vols. I. to VI. 1826 to 1828.

* The systematic works on Indian Botany, Cryptogamia, and Diatoms, are full of marginal notes and cross references of great interest and value.—H. C.

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6. Notulæ Botanicæ. Loudon's Mag. Nat. Hist. Vol. I. 1829.
7. On the Hyahya, or Milk-tree of Demerara. Ed. N. Phil. Jour. Vol. VIII. 1830.
8. Remarks on the Genera Callitriche and Elatine. Ed. Jour. Nat. Geog. Sc. Vol. I. 1830.
9. Notes on some Species of Veronica, Melampyrum, and Helianthemum. Same work and vol. 1830.
10. Notes on *Aspidium aculeatum* and its Allies. Same work. Vol. II. 1830.
11. Botany of Beechey's voyage (Hooker and Arnott). 1 vol. 4to (plates). 1830–40.
12. On some New Species of Loasæ. Edin. Jour. Nat. Geog. Sc. Vol. III. 1831.
13. On some New Species of Portulaceæ. Same work and vol. 1831.
14. Notes on Alismaceæ, Euphorbiaceæ, and a Flora Virgiliana. Same work and vol. 1831.
15. Article "Botany." Encycl. Brit. Vol. V. (7th ed.) 1831.
16. Contributions towards a Flora of South America and the Islands of the Pacific (Hooker and Arnott). Hook. Bot. Misc., Vol. III. Hook. Jour. Bot. (1st series) Vols. I. and II. Hook. Comp. to Bot. Mag., Vols. I. and II., (in all ten papers). 1833.
17. Characters of some New or Little Known Genera of Plants (Wight and Arnott). Edin. N. Phil. Jour. Vols. XIV. XV. XVI. 1833.
18. On some New Genera of Plants. Same work, Vol. XVII. (Arnott and Nees von Esenbeck). 1834.
19. Note sur la plante qui produit la Coque du Levant (*Cocculus Indicus*). Ann. Sci. Nat. Vol. II. (Bot.) 1834.
20. Observations sur quelques Plantes décrites dans la Flore de Sénégambie. Same work and vol. 1834.
21. Historia Balsaminearum systematica accessionibus nonnullis aucta. (Arnott et Röper) Linnæa. Vol. IX. 1834.
22. Prodromus Floræ peninsulæ Indiæ Orientalis. Vol. I. 1834. (Wight and Arnott.)
23. On the East Indian Asclepiadaceæ (Wight and Arnott). "Wight's Contributions to Botany of India." 1834.
24. New Indian Balsamineæ. Hook. Comp. Bot. Mag. Vol. I. 1835.
25. Remarques sur la Flore de Sénégambie. Ann. Sci. Nat. Vol. III. (Bot.) 1835.
26. Neue oder wenig bekannte ostindische Pflanzen-Gattungen. Flora. Vol. XVIII. (Arnott und Wight). 1835.

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27. Pugillus Plantarum Indiæ Orientalis. Acad. Cæs. Leop. Nov. Act. Vol. XVIII. 1836. Ann. Sci. Nat. Vol. XI. (Bot.) 1839.
28. New Ceylonese Melastomaceæ. Hook. Comp. Bot. Mag. Vol. II. 1836.
29. Synopsis of the East Indian Species of *Drosera* and *Parnassia*. Same work and vol. 1836.
30. Illustrations of Indian Botany (Wight and Arnott). Same work. Vols. I., II. Ann. Nat. Hist. Vol. I. 1836–38.
31. Professori D.F.L. Schlechtendal hæc pauca de Grabowskia scribit. Linnæa. Vol. XI. 1837.
32. Clavis Analytica of the Convolvulaceæ of the Peninsula of India. Madras Jour. Sci. Vol. V. 1837.
33. On the Genus Torreya. Ann. Nat. Hist. Vol. I. Ann. Sci. Nat. Vol. X. (Bot.) 1838.
34. On the Rhizophoreæ. Ann. Nat. Hist. Vol. I. 1838.
35. Observations on some New or Obscure Species of Plants. Jard. Mag. Zool. Bot. Vol. II. 1838.
36. Some Account of the Genus Langsdorffia. Ann. Nat. Hist. Vol. II. 1839.
37. Descriptions of some New or Rare Indian Plants. Ann. Nat. Hist. Vol. III. 1839.
38. Exaci species ex peninsula Indica ac ex insula Ceylano. Ann. Sci. Nat. Vol. XI. (Bot.) 1839.
39. Notes on some South African Plants. Hook. Jour. Bot. Vol. III. 1841.
40. On the Cucurbitaceæ. Same work and vol. 1841.
41. On the Introduction of Anomalous Genera into Natural Orders. Glasgow Phil. Soc. Proc. Vol. II. 1844–48.
42. Correction of certain errors in Dr Balfour's Communication to Bot. Soc. Glasgow. Phytologist. Vol. II. 1845.
43. Notice Regarding the Measurements of Heights by means of the Boiling Point of Water. Glasgow Phil. Soc. Proc. Vol. III. 1848–53.
44. Account of a Botanical Excursion to the Rhinns of Galloway. Same work and vol. 1848–53.
45. Notice of the Species of *Salvadora*. (1851.) Same work and vol. 1848–53.
46. Note on *Samara læta*, L. Linn. Soc. Proc. Vol. I. 1849. Linn. Soc. Trans. Vol. XX. 1851.
47. Synoptical Tables to Hooker's British Flora. 5th edition. 1849. (These were incorporated in future editions.)
48. British Flora (Hooker and Arnott). 6th edit., 1850; 7th edit. 1855; 8th edit. 1860.
49. Observations on some British Plants. Ann. Nat. Hist. Vol. VI. 1850.

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50. Note on Platynema. Hook. Jour. Bot. Vol. III. 1851.
51. Note on *Campylodiscus Hodgsonii.* Micro. Soc. Trans. Vol. VI. 1858.
52. On Rhabdonema, and a new Allied Genus. Jour. Micro. Sci. Vol. VI. 1858.
53. On Arachnoidiscus. Same work and vol. 1858.
54. On the Structure of Amphora, a Genus of Diatomaceæ, and the Diagnosis of its Species. Same work and vol. 1858. Roy. Soc. Edin. Proc. Vol. IV. 1862.
55. Notes on Arachnoidiscus, Pleurosigma, Amphiprora, Eunotia, and Amphora. Jour. Micro. Sci. Vol. VI. 1858.
56. Dr Walker-Arnott in Reply to Dr Donkin. Jour. Micro. Sci. Vol. VII. 1859.
57. What are Marine Diatoms. Same work and vol. 1859.
58. Note on *Hypericum Anglicum.* Ann. Nat. Hist. Vol. VI. 1860.
59. On Cyclotella. Jour. Micro. Sci. Vol. VIII. 1860.
60. Notes on Cocconeis, Nitreschia, and some allied genera of Diatomaceæ. Proc. Nat. Hist. Soc. Glas. 1868.

II. *Obituary Notice of N. B. Ward, Esq.* By Professor Balfour.

I have this evening the painful duty of recording the death of Nathaniel Bagshaw Ward, one of the oldest fellows of our Society, having been elected on 9th June 1836, and having acted as our local secretary in London from that time till his death.

He was born in 1791, in the east part of London, where his father, Stephen Smith Ward, acted as a medical practitioner. His views were at first directed to a sea life, and at the age of thirteen he made a voyage to Jamaica, where he had an opportunity of observing the luxuriant vegetation of that island, and was led to take an interest in natural history pursuits, more especially botany, to which science he afterwards devoted his attention with great ardour. On his return from Jamaica he entered upon the study of the medical profession at the London hospital. After passing through the usual curriculum of study, he became a member of the Royal College of Surgeons, and of the Apothecaries' Company of London. He then became assistant to his father, and afterwards succeeded him in practice, taking up his residence in Wellclose Square. Here he continued

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for many years, and practised his profession with great acceptability. He became vaccinator to the National Vaccine Establishment in the locality. He was a kind, generous, and attentive practitioner, and won the affection and esteem of his patients.

I often visited Mr Ward in Wellclose Square, and I recollect well the delight which I experienced in my early days, in seeing the beautiful plants which he cultivated in his double-sashed window frames, even in the murky and uncongenial atmosphere of Whitechapel. He was a great admirer of nature, and specially of flowers; and he occupied the leisure which he could secure from a laborious profession in prosecuting botany. He had attended the lectures of Mr Wheeler, of the Apothecaries' Company, and to him he was indebted for much of his early botanical knowledge. He often occupied the morning hours in botanical trips to Wimbledon and Shooter's Hill, and he made collections of plants in these localities. He paid frequent visits to Kew, Loddiges, and Chelsea gardens, and he took excursions with his family to Cobham, in Kent. He entered the Linnean Society on 21st January 1817.

It was during his residence in Wellclose Square that he first entertained the idea of constructing those plant cases which have been called after him, and which have been so useful in the transport of plants from foreign countries, and in the cultivation of plants in towns. He had been disappointed in his attempts to cultivate the vine, Virginian creeper, and other plants, in consequence of the soot and dust, which caused the leaves to fade and wither, and he resolved to try the effect of close glass cases in preventing these injurious effects.

The following account is given by his son of the invention of the Wardian Case:—

"Actuated by an ardent zeal for botany, Mr Ward had for years striven to realise the *rus in urbe*. Not content with the plebeian myrtle, geranium, and rhododendron, he had extended his attention to the more delicate members of the vegetable world. All the protective care and nursing that he could bestow upon his pets were, however, ineffectual in enabling them to maintain the struggle with opposing influences. The soot and dust clogged up their

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tender lungs, and impeded their respiration; the cold, dry winds carried off the vapours from their leaves, and the moisture from the mould in which they were planted, and caused them to shrink and wither; the deleterious gases entangled in the smoke-cloud poisoned them. The only resource left him was, on each occasion of a visit to the country, to bring back a fresh relay of plants, and thus maintain a fluctuating appearance of freshness and verdure. In the summer of 1829 he had placed the chrysalis of a sphinx in some mould in a glass bottle, covered with a lid, in order to obtain a perfect specimen of the insect. After a time a speck or two of vegetation appeared on the surface of the mould, and, to his surprise, turned out to be a fern and a grass. His interest was awakened. He placed the bottle in a favourable situation, and found that the plant continued to grow and maintain a healthy appearance. On questioning himself about the matter, the answers readily presented themselves, inasmuch as air, light, moisture, and other requirements of the plant were contained within the bottle.

"This parent closed case gave birth to numerous others; the plan was tested, and its success demonstrated, under various conditions as regards size, aspect and different tribes of plants; and after a few years Mr Ward had the satisfaction of feeling that through his discovery he had been the means of introducing nature into the crowded city, in all the attractiveness and purity, if not on the extended scale in which she exhibits herself in the country."*

A writer in the "Gardeners' Chronicle" says:—"In 1836, Mr Ward wrote a letter to the late Sir William Hooker, announcing his discovery, and the letter was published in the "Companion to the Botanical Magazine" for May of that year. In 1838 Mr Faraday lectured upon the subject to a large audience at the Royal Institution. In 1842 the first edition appeared of Mr Ward's work, "On the Growth of Plants in Closely-glazed Cases;" a second edition followed some years after, with illustrations by E. W. Cooke, R.A., and the late Mrs S. H. Ward. A second lecture upon the

* On Wardian Cases for Plants, and their Applications. By Stephen H. Ward, M.D. London, 1854.

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subject was delivered at the Royal Institution in 1854. Mr Ward himself, in a strikingly happy manner of his own, also explained his plan at various societies, and at meetings of the British Association."

Wardian cases have now become familiar to us in our dwelling houses, and by means of them many valuable plants have been successfully introduced into this country. Even among the inmates of our crowded closes and lanes these Cases have been introduced, and have acted in ameliorating to a certain extent the condition of the poor.

Mr Ward expressed great delight in showing to visitors his cases and window frames filled with plants, which grew luxuriantly in one of the apparently most unsuitable situations in London. He inspired others with a portion of his own enthusiasm for botany, and was instrumental in diffusing a taste for plant culture. His love of botanical science continued throughout his whole life; and when he removed his residence to Clapham Rise, he was able to carry on his labours under more favourable circumstances. He had the art of adapting the mode of culture to the constitution of the plant. Ferns were made to grow in circumstances best fitted for their full development. The dripping water was made to promote the growth of the *Trichomanes radicans.* Alpine plants were grown in suitable localities, and a winter covering was given to them, to supply the lack of snow. Every plant was treated in the way most suited for its development.

Mr Ward showed at all times a great desire to introduce botany among the working classes, as a science which could be prosecuted at all times even by the poorest member of society, and one which contributed greatly to healthy recreation and enjoyment.

Mr Ward was a zealous member of the Apothecaries' Company, and he filled the important office of Master in 1854, and of Treasurer at a later period. For a long time he took the direction of the Apothecaries' Garden at Chelsea, and did much to improve it and make it available for medical students. He became a Fellow of the Royal Society of London on 8th June 1825. He was one of the founders of the London Microscopical Society. In this he acted with Mr Edwin Quekett and Dr Bowerbank. I was present at

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many pleasant microscopical reunions with him, at a time when less attention was paid to such studies than at present.

Mr Ward was a great favourite with every one who came in contact with him. He was very modest and retiring, and did not get the credit due to him for his persevering efforts to advance botany and horticulture. In 1863 some friends proposed to have a portrait of him executed. The required sum was speedily collected, and the portrait is now in the hall of the Linnean Society at Burlington House.

Mr Ward contributed several communications on botany to our Society, his last being "Under the Snow, or Notes of Alpine Plants and their Mode of Growth." He was fond of studying the aspects of nature in a botanical point of view, and he had specimens in his collection arranged so as to exhibit the flora of different regions.

He died at St Leonards, on Thursday 4th June, at the age of 77, and was interred in Norwood Cemetery, his friends Hooker, Wight, Cooke, and others, attending the funeral. He was a truly Christian man of science, and his loss will be felt by a large circle of naturalists.

III. *Florula Discoana: Contributions to the Phyto-Geography of Greenland, within the Parallels of* 68° *and* 70° *North Latitude.* By Robert Brown, F.R.G.S., &c.

I. *Review of Greenland Botanical Literature.*—The flora of Greenland has been at various times partially examined by different botanists. The early missionaries Egede, Fabricius, Saabye, and others, made collections of the plants of the districts over which their ministerial functions extended, and some of these are yet in the herbarium at the Botanic Garden in Copenhagen. In 1826 the Chevalier Charles Louis Giesecke (better known as Sir Charles Giesecke) Professor of Mineralogy to the Royal Dublin Society, who had passed several years in Greenland as a mineral collector, published a list of the plants of that country.* His list comprehends a large number of species, but he is manifestly wrong in regard to many of them. Some, which may possibly be members of the Greenland flora, have never been found since his day. The various explorers in search of Franklin, and the surgeons of whalers,

* Article "Greenland," Brewster's Edinburgh Encyclopædia.

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have at different times added to our knowledge of the distribution of the plants, by collecting on various portions of the coast.* But by far the most important collections which ever came from Greenland were those of Vahl, who botanised with the utmost assiduity over the whole extent of Danish Greenland, and has published various papers on the plants. The most valuable literary contribution, however, to the history of the Greenland flora, is the list in the appendix to Rink's "Grönland Geographisk og statistisk," by my friend Professor Johann Martin Lange of Copenhagen, forming a summary of the labours of all former Danish botanists, and a determination of the collections of Egede, Vahl, Rink, Holböll, and others contained in the Herbarium of the University of Copenhagen.† Drs Kane ‡ and Hayes § have added to our knowledge of the plants of the extreme northern shores of Greenland. Professor Lange's list, dealing only with the Danish possessions in that country, does not touch upon these. It is to be hoped, however, that he will yet undertake an extended flora of Greenland, a task for which he is so well qualified, both from his knowledge of the subject and the opportunity which he possesses of consulting Herbaria.

* Lyall's collections, by Hooker, in Journ. Linn. Soc. Bot. vol. i. pp. 114–124; Notes on Arctic Plants, Dickie, Journ. Linn. Soc. Bot. vol. iii. (1859) pp. 109–112 (plants collected by Clarke, Clark, Maitland, Philips, Craig, and Sutherland); Dickie (Sutherland's Plants) in Appendix to Inglefield's "Summer Search for Sir John Franklin," (1853); Sir W. J. Hooker and Dickie in Appendix to Sutherland's Narrative of Penny's Expedition; Account of the Botany of M'Clintock's Expedition (Walker's Plants) Hooker and others, Journ. Linn. Soc. Bot. vol. v. p. 85; Taylor on Davis' Straits Plants, Trans. Bot. Soc. vol. vii. p. 323, or Edin. Phil. Journ. 1862; Sadler's Notice of Cryptogamia collected by R. Brown on islands of Baffin's Bay, Trans. Bot. Soc. vol. vii. p. 374; Sutherland on *Cystopteris alpina*, Trans. Bot. Soc. vol. vii. p. 393; and generally Hooker, Linn. Soc. Trans. 1864.

† Oversigt over Grönlands Planter af Joh. Lange (Bibliothekar og Assistent ved den botaniske Have) Tillæg Nr. 6 til Rink in lib. cit; Vahl om Stellaria Grönlandica og Dryas integrifolia (Nat. Selsk. Skirv. 4 Band. 2 h. ss. 169–172); *vide* also Rink, "Om den geographiske Beskaffenhir af de Danske Handels districter i Nördgrönland med Kart, &c." (Afskrf. af Vidensk. Selskab. Sk. 5 B-3 B). Drejers Revisio Critica Caricum borealium (Kroyers Tidsskr. iii. p. 423). Hornemann in Graah's Journey to East Coast of Greenland (Trans.) Appendix; Flora Danica; Retzius' Floræ Scandinaviæ Prodromus, &c.

‡ Elias Durand in Appendix to Kane's "Arctic Explorations," vol. ii.

§ Hayes' Open Polar Sea, and Durand in Proc. Phil. Acad. Nat. Sciences, March 1863, as well as partially in "Das Nordlichste Land der Erde."—Petermanns Geographische Mittheilungen (1867) p 176. *et seq.*

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II. *The present Collections.*—During the summer of 1867, from June until September, I passed the season in Danish Greenland, collecting specimens in all departments of natural history, and pursuing scientific investigations. The summer was very favourable for botanical research. Accordingly, though my time was very limited, and greatly occupied with other pursuits, I made a large collection of plants, of all orders, found in the country between Egedesminde and Kudlesæt. As the country was chiefly in the vicinity of Disco Bay, I have denominated the account of these collections the *Florula Discoana.* These plants are here enumerated by the assistance of various botanical friends, whose reputation is a sufficient guarantee for the accuracy of the lists under their names. Though containing few plants really new to science, the list is interesting as being the most complete one of the plants of that section of country, and as adding to our knowledge of the phyto-geography of the coast,—the earlier collections being to a great extent useless for that purpose, as the labels merely afforded the information that they were collected in "Greenland." As far as I can learn, it is the largest collection of Arctic plants ever brought to Britain, and perhaps the fullest ever collected in the same time in Greenland. The present lists were intended for a more extended joint account by myself and my companions of our travels in that country. Accordingly, I have only published the localities, &c., in abstract, reserving a more elaborate description for that work when completed. The only exceptions to this are in the case of the lists prepared by Dr Dickie and Mr Croall, which I have given in full, their observations not admitting of being abstracted. Mr Croall likewise furnished extended notes on each individual marine alga, which I have incorporated in his general account of the marine algæ. Dr Lindsay hopes to publish a memoir on the Greenland lichen-flora at a future period, and his more extended descriptions will be incorporated in that treatise. For the same reason (with the exceptions mentioned) I have not thought it necessary to make any further classification of the species, than into genera and species.*

* Of this collection made by me, which contained a very large number of duplicates, a full and authentic set of the Phanerogamia and Mosses has

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III. *Climate.*—During the winter the country is covered with snow, and the plants protected under its warm covering. Darkness then covers the whole face of the country for about four months. About May and the beginning of June, according to the state of the season, the earth again begins to appear. By July the snow has generally cleared off all the lower grounds, and only lies in hollows, on the hills, or in places shaded from the sun. From this period until the middle of September, very little snow ever falls, and the climate is mild, and even warm and sunny, as during the summer of 1867. A little rain also falls during most seasons. Vegetation springs up apace, and during the long summer day, of four months, soon comes to maturity. By the beginning of August the flowers are on the wane, and by the end of that month have wholly disappeared. The weather in September is uncertain, showers of snow falling, and the nights being dark and cold. By October "bay ice" begins to form in quiet harbours or inlets, and the ground gets its winter mantle of snow. The soil freezes hard to the depth of several feet (where it is so thick), and all nature slumbers. Meteorological observations have been taken at various royal trading posts throughout

been incorporated in the Kew Herbarium. The rest of the specimens are, in common with the geological and zoological (undescribed) collections, in the possession of my companion, Mr Edward Whymper, Canterbury Place, Lambeth Road, London, who undertook the management of the business arrangements of the party, and was of much assistance to me in packing the collections and in seeing them through the custom-houses in Copenhagen and London. It is only right to state that the British Association and the Government Grant Committee of the Royal Society liberally contributed £300 towards the expenses of the expedition, and that the collections made were of very considerable pecuniary value. The Royal Geographical Society and the Meteorological Department of the Board of Trade, through the good offices of Sir R. I. Murchison and Mr R. H. Scott respectively, also gave the use of some valuable instruments. Though, possibly, this expedition may have, *primarily*, cost more, yet I coincide in the universal opinion of the Danish officers and others, that with equal facilities to those granted to us by the Danish Government, through the thoughtful kindness of the Chevalier C. S. M. Olrik, Direktor af Den Kongelige Gronlandske Handel, the *actual* and *necessary* expenses of any expedition on an equal scale, judiciously and intelligently conducted by experienced travellers, *need* not cost more than the sum mentioned, in addition to what might be derived from the sale of the collections. I have embraced the permission accorded to me by the articles of the expedition, to publish this account of its botanical results, as this is only due to the botanists who were engaged in the work.

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Greenland.* At Jakobshavn, one of these settlements, Dr Rudolph, now Governor of Upernavik, kept for upwards of three years a careful register of the thermometer. Jakobshavn was our head-quarters, and the locality for the chief portion of the species here enumerated, and it may be taken as typical of the climate of Disco Bay. I therefore present the means of temperature there, as a mean of the climate over the region embraced in the title of this paper.

THERMOMETRICAL MEANS OF THE CLIMATE OF JAKOBSHAVN.

Lat. 69° 13′ 26″ N.

January,	÷ 2·4 Fahr.	July,	45·4 Fahr.
February,	0·3	August,	42·4
March,	8·2	September,	34·6
April,	+ 18·8	October,	25·1
May,	32·5	November,	12·5
June,	41·5	December,	÷ 7·5
Winter (Mean Temp.)	÷ 3·4	Summer,	+ 43·1
Spring, „	19·9	Autumn,	24·1

Whole year, 22·5

IV. *Character of the Country over which the Plants were Collected.*—The character of the country over which the specimens were collected consists chiefly of bare rounded granitic hills, planed by old ice action, and covered with boulders and travelled blocks of stone. In the hollows, where the melting of the snow collects, are peaty bogs, and in other places dry heathy-looking tracks, covered with *Empetrum nigrum*, *Cassiope* (*Andromeda*) *tetragona*, *Betula nana*, and such like plants. The eastern side of these glens is richest in plants, and the vicinity of streams and dripping springs yields a considerable variety. In the Waigatz Straits, about Kudlesæt, Ounartok, and Atanakerdluk, the geology changes, and bold trap cliffs and dykes burst through sedimentary rocks of miocene age. Here is the limited district containing the now celebrated fossil beds of Greenland.†

I may shortly describe each individual district, taking the Danish trading divisions as guides, and looking upon the

* *Collectanea Meteorologica*, Fasc. iv. Hauniæ, 1856. Rink Tillœg Nr. 8, "Meteorologie" til *Grönland geographisk og statistisk beskrevet*, Andet Bind, 1857.

† The plants of these beds are now being described by Professor Heer of Zurich, and the lithology by the author.

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chief post in each district as the centre and type of the division. It was also in the immediate vicinity of these posts that the greater number of the plants here enumerated were collected.

(1.) *Egedesminde.*—Lat. 68° 42′ 39″ N., long. 52° 43′ 48″ W.* The island on which the settlement is built is low-lying, bare, and bleak. The vegetation is very stunted, and is affected by the cold wind—no high mountains being in that vicinity to shield the low-lying ground, and few cliffs which can radiate the sun on the soil. The climate here is more foggy than in other places further to the east and nearer the mainland. The cranberries and whortleberries on the small hills in general bear no ripe fruit; the arctic willows and the birch do not grow in any great luxuriance; and the greater part of the country is covered with swampy moss, only allowing a little green to appear now and then. Warm springs (so called, I daresay, on the principle of *lucus a non lucendo*, for, though warmer than the air, they are yet sufficiently cold) are found on the island of Sakartloek, lying at the head of Tessiursak Bay, about eight miles from Egedesminde, and near the mouth of a little river flowing over a level tract scattered with boulders. One of these springs runs out in a large stream out of a very solid granite wall and over a smooth mossy ground, out of which other two or three springs run between the stones and moss with about the same force. The temperature, according to Dr Rink, is 42°·1 Fahr., or 20°·2 Fahr. higher than the mean temperature of the island. A little basin, a few hundred feet in length, which the spring forms, is never frozen; and at the bottom of the bay, where the stream debouches, no ice lies in the winter. Large banks of *Bartramia fontana*, &c., form round the springs, which

* In most cases, and in reference to the latitudes invariably, I follow my own observations made during the past summer. In reference to the longitudes, my own observations not being all yet (owing to the arrangements of the expedition) accessible, I have followed either Graah's observations (in "Tabel over adskillege punkters observerede Brede og Laengde paa Vestkysten af Grönland," in "Beskrivelse til det Vixende Situations kaart over den Vestilige Kyst af Grönland," &c., &c. Kjobenhavn, 1825), or others given to me through the politeness of Premier Lieutenant H. L. M. Holm of the Kongl. Kaart Archiv in Copenhagen. The position is that of the chief "colonie" or trading post.

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keep these moss banks always in a tremulous motion. On the island of Aito, and the surrounding islands, the same characteristics prevail as in the vicinity of Egedesminde. The vegetation is exceedingly scanty, and but little can be seen but brown rust-coloured rocks and stunted vegetation. Here is found *Sedum Rhodiola*, D.C.—found nowhere farther north than South-East Bay. It is said to be here very abundant on the top of the small sterile islands, tipped by turf and the excrement of birds. We arrived at Egedesminde on the 6th of June, and left on the 14th of the same month. During most of this time the weather was snowy, and little or nothing except a few lichens and mosses rewarded my search. I am, however, under obligations to Freoken Julie Leveson for most kindly presenting to me a small collection of Egedesminde plants, made by her in the preceding year, which has enabled a few localities to be added to the Disco flora, and one or two additions to be made to the scanty list. The general character of the country at this season of the year may be gathered from the following jotting in my journal; and as it is equally characteristic of other portions of Disco Bay, I may be excused quoting it:—"*June* 6.—To-day we took an excursion over the island on which the settlement of Egedesminde ('the memory of Egede') is built. The Eskimo name of it is *Arsiat*, and means the summer place; and they remark, not inaptly, that it lies in its little archipelego of islands, like a spider in its web. Nothing was to be seen but bare granite rocks, worn by ice, or covered with poor Franklin's *tripe de roche*—the *tudluak* of the natives—with snowy drifts in every shady place, and bogs in the hollows, or lakes with the surface ice yet unmelted. Few living things were out: a bee, a spider or two, and a *Dyticus* in the pools, with a snow-bunting (*Emberiza nivalis*) looking out for a nesting-place, were the only specimens of animal life we came across in our rambles. No flowers were as yet above the ground to any extent. The willows were shooting up, and the Empetrum was green above the half-thawed soil. Eriophorums were coming into flower, but the only plant in bloom was *Cassiope tetragona*. Masses of woolly-looking matter, apparently bleached Confervaceæ, mantled some of the stagnant pools near the village, which were half choked

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up with rotting fragments of seals and other animals. Near the top of the island were found larvæ and cocoons of Lepidoptera, pieces of the shell of *Echinus drobachiensis*, Mull., and the shell of a decapodous crustacean, apparently carried up there by sea-birds, or perhaps by the wind. If we are to credit the Eskimo tales of *Asaminak*, the south-east wind, it has force enough to carry for some distance much heavier matters than shells. In some of the little valleys we met Greenland women laden with the dwarf birch, Empetrum, and willows—collectively the *Brœndsel* of the Danes—for fuel in their houses."

(2.) *Christianshaab*—Lat. 68° 49′ 19″ N., long. 51° W.—I visited this locality for two days in the first week of August, and added several plants to my collection. My recollections of it are very pleasant indeed, and my notes describe it as possessing " more varied scenery than any of the other settlements I have yet seen, lying in a long 'hope' with green slopes to the water's edge, and fells of syenite 1600 feet in height in front of the 'colonie,' and beyond,—the way leading through a green grassy valley,—a lake alive with wild geese (*Anas acuta*, Linn.). Behind and all around are sunny 'braes,' green with the moisture of rushing rivulets, and many flowers as yet strangers to my collection." The coast between Christianshaab and Claushavn is low and easily landed on, with green slopes and streams running down from the hills and bursting through the boulder clay. On one of the islands (particularly *Krikertasasuk*, " the long big island ") about six miles from Christianshaab, I added several plants to my collection, particularly *Potentilla anserina*, L., which, though found further north, is yet only entered in Lange's list on Vahl's authority, and was not found by me elsewhere in the vicinity of Disco Bay.

(3.) *Claushavn*—Lat. 69° 7′ 31″ N., long. 50° 55′ 30″ W.—This commercial establishment is built on a flat, backed by hills of considerable height. On this flat is a small lake, round the marshy borders of which plants grow luxuriantly. This flat is divided off into one or two little glens by *roches moutonnées* like knolls of rocks, each glen ending in a terminal moraine at the lower edge, and exhibiting the same evidences of ancient glaciers. Many

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plants are found here on this sunny flat which I did not observe at Jakobshavn, only seven miles north of it across the Icefjord. For Greenland, Claushavn is a sunny spot, and not unpleasant. Here *Epilobium latifolium*, L., luxuriates, and *Lychnis apetala*, L., is found growing in considerable quantity among the rocks behind the Colonibestyrers house. *Armeria vulgaris*, Willd., *Trisetum subspicatum*, P. B., and *Juncus triglumis*, L., were found by me only in this locality. From Il-ŭl-iā-mĭn-ĕr-sūāk ("the big mountain overlooking the Icefjord"), rising to the height of 1400 feet, can be seen the Icefjord, and little lakes lying in rugged valleys, with the commencement of the Tessiusak just peering out, and away beyond to the eastward the dreary stretch of the inland ice. *Rhododendron lapponicum*, Stellarias, and Drabas were the plants most prominent. *Papaver nudicaule*, the hardiest of all arctic plants, was found here long after *R. lapponicum* had disappeared. I visited Claushavn first on the 24th June, and subsequently at various times in July, and afterwards while travelling to Christianshaab in the beginning of August.

(4.) *Jakobshavn*—Lat. 69° 13′ 26″ N., long. 50° 55′ W.—This was our head-quarters for the whole of our residence in the country, and the greater number of the plants were collected here. The settlement is built on rounded knolls of rocks, with boggy little valleys between, where the vegetation springs; further back are various boulder clay valleys, where considerable vegetation appears, though very little exposed to the sun. The flora is not nearly so profuse as at Claushavn. The whole country in this region is composed of rounded syenitic hills of various heights up to 1200 feet, bare or polished with ice action, or covered with black, horny lichens, and scattered with boulders and angular blocks of stone lying in all kinds of positions over their summits and faces wherever it is possible for them to lie. Between these fells and rocks lie flat valleys, composed of boulder clay beneath, but capped with a boggy covering of turfy peat, which the natives cut and dry in stacks for winter fuel. Early in the summer these are mere bogs or marshes, into which you sink over the knees. Here the melting of the winter's snows accumulate, forming miniature lakes in the hollow places, permanent all the year round,

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bordered by a thicket of Cyperaceæ and bright with the yellow ranunculus and other arctic marsh-plants, and finally the overflow is emptied by streams which pour in mimic cascades over the sea cliffs. In some of these lakes or boggy places I found *Hippuris vulgaris*, which I did not observe anywhere else in the district. A fruitful habitat for plants was the dripping rocks, where a little stream flowed in through a valley at the head of the harbour. Outside of the little harbour a few Algæ were found, the continual grinding of icebergs off the shore hardly allowing of their growth. However, just below the "kirke" where we lived, the rocks yielded not a few species, and the scum of pools furnished some interesting fresh-water species. North of Jakobshavn the coast is very similar—low-lying, with glens and valleys, the outlets of former glaciers, scattered with old moraines, but presenting nothing particularly worthy of notice in a botanical point of view. On the site of Eskimo villages (such as *Akotout*, in Rode Bay) a very luxuriant growth of vegetation springs up; and here I gathered some plants, which will be found recorded in their proper places.

(5.) *Illartlek Inlet.*—This inlet breaks the coast in lat. 69° 27′ N. Like all of such fjords or inlets, it is the site of an ancient glacier which here reached the coast. The entrance of it is in Pakitsok Bay, and is marked by an immense terminal moraine, where many plants grow luxuriantly.* I have always noticed that plants grow most luxuriantly near large rocks or boulders, the rock attracting a greater amount of heat to the soil. This is very evident on the broad American prairies, where stones are rare; and was equally apparent here, though on a lesser scale. At the head of this inlet (or at least one of the heads) a muddy glacier stream flows in, silting up the head of the inlet for several miles. On the left hand is a bold bluff of boulder (glacier?) clay and boulders, a remnant, as all such are, of the former upheaval of the coast, though at present, in the vicinity of Disco Bay at least, the coast is perceptibly sinking. This clay was in the form of fine sand, and kept together by a turf of Empetrum, Betula, and grasses; but on the windward side, where it meets the

* In this catalogue "Illartlek" refers to this locality; "Illartlek glacier," to the immediate vicinity of the glacier and inland ice, &c.

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blast from the glacier, it was bare of vegetation, and the fine powdery clay was blown into hillocks around a few willow tufts. On the less exposed places a few stunted plants grew, particularly *Ledum palustre*, here at least belying its trivial name, for it grows mostly on dry ground. Between the glacier and this place is a flat valley, after ascending the first slope, covered with a spongy turf and permeated by streams, and ornated with a little lake where the wild geese breed. On the slope, just before crossing over a little ridge to the glacier, I found the rare lichen *Dactylina arctica*, Nyl., in considerable profusion, but nowhere else. This valley is plentifully tufted with the fragrant *Hierochloe alpina*, which is used for stuffing the native boots. Crossing the ridge mentioned, we descend a little slope and face the glacier, the overflow of that great *mer de glace* which overspreads the whole interior of Greenland with an icy covering. The slope facing the glacier and the cliffs around are bare of vegetation, and the whole vicinity is very chilly and dreary. The cold blasts have even nipped the usual profusion of arctic vegetation, and we have to go far afield to gather the dwarf birch for our cooking fire. "On the slope, however, survive nearly all the species of Saxifraga, and on the sunny spots *Vaccinium uliginosum* is bearing its pleasant-tasted berries, all of which tell us that autumn (after which cometh the winter, when no man can work) is travelling on apace. Stellarias and Oxyria show themselves frequently, as do also *Epilobium latifolium*, and the Eriophorum with its tasselled head of cottony down, in the boggy places here and there, while *Stellaria Edwardsii* is occasionally seen quite abundant at the head of the inlet. *Papaver nudicaule* is coming into seed, as well as the species of Pedicularis, which, with *Lycopodium annotinum*, &c., maintain their ground in appropriate situations." The glacier face was in lat. 69° 24′ 12″ N. We entered the inlet on the 20th of July, and left on the 29th of the same month.

(6.) *Ritenbenk*—Lat. 69° 45′ 34″ N., long. 51° 7′ W.—The island on which this settlement is situated is called *Akpaet*, and presents nothing phytographically remarkable. There is a considerable amount of dwarf willow and turf on it. By the time we arrived here (August 20) the

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arctic flora was nearly gone, so that Ritenbenk does not figure much in this catalogue. The shore afforded, however, a few sea-weeds.

(7.) *Sakkak*—Lat. 70° 0′ 28″ N., long. 52° W. (approx.)—At this little outpost there is a broad sunny flat, with the "inland ice" appearing as miniature glaciers down between the cliffs behind. Here I found *Festuca ovina*, L., in great luxuriance, but except a few algæ from the shallow muddy ice-choked harbour I did not add greatly to my collection.

(8). *Atanakerdluk*—Lat. 70° 02′ 30″ N., long. 52° W. (approx.)—By the time we arrived here phanerogamic vegetation was nearly over; and except a few cryptogamic plants I have little to add from this locality. Here, as I have remarked, the geology entirely changes from the primitive to sedimentary formations; and the few days we spent here (22d to 24th August) were occupied by me almost entirely in collecting the miocene plants, and describing and making sections of the strata, the arid slope presenting no recent plants to collect. Though, of course, the limited materials possessed will scarcely admit of deciding what influence the change of soil, consequent on the altered geological conditions, may have in giving an altered character to the flora; yet, so far as I was able to judge from the decayed plants which remained above ground, it seems that they were, to a great extent, different from those gathered on the granitic soil.

(9.) *Ounartok*—Lat. 70° 2′ N., long. 52° 24′ W. (both approx.)—The locality known under this name seems to have been at one time a native "house-place," and traces can yet be seen of former habitations at the mouth of a gurgling creek which flows from the mountains, and it is yet a favourite camping place for the rare visitors and wayfaring-men along this dreary coast. Much debris has been brought down by this creek as it dashes from the mountains and the inland ice of Disco Island (for it is situated on the opposite shore of the Waigatz Strait, as are also the two next localities mentioned), and bursts through the sedimentary strata which lie in its way.

(10.) *Kudlesæt*—Lat. 70° 5′ 35″ N., long. 52° 32′ W. (approx.)—This was the most northerly locality reached by

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us in 1867. Here are green mossy slopes, but as the sun does not reach this spot for several hours in the day, the vegetation, even on the 27th of August, was backward. Here several streams flow down and form a marshy flat at one place before reaching the sea. On this wet ground, and on the sandy "links" which skirt the coast for a few yards in breadth at this place, I found one or two plants, such as *Juncus triglumis*, L., *Equisetum variegatum*, L., &c., which, though not peculiar to the locality, are yet rather uncommon in this region.

(11.) *Godhavn* or *Lievely*—Lat. 69° 14′ 58″ N.,* long. 53° 24′ 40″ W.—This little post, situated at the south-western point of Disco Island, is perhaps the best known botanical locality in all Greenland, having been a regular halting place for whalers and the numerous Arctic Expeditions. Hence we find plants from this locality figuring in all the lists hitherto published, and containing some not in this catalogue, as by the time we arrived (4th Sept.) vegetation had almost entirely disappeared. The settlement itself is built on an off-lying islet of syenite; but on the other side of the harbour on Disco Island, where the syenite meets with that great trap dyke which, either in its main body or in its offshoots, traverses the whole breadth of the islands of Disco and the Noursak peninsula, there is a "warm" stream of the same character as that on the island near Egedesminde, already described. This stream falls into the harbour, flowing through a little green valley called Lyngemarken (or the "heath valley"), backed by huge fells of trap. This Lyngemarken is the best botanical locality which I have yet seen in Greenland. Though most of the plants had faded down in this valley, yet, from what I was able to identify, or from other small collections, it appears to be very rich in species. The most characteristic plants are *Salix glauca*, *Betula nana* (seldom over one foot high), *Rhododendron lapponicum*, *Cassiope tetragona*, *Empetrum nigrum*, *Saxifraga tricuspidata*, *S. Aizoon*, *S.*

* Graah gives the lat. as 69° 14′ 22,″ while the late Lieut. Ulrich (in general a very good observer), according to a meridian altitude given me by the Royal Chart Office of Denmark, states it as 69° 13′ 30″ N.; but as Capt. Graah's position and mine agree so closely, I believe that we are nearer the truth.

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cæspitosa, *S. rivularis*, *Azalea procumbens*, *Gnaphalium norvegicum*, *Veronica alpina*, *Arnica alpina*, *Bartsia alpina*, *Campanula uniflora*, *Epilobium angustifolium*, *E. latifolium*, *Dryas octopetala* var. *integrifolia*, *Papaver nudicaule*, *Pedicularis flammea*, *Silene acaulis*, *Armeria maritima*, *Alchemilla vulgaris*, &c.; and among Cryptogamia, *Cetraria islandica*, *C. nivalis*, *Cladonia glacialis*, *Peltidea aphthosa*, *Polytrichum junperinum*, *Racomitrium canescens*, *Sphærophorum coralloides*, &c. (*vide* Dr Rink, &c.) The valley graduates by a gentle slope to a dark beetling precipice. At between one or two thousand feet from the shore the vegetation seems to be lost, and there is only seen mountain cliffs or debris of rocks rolled from above, through which the stream runs gurgling along. The most remarkable of all the plants, however, which I saw in this valley were remains of the "Qvan" (*Angelica officinalis*, Hoffm.), well known by its native and Norse name (apparently one of the words of the old Norsemen which have got incorporated in the Eskimo language), which grew in patches by the side of the stream, and occasionally in the moist ground. It is one of the most interesting plants of Greenland, and is only found on the island of Disco, in North Greenland. It is, however, abundant in the vicinity of South Greenland fjords, and particularly in the district of Julianshaab, so much so, that the natives say that Disco was once a portion of Julianshaab district, and that a great angekok or wizard towed it north. He would have towed it still further had not a rival cut the rope! This is what may be called a "myth of observation." The Danes and Greenlanders use the leaves much as an antiscorbutic. On the leaves is occasionally found *Vitrinia angelicæ*. By the borders of the stream, and at the northern head of the valley, I found *Achemilla vulgaris*, L., growing. I heard much of a place, about twelve miles from Godhavn, called *Qvannersoit*, "the place of the Qvan," which, if all stories are true, seems to be the most agreeable spot in the district. It is situated between high falls and "jokulls," with numerous waterfalls from them, and green slopes covered with the most luxuriant vegetation in all North Greenland. Angelica has been found at various places on the island of Disco, but nowhere so abundantly as here, as the name indicates.

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The willow is here eight feet high * when raised up from the ground. Numerous flowers grow here. *Rhododendron lapponicum*, *Pedicularis flammea*, *Ledum grönlandicum* (*palustre*), &c., are seen in profusion. Godhavn was the last locality visited in Greenland, and on the 12th of September we left in the royal trader "Hvalfisk," Capt. Hans Seistrup, for Denmark, just as the snow was beginning to cover the hills, and the nights were getting cold, dark, and dreary. My time was much occupied in zoological, geological, and astronomical work, besides having a full share of the varied duties of the party, so that my leisure for botany was limited; and when we take into account the time occupied in going from place to place, the period over which the collecting extended did not much exceed two months, the whole extent of our residence in the country being only three months.†

IV. *Economic Botany of Disco Bay*.—(1.) *Gardens*.—Around most of the little trading posts the Danish officers have attempted to cultivate a few garden vegetables, and by bringing soil from old Eskimo houses, and taking the greatest care, a few of the hardier vegetables are raised in small quantities. Potatoes never get bigger than marbles; but spinach, radishes, lettuces, &c. prosper, and are ready for use about the middle or beginning of August. Of Dr Pfaff's and Hr Anderson's gardens at Jakobshavn and Ritenbenk we have most pleasant remembrances. The garden at the latter place deserves honourable mention, and as it was, perhaps, one of the most favoured and favourable specimens of such, the description will suffice for all. It is situated on a sunny slope, with a southern exposure, and composed of earth brought from Old Greenland houses (and therefore richly manured), heaped up to the depth of two feet. The vegetables were most luxuriant—lettuce, cabbage, turnips (white), carrots, parsley, and onions. This garden parallelogram of 18 by 12 yards, with its luxuriant vegetation, the gravel walk, the miniature

* I have seen a stem of *Betula nana* from Upernavik (72° 48′ N.) two inches in diameter, and another from South-East Bay equally thick.

† It has been necessary to give these dates, in order to show the times of flowering, and to avoid repetitions, though the object of this paper is not to furnish any narrative of the journey.

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summer-house in the centre, the green watering-pot, and the bird nets over the lettuce, had quite a home aspect amid the barren Sahara of grey syenite and granite, and with hundreds of icebergs in sight at any hour. The Danish ladies cultivate in their houses most of our garden flowers, geraniums, fuchsias, roses, Nasturtiums (a great favourite), ivy, &c.; but they are apt to be destroyed if placed out of doors.

(2.) *Fuel.*—It is a great mistake to suppose that the Eskimo burn nothing but blubber for fuel. Their principal fuel is the turf, the birch, Empetrum, willow, Andromeda, Ledum, Vaccinium, &c., which they collect and store for winter use, or use immediately in the summer. We used this in all our travels, though, indeed, an armful soon blazes up like a bunch of straw. The collection, storing, and cutting of the various descriptions of fuel is interesting; but I must pass it over with this notice.

(3.) *Food Plants.*—Equally erroneous is the notion that they use no vegetable food. Berries form their principal article of vegetable diet, and comprehend blaeberries (*Vaccinium uliginosum*), cranberries, *Empetrum*, *Vaccinium Vitis-idæa*, &c. Though the latter is used by the Danish residents as a preserve, yet it is not eaten generally by the natives; and even the blaeberries are eaten cautiously by them, on account of some supposed noxious quality.

(4.) *Plants used Hygienically.*—There are some plants, of which the flowers, leaves, or roots are eaten raw or boiled, such as *Sedum Rhodiola*, the flowers of *Epilobium*, *Pedicularis hirsuta*, of which the flower tops are boiled and eaten as a sort of cabbage; the sorrel (*Oxyria*), and the well-known scurvy grass (*Cochlearia*), which is used in scurvy by the natives, who are often affected by that disease, though never touching salt. I have already spoken of the use of the Angelica by the Danes and Greenlanders. Iceland moss (*Cetraria islandica*) is found in various places; but is rarely, if ever, used by the natives. Various species of algæ are used as food, but only resorted to when they are hard pressed by hunger. The species chiefly used is called Aukpadlurtok (*Chorda Filum*, Ag.) *Fucus vesiculosus*, L., *Alaria Pylaii*, Grev. (Sutluitsok), (the ally of which, *Alaria esculenta*, is eaten on our own shores), *Rhody-*

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menia palmata, Grev., are also used. *Lycoperdon Bovista*, is said to be applied to bleeding wounds.

V. *Introduced Plants.*—In another memoir I propose discussing the origin and nature of the Greenland flora, its geographical range in Greenland, and the hypsometrical distribution of the species; but I believe it will not be out of place to conclude these introductory remarks on the Disco flora, by calling the attention of future collectors to the subject of introduced or colonist species. Species at all tender, if accidentally introduced into Greenland, though they may survive the summer, yet can scarcely be expected to live over the winter. There are, however, some plants found in Greenland, the indigenous character of which is doubtful. On the sides of the fjords, up to 61°, is found, in the form of small shrubs, the well-known *Sorbus Aucuparia*, L., and from its position there seems to be some good reason for supposing it was brought to Greenland by the old Norse and Icelandic colonists. Again, *Xanthium strumarium*, L., was found by Giesecke in the garden of the Moravian Brethren at Lichtenau in the Frith of Agluitsok, near Cape Farewell, in 60° N. lat.; but was probably sent from Europe in seed. These subjects, as well as the means by which plants may be transported from place to place, the hybridising of some of the more variable species, especially the Drabas, are all eminently worthy of being attended to; and as several Arctic expeditions will be in the field next summer, we may hope to obtain some more enlightenment on these matters.

VI. In addition to the gentlemen who have so minutely examined the collections, and regarding whose work I will not say a single word, as it speaks for itself, I have specially to thank Dr Hooker, Professor Oliver, and Mr J. G. Baker, of the Herbarium at Kew, for much assistance, and a *carte blanche* in the way of whatever aid the magnificent collections under their charge could afford to me while studying and assorting my collections. These collections comprehend all the species actually brought home, as far as flowering plants and ferns are concerned. Several other species, however, were identified, but too far gone to be preserved. It is possible that a further examination of some of the marine algæ and

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lichens may show some of them to be distinct, and during the examination of the zoological collections, a few minute species of algæ may be found. The diatomaceous and desmidious collections are so extensive that it was found impossible to present the result of their examination in this place, and a large portion of them is not yet accessible to science.* Though a large number of the species recorded in this *Florula* were identified by me at the time of collection, yet for the nomenclature as it now stands, the botanists whose names are placed after each division are responsible. For remarks regarding locality, I am solely answerable.

(I.) *Phanerogmia and Vascular Cryptogamia.* By D. Oliver, F.R.S., F.L.S., Professor of Botany, University College, London, &c.

1. *Thalictrum alpinum*, L. (In leaf only.) Lyngemarken, Disco I.
2. *Ranunculus hyperboreus*, Rottb. Jacobshavn, Akatont
3. *R. pygmæus*, Wahl. Akatont Jakobshavn, Christianshaab, Illartlek, Claushavn.
4. *R. lapponicus*, L. Jacobshavn.
5. *Papaver nudicaule*, L Green.† *Nasoot*, Claushavn, Jakobshavn, &c.
6. *Cochlearia officinalis*, L., var. *fenestrata*. (R. Br.) Jakobshavn, Egedesminde.
7. *C. officinalis*, L. Illartlek Inlet.
8. *Arabis alpina*, L. Claushavn, Ounartok.
9. *Cardamine bellidifolia*, L. Jakobshavn.
10. *Draba incana*, L. Jakobshavn.
11. *D. incana*, var. Claushavn, Jakobshavn.
12. *D. hirta*, L. Claushavn, Jakobshavn, Ounartok, Egedesminde.
    D. hirta, var. Ounartok, Illartlek.
13. *D. hirta*, var. (?) Siliqua ovato-elliptica v. ovato-oblonga demum parce puberula valvis reticulatis, pedicello æquilonga v. cod. longiore. Godhavn.
14. *D. muricella*, Wahl. (*D. nivalis*, Lilj.) Jakobshavn.

* For the species causing the discoloration of the sea, see *Transactions of the Society* for December, *Quarterly Journal of Science*, and *Seemann's Journ. of Botany*, 1868, and Translation in *Das Ausland* (Augsburg), Feb. 27, 1868.

† "Green."—Greenlanders. The name succeeding is the native one in the North Greenland dialect.

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15. *D. rupestris*, R. Br. Jakobshavn. Egedesminde, Illartlek.
16. *D. aff. D. rupestri*, differt: glabrilie, pedicellis inferioribus longioribus, siliquis late ovato-ellipticis v. fere rotundatis. Jakobshavn.
17. *Silene acaulis*, L. Egedesminde, Claushavn.
18. *Lychnis apetala*, L. Claushavn.
L. apetala, var. *triflora*. (R. Br.) Claushavn.
19. *L. alpina*, L. Claushavn, Jakobshavn.
20. *Cerastium alpinum*, L. Jakobshavn, Claushavn, Egedesminde.
21. *C. alpinum*, var. From the same localities.
22. *Stellaria humifusa*, Rottb. Jakobshavn, Akatont, Godhavn, Island north of Christianshaab (Krikertasasuk).
23. *S. longipes*, Goldie. Christianshaab.
24. *S. longipes*, var. (*S. Edwardsii*, R. Br.) Claushavn, Illartlek, Akatont, Jakobshavn, Christianshaab.
25. *S. media*, L. (Near houses only.) Christianshaab.
26. *S. cerastoides*, L. (*Cerastium trigynum*.) Claushavn, Godhavn, Ounartok, Lyngemarken.
27. *Arenaria arctica*, Stev. (*A. biflora*, Wahl.) Lyngemarken, Claushavn.
28. *A. verna*, L. Jakobshavn, &c.
29. *Montia fontana*, L. Akatont, Claushavn.
30. *Alchemilla vulgaris*, L. Lyngemarken.
31. *Dryas octopetala*, var. *integrifolia* (V.) (*D. integrifolia*, V.)—foliis in speciminibus nonnullis basin versus crenato-dentatis. Egedesminde (Miss Levesen, 1866), Illartlek, Christianshaab, Claushavn, Jakobshavn.
32. *Potentilla nivea*, L. β. (*P. groenlandica*, R. Br.) Claushavn.
33. *P. nivea*, L. Illartlek, Claushavn, Jakobshavn.
34. *P. tridentata*, L. Christianshaab, Lyngemarken.
35. *P. anserina*, L. Krikertasusuk Island, six miles north of Christianshaab.
36. *Sibbaldia procumbens*, L. Jakobshavn.
37. *Saxifraga oppositifolia*, L., Green. *Kakethlanglet*. Jakobshavn, Illartlek, Christianshaab, Egedesminde.
38. *S.* (*Aizoon*, Jacq.) *Cotyledon*, L. Christianshaab.
39. *S. cæspitosa*, L. Illartlek, Christianshaab, Jakobshavn, Egedesminde, Claushavn.
40. *S. stellaris*, L. Jakobshavn.
41. *S. rivularis*, L. Jakobshavn, Illartlek, Egedesminde (Miss Levesen).
42. *S. cernua*, L., Green. *Akudleloot*. Illartlek, Christianshaab, Egedesminde (Miss Levesen), Claushavn, Jakobshavn.
43. *S. tricuspidata*, Retz, Green. *Nōovēet*. Proven, lat. 72° (Miss Levesen), Egedesminde (Miss Levesen), Claushavn, Jakobshavn

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44. *S. nivalis*, L. Jakobshavn, Sakkak. Egedesminde (Miss Levesen).
45. *Hippuris vulgaris*, L. Jakobshavn.
46. *Epilobium latifolium*, L. Christianshaab, Claushavn, Jakobshavn, Egedesminde (Miss Levesen).
47. *E. angustifolium*, L. Varietas foliis oblongo-lanceolatis basi obtusis sessilibus v. subsessilibus interdum ternatim approximatis, racemis brevibus foliosis, stylo staminibus breviore. Lyngemarken.
48. *Campanula rotundifolia*, L., var. *linifolia* (Haenk). Claushavn, Jakobshavn, Illartlek Inlet.
49. *C. uniflora*, L. Jakobshavn.
50. *Vaccinium uliginosum*, L., Green. *Pŭllōot.* Egedesminde, Illartlek, Christianshaab, Jakobshavn.
51. *Pyrola rotundifolia*, L., var. *grandiflora*, D.C., Green. *Lapasert.* Jakobshavn, Illartlek, Proven, and Egedesminde, 1866 (Miss Levesen).
52. *P. rotundifolia*, var. Christianshaab, Claushavn.
53. *Diapensia lapponica*, L Jakobshavn, Claushavn, Egedesminde (Miss Levesen).
54. *Cassiope hypnoides*, D M. Egedesminde (Miss Levesen).
55. *C. tetragona*, D.M., Green. *Isutseet.* Egedesminde (Miss Levesen), Jakobshavn, Claushavn.
56. *Phyllodoce taxifolia*, Salisb. Egedesminde and Proven (Miss Levesen), Claushavn, Christianshaab.
57. *Ledum palustre*, L., Green. *Karasatch.* Claushavn, Jakobshavn, Godhavn, Egedesminde (Miss Levesen).
58. *Loiseleuria procumbens*, Desf. Egedesminde (Miss Levesen), Jakobshavn, Claushavn.
59. *Rhododendron lapponicum*, Wahl. Egedesminde, Jakobs havn, Godhavn, Claushavn, Christianshaab.
60. *Erigeron alpinus*, L. Jakobshavn. Claushavn.
61. *E. compositus*, Pursh. Atanakerdluk.
62. *Artemisia borealis*, Pall. Christianshaab.
63. *Gnaphalium norvegicum*, Gunn. Lyngemarken.
64. *Artemisia alpina*, L. Atanakerdluk. Lyngemarken, Jakobshavn, Claushavn.
65. *Arnica montana*, L., var. *angustifolia*. Claushavn, Illartlek, Jakobshavn.
66. *Taraxacum dens-Leonis*, Desf., var. *palustre*. Claushavn.
67. *Pedicularis lapponica*, L., Green. *Udenarooset.** Claushavn, Christianshaab, Jakobshavn.
68. *P. flammea*, L. Jakobshavn, Claushavn, Egedesminde (Miss Levesen).
69. *P. hirsuta*, L. Jakobshavn, Illartlek, Egedesminde (Miss Levesen).

* Probably all the genus has the same name.

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70. *Veronica alpina*, L. Lyngemarken.
71. *Bartsia alpina*, L. Christianshaab.
72. *Pinguicula sine flore verisim. P. vulgaris.* Christianshaab.
73. *Armeria vulgaris*, Willd. Claushavn.
74. *Plantago maritima*, L. Claushavn, Illartlek.
75. *P. borealis*, Lange.* Jakobshavn. (Rocks near Dr Pfaff's house, very sparingly.)
76. *Polygonum aviculare*, L. Christianshaab (Colonist?) Jakobshavn, Claushavn, Christianshaab, Proven, and Egedesminde (Miss Levesen).
77. *Oxyria reniformis*, Hk., Green. *Somnit*. Jakobshavn, Illartlek.
78. *Betula nana*, L., Green. *Modikoote*. Jakobshavn, Egedesminde (Miss Levesen), Godhavn.
79. *Empetrum nigrum*, L., Green. *Panukojet*. Egedesminde, &c. (universally distributed).
80. *Salix glauca*, L. Jakobshavn, Claushavn, Egedesminde.
81. *S. arctica*, R. Br.? Green. *Seet*. Egedesminde, Jakobshavn.
82. *S. herbacea*, L. Jakobshavn.
83. *S.*, sp. (♀ fl.) Egedesminde.
84. *S.*, an var. *S. arctica?* Egedesminde (Miss Levesen).
85. *S. glauca*, L., var. foliis latioribus apice rotundatis late acutatisve (poll. latis), Jakobshavn.
86. *Tofieldia palustris*, L. Claushavn, Jakobshavn, Christianshaab.

* This species was only recently described by Professor Lange, of Copenhagen, in Fasiculus 46, of the *Flora Danica* (tab. 2707, Supplement), and was identified by me on Dr Lange showing me the plate and specimens. As this publication does not seem to have yet reached England, I append a short description which I have received from that gentleman (in letter, 9th August 1868):—"*Plantago borealis*, Lge., perennis 2-3 pollicaris; foliis radicalibus crebris, cum scapis numerosis; foliis vix. v. parum superantibus cæspitoso—congestis carnulosis, anguste linearibus, obtusis, integerrimis; spica ovato-subgloboso v. cylindrico-ovali; bracteis ovatis, acuminatis, basi barbatis, ceterum glabris; sepalis ovali-obovatis apice ciliatis, nervo dorsali fusco valide prominente, margine pallidis; corollæ albidæ v. sordide luteolæ laciniis lineari-lanceolatis, acutis v. acuminatis, tubo conico, villoso, antheris sagittatis luteis; capsula ovali infra medium circum-cissa, c. 4-sperma; semenalibus ovalibus, membranaceo-alatis—Lge. inser. ad Babingt. fl. Island ined. *P. alpina*, Dcne, in DC. Prod. xiii. 731, ex part (quoad pl. Island.); Lindsay, Fl. of Iceland, p. 31; *P. maritima*, var. *glauca*, Hornen., Pl. Ed. 3, p. 167; *P. glauca*, Wormskj.. inser. (non Cutchey). In *Islandia*, Herbb. Hornenmann et Leebmann); Eadem speciem in Grönlandia a legerunt, J. Vahl. Holböll et Rink. Specimen 2 ex Islandia, 1–3 ad littora sinus Igaliko Grönlandiæ (Vahl)." Its nearest ally is *P. alpina*, an alpine species of Southern Europe and the Pyrenees. It appears to be distinct, but the genus is a very difficult one. No other plantago grew near where I collected it.—R. B.

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87. *Juncus biglumis*, L. Kudlesæt.
88. *J. triglumis*, L. Claushavn.
89. *J. castaneus*, Sm. Claushavn, Jakobshavn.
90. *Luzula spadicea*, DC. Lyngemarken.
91. *L. hyperborea*, R. Br. Jakobshavn, Lyngemarken.
92. *L. campestris*, Sm., var. *congesta*. Claushavn, Jakobshavn, Illartlek.
93. *Scirpus cæspitosus*, L. Claushavn.
94. *Eriophorum capitatum*, Hist., Green. *Okăliousăk*.* Illartlek, Egedesminde.
95. *E. vaginatum* ? L. Jakobshavn.
96. *E. angustifolium*, Hoppe. Jakobshavn.
97. *Carex rupestris*, All. Claushavn, Jakobshavn.
98. *C. lagopina*, Wahl. Godhavn.
99. *C. rigida*, Good (*et* vars.) Jakobshavn, Lyngemarken, Egedesminde (Miss Levesen).
100. *C. aquatilis*, Wahl. Jakobshavn.
101. *C. rariflora*, Sm. Akatont, Illartlek, Jakobshavn.
102. *C. alpina*, Sm. (*C. Vahlii*, Sch.) Single specimen, Jakobshavn.
103. *C. aff. C. stenophyllæ*. Jakobshavn.
104. *Alopecurus alpinus*, L. Jakobshavn, Egedesminde.
105. *Hierochloe alpina*, L., Green. *Eeweek*. Claushavn, Jakobshavn, Illartlek, &c.
106. *Phippsia algida*, R. Br. Jakobshavn.
107. *Calamagrostis lanceolata*, Robb. (var. *C. phragmitoides*, Hart.) Lyngemarken, Jakobshavn.
108. *Trisetum subspicatum*, P. B. Claushavn.
109. *Elymus arenarius*, L. Illartlek, Akatont, Claushavn.
110. *Agrostis rubra*, L. (*A. alpina*, Wahl.) Jakobshavn, Christianshaab.
111. *Poa annua*, L. Jakobshavn.
112. *P. alpina*, L. Claushavn, Lyngemarken, Jakobshavn.
113. *P. alpina*, *forma elatior*. Akatont.
114. *P. cæsia*, Sm. Claushavn, Christianshaab, Jakobshavn.
115. *P. nemoralis*, L. Claushavn, Jakobshavn.
116. *P. pratensis*, L. Proven (Miss Levesen), Claushavn, Jakobshavn, Christianshaab.
117. *P. flexuosa*, Wahl. Illartlek, Jakobshavn.
118. *P. nemoralis*, L., var. Jakobshavn, Akatont, Illartlek.
119. *P. flexuosa*, Wahl., var. (*P. cenisia*, All.) Illartlek.
120. *Glyceria maritima*, M. & K. Illartlek.
121. *G. (Poa) angustata* (Br.) Akatont, Christianshaab.
122. *Festuca ovina*, L. Sakkak, Claushavn, Illartlek. Jakobshavn.

* A generic name.

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123. *Lycopodium Selago*, L., Green. *Toterurese.* Jakobshavn, Egedesminde, &c.
124. *L. annotinum*, L. Jakobshavn, Illartlek.
125. *Equisetum arvense*, L. Jakobshavn, Kudlesæt, Lyngemarken, Claushavn.
126. *E. variegatum*, L. Lyngemarken, Kudlesæt.
127. *Cystopteris fragilis*, Bernh. Claushavn, Jakobshavn, Illartlek Inlet.
128. *Woodsia ilvensis*, R. Br. Claushavn, Jakobshavn, Christianshaab.
129. *W. ilvensis*, var.? Too young to determine, but possibly this may be *W. glabella*, R. Br. Jakobshavn.

(II.) *Mosses.* By M. A. Lawson, M.A., Professor of Botany in the University of Oxford.

1. *Andreæa rupestris*, Hedw. Jakobshavn.
2. *Sphagnum squarrosum*, Persoon. Egedesminde.
3. *Splachnum sphæricum*, Hedw. Jakobshavn.
4. *Aulacomnium palustre*, Schw. Jakobshavn.
5. *Polytrichum juniperinum*, Linn., var. *alpestre.* Jakobshavn.
6. *P. sexangulare*, Hoppe. Jakobshavn.
7. *Bryum pallens*, Sw. Jakobshavn.
8. *B. pseudotriquetrum*, Br. Lyngemarken, Disco. I.
9. *B. crudum*, Schreb. Jakobshavn.
10. *B. inclinatum*, Dicks Jakobshavn.
11. *B. cæspiticium*, Schw. Jakobshavn.
12. *B. Zierii* (? no fruit), Dicks. Jakobshavn.
13. *B. carneum* (?) B. Jakobshavn.
14. B. *capillare*, H. & W. Jakobshavn.
15. *Leptobryum pyriforme*, Wils. Jakobshavn.
16. *Psilopilum arcticum*, Brid. Jakobshavn.
17. *Dicranum virens*, Hedw. Jakobshavn.
18. *D. cerviculatum*, Hedw. Jakobshavn.
19. *D. squarrosum*, Starke. Lyngemarken and Egedesminde
20. *D. palustre*, Brid. Jakobshavn.
21. *D. polycarpum*. H. & T. Jakobshavn.
22. *Grimmia pulvinata*, Hook et Tayl. Godhavn.
23. *Orthotrichum rupestre*, Schlech. Jakobshavn.
24. *Conostomum boreale*, Sw. Jakobshavn.
25. *Bartramia ithyphylla*, Bred. Jakobshavn.
26. *B. fontana*, Schw. Jakobshavn and Lyngemarken.
27. *Tortula fallax*, Hdw. Jakobshavn.
28. *Ceratodon purpureus*, Bred. Jakobshavn.
29. *Didymodon rubellus*, Br. Jakobshavn.
30. *Weissia cirrhata*, Hdw. Godhavn.

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31. *Distichium capillaceum*, Br. et Sch. Jakobshavn.
32. *Hypnum Schreberi*, Willd. Jakobshavn.
33. *H. uncinatum*, Hdw. Jakobshavn.
34. *H. riparium*, L. Jakobshavn.
35. *H. fluitans*, L. Jakobshavn.
36. *H. pulchellum*, Dicks. Jakobshavn.
37. *H. molle*, Dicks. Jakobshavn.
38. *H. rutabulum*, Linn. Jakobshavn.
39. H. *stramineum*, Dicks. Jakobshavn.

In addition to the above, Mr Alex. Croall detected among algæ gathered on the shore, or washed up from the harbour of Godhavn, several species of mosses, which had been swept down by the mountain torrents from Lyngemarken Fell, and other of the bold mountains surrounding the "good harbour." They may have possibly some geological interest in reference to the imbedding of land species in marine formation in company with marine plants. They are as follows:—

Dicranum scoparium,
Polytrichum urnigerum,
sexangulare,
piliferum,
Bryum albicans,
Bryum nutans,
Wahlenbergii,
Hypnum fluitans.
stramineum.

Some of them are also additions to the muscological flora of Greenland.

(III.) *Hepaticæ.* By Benjamin Carrington, M.D., F.L.S., Eccles.

[The Hepaticæ here enumerated were almost solely collected at Jakobshavn along with the mosses already described. As none of them are of any great rarity, it has not been thought necessary to affix in this summary the exact localities in every case.]

1. *Jungermannia barbata*, var. *attenuata*, Mart.
2. *J. barbata*, var. *Floerkii*, N. ab E.
3. *J. barbata*, var. *lycopodioides*.
4. *J. catenurlata*, Hubener.
5. *J. divaricata*, E. B.
6. *J. acuta*, Lindbg.
7. *J. minuta*, Swz.

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8. *J. alpestris*, Schleich. A few stems among *J. minuta*.
9. *J. setiformis*, Ehrh.
10. *Ptilidium ciliare*, N. ab E.
11. *Marchantia polymorpha*, Linn.*

(IV.) *Lichens*. By W. LAUDER LINDSAY, M.D., F.R.S.E., F.L.S., Perth.

1. *Alectoria jubata*, L., var. *chalybeiformis*, L. Jakobshavn, &c.
2. *A. ochroleuca*, Ehrh. Jakobshavn and Godhavn.
3. Do., var. *nigricans*, Ach. Illartlek glacier.
4. *Cetraria islandica*, L., var. *Delisei*, Bory.
5. *C. islandica*, var. *leucomeloides*, Linds.
} Lyngemarken, Godhavn, Egedesminde, Jakobshavn, &c.
6. *C. cucullata*, Bell. Jakobshavn, Egedesminde, and Illartlek glacier.
7. *C. nivalis*, L. Jakobshavn, &c.
8. *C. aculeata*, Ehrh. Jakobshavn, &c.
9. *Dactylina arctica*, Nyl.† Near Illartlek glacier.
10. *Nephroma arcticum*, L. Godhavn.
11. *Peltigera aphthosa*, Ach. Egedesminde.
12. *P. venosa*, L.? Jakobshavn, &c.
13. *P. canina*, Hoffm.
14. Do., var. *rufescens*, Auctt. pr. p. Egedesminde, Lyngemarken, &c.
15. *Solorina crocea*, L. Lyngemarken, Illartlek glacier.
16. *Parmelia saxatilis*, L. Jakobshavn, Illartlek glacier.
17. *P. saxatilis*, var. *panniformis*, Ach. Illartlek, &c.
18. *P. saxatilis*, var. *sphærophoroidea*, Linds. Egedesminde, &c.
19. *P. saxatilis*, var. *omphalodes*, L. Jakobshavn, Egedesminde, Illartlek glacier, &c.
20. *P. olivacea*, L. Egedesminde. The collection contains several varieties of this.

* Dr Carrington (in letter, Aug. 7) remarks,—"I have also (from Greenland) *J. groenlandica*, N. ab E.; *J. cordifolia*, Hook.; *J. albescens*, Hook.; *J. saxicola*, Schradr.; *J. bicuspidata*, L.; *J. julacea*, Lightf.; *J. laxifolia*, Hook." The following species have also been recorded from Greenland:—*Sarcoscyphus sphacelatus*, N. ab E.; *Gymnomitrum concinnatum*, Corda; *Alicularia compressa*, Hook.; *Scapania compacta*, Lindbg.; *S. uliginosa*, N. ab E.; *Marpanthus Flobovianus*, N. ab E.; and *Fimbriaria pilosa*, Tayl.

† This rare fungoid-looking lichen was found by me in considerable abundance on a dry mossy slope before reaching the Illartlek glacier. It was detected by Mr W. G. Smith, having been accidentally packed in the fungi parcels.

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21. *P. Fahlunensis*, L. Jakobshavn, &c.
22. *P. lanata*, L. Jakobshavn, Illartlek glacier.
23. *P. encausta*, Sm. Jakobshavn, &c.
24. *P. stygia*, L. (Several varieties.) Jakobshavn, Illartlek glacier.
25. *Physia pulveruenta*, Pers. Jakobshavn.
26. *P. cæsia*, Hffm. Kudlesæt.
27. *Physica stellaris*, L. Jakobshavn.
28. *Placodium elegans*. Link. Jakobshavn, &c.
29. *P. chrysoleucum*, Sm. } Kudlesæt.
30. *P. chrysoleucum*, var. *opacum*, Ach. } Kudlesæt.
31. *Pannaria brunnea*, Sw. } Ounartok, Godhavn, Lyngemarken, and Illartlek glacier.
32. *P. brunnea*, var. *coronata*, Hffm. } Ounartok, Godhavn, Lyngemarken, and Illartlek glacier.
33. *Squamaria saxicola*, Poll. Jakobshavn, Godhavn.
34. *Lecanora ventosa*, L. Jakobshavn.
35. *L. tartarea*, L. } Jakobshavn, Lyngemarken, Godhavn, Illartlek glacier.
36. *L. tartarea*, var. *frigida*, Sw. } Jakobshavn, Lyngemarken, Godhavn, Illartlek glacier.
37. *L. tartarea*, var. *gonatodes*, Ach. } Jakobshavn, Lyngemarken, Godhavn, Illartlek glacier.
38. *L. parella*, L. Kudlesæt.
39. Do., var. *Upsalienis*, L. Jakobshavn, &c.
40. *L. oculata*, Dicks. (Various varieties.) Jakobshavn and Illartlek glacier.
41. *L. polytropa*, Ehrh. Jakobshavn, Ounartok, Egedesminde, &c.
42. *L. polytropa*, var. *intricata*, Schrad. Ounartok.
43. *L. badia*, Ehrh. Jakobshavn, Ounartok.
44. *L. subfusca*, L. Jakobshavn, &c.
45. *L. subfusca*, var. *epibrya*, Ach. Jakobshavn, &c.
46. *L. bryontha*, Ach. Jakobshavn, &c.
47. *L. turfacea*, Whlb. Jakobshavn, &c.
48. *L. sophodes*, Ach. (Many varieties.) Jakobshavn, &c.
49. *L. calcarea*, L. Kudlesæt and Jakobshavn.
50. *L. cinerea*, L. Kudlesæt (various forms).
51. *L. smaragdula*, Whlb. Jakobshavn.
52. *Stereocaulon paschale*, L.
53. *S. tomentosum*, var. *alpinum*, Laur.
54. Do., var. *denudatum*, Auctt. Egedesminde, &c.
55. *Cladonia pyxidata*, L. (Various vars.) Jakobshavn and Illartlek glacier.
56. *C. verticillata*, Hffm., var. *cervicornis*, Ach. Jakobshavn, &c.
57. *C. gracilis*, L. (Various vars.) Jakobshavn, Illartlek glacier, &c.
58. *C. amaurocræa*, Flk. Egedesminde and Godhavn.
59. *C. furcata*, Schreb. Godhavn (various forms).
60. *C. cornucopioides*, L. (Various vars.) Jakobshavn, &c.

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61. *C. fimbriata*, L. Jakobshavn, &c.
62. *C. deformis*, L. Jakobshavn, Egedesminde, &c.
63. *C. rangiferina*, L. Egedesminde.
64. *C. degenerans*, Flk. Jakobshavn, &c.
65. *C. uncialis*, L. Godhavn.
66. *Thamnolia vermicularis*, Sw. Jakobshavn.
67. *Umbilicaria hyperborea*, Ach. (Various vars.) Jakobshavn, &c.
68. *U. arctica*, Ach. Illartlek glacier.
69. *U. cylindrica*, L. (Various vars.) Jakobshavn and Egedesminde.
70. *U. vellea*, L. Jakobshavn.
71. *Lecidea Groenlandica*, Linds.* (Nova species.) Jakobshavn.
72. *L. vernalis*, L. Jakobshavn, &c.
73. *L. parasema*, Ach. (Vars.) Lievely, Atanakerdluk.
74. *L. lapicida*, Ach. Jakobshavn, &c.
75. *L. fusco-atra*, L. Jakobshavn.
76. *L. castanea*, Hepp? Illartlek glacier.
77. *L. subuletorum*, Schreb. Jakobshavn, &c.
78. *L. obscurata*, Smrf.? Jakobshavn, &c.
79. *L. disciformis*, Fr. (Various vars.) Illartlek glacier, &c.
80. *L. atro-alba*, Ach. (Various vars.) Jakobshavn, &c.
81. *L. petræa*, Wulf. (Var.) Atanakerdluk, Jakobshavn, &c.
82. *L. geographica*, L. (Various vars.) Jakobshavn, Egedesminde, &c.
83. *L. alpicola*, Schr. Jakobshavn, Egedesminde, &c.
84. *L. sulphurella*, Th. Fr.? Atanakerdluk.
85. *L. myriocarpa*, D.C. Jakobshavn, Egedesminde, &c.
86. *Sphærophora coralloides*, Ach. (Various vars.) Egedesminde, Illartlek glacier, &c.
87. *Coniocybe furfuracea*, L. Illartlek glacier, Claushavn.
88. *Collema melænum*, Ach. Jakobshavn.
89. *Leptogium lacerum*, Sw. Jakobshavn.
90. *Ephebe pubescens*, L. Egedesminde.
91. *Normandina viridis*, Ach. Lyngemarken.

(V.) *Marine Algæ*. By ALEX. CROALL, Associate B.S. Derby.†

[I did not make the collection of Algæ a special object, and the comparatively large number of species here recorded is due more to the skill and patient industry of Mr Croall,

* This species, along with other *new* forms (species and varieties) not here enumerated, will be described in a separate Memoir in preparation.

† Joint author of "The Nature-Printed British Seaweeds."

than to any special acumen or diligence on the part of the collector. Hitherto, exclusive of fresh water forms, there have been found beyond 60° north latitude over the whole Arctic region 63 species of marine algæ.* The well-known algologists who have examined this collection have been able to detect, by critically examining every scrap, 41 species of marine and 11 fresh water forms in or around Disco Bay alone.]

MELANOSPERMEÆ.

1. *Fucus vesiculosus*, L. Ritenbenk shore, with *Ectocarpus crinitus* &c. 30th August, v.c. Egedesminde, off Rifkol, &c.

Most of the specimens are rather dwarfish, some of them even less than an inch in length, yet even some of these bear fruit, and among them are specimens both with and without air vesicles.

2. *Fucus nodosus*, L.

Rather more slender than usual, and the receptacles more globose; but similar forms may be seen on our own shores. Floating in sea out of sight of land, in Davis' Straits, off Lichtenau. June.

3. *Desmarestia aculeata*, L.

Scarcely differing from ordinary specimens, and barren as usual. Jakobshavn harbour, in 4 to 5 fathoms, muddy bottom; very plentiful.

4. *Alaria Pylaii*, Grev.

Common just within low-water mark at Jakobshavn, &c. Eaten by the natives.

5. *Laminaria saccharina*, Lam.

Everywhere in the Laminarian zone; called *kăk-wŏk* by the natives.

6. *Chorda filum*, Ag.

Rockpools, and similar to such on our own shores, also in 2 fathoms; abundantly. Sakkak, Waigatz Strait. August.

7. *Agarum Turneri*, P. & R.

Very abundant in Egedesminde harbour, in from 5 to 6 fathoms; substance of frond very brittle when fresh.†

* Dickie, Journ. Linn. Soc. Botany, vol. ix. pp. 235–243.

† In both 1861 and 1867 I identified as common along the Arctic shores, *Laminaria longicruris*, De la Pyl., and *L. fascia*, Ag. Among a small collection made at Godhavn by Fru Smith, wife of the Royal Inspector of North Greenland, I detected *L. digitata*, L., in addition.

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DICTYOTACEÆ.

8. *Dictyosiphon fœniculaceus*, Grev.

The specimens exhibit both the solid and fistulose state of the plant, but no spores were observed. Most of the specimens had been found floating. Jakobshavn, 3 fathoms, July 5, with many Diatomaceæ; Egedesminde, June 10th, high-water mark; pools on shore, with *Schizonema obtusum;* Claushavn, 30th June, floating near shore; Disco Bay generally; Ritenbenk, on shore, August; Sakkak, in 2 fathoms, August, &c.—everywhere common.

CHORDARIACEÆ.

9. *Chordaria flagelliformis*, Lam.

Parasitic on *L. longicruris*, floating in Davis' Straits, May 29th; Rock-pools at high-water mark, Egedesminde, 10th June.

10. *Elachishta fucicoli,* Fries.

Parasitic on *Fucus vesiculosus*, in company with *E. crinitus;* in rock-pools within high-water mark, where streams of fresh water flow over it during a portion of the day. Jakobshavn. June.

ECTOCARPACEÆ.

11. *Sphacellaria plumosa*, Ag.

12. *Sphacellaria cirrhata*, Ag.

The first species appears to be the most common, as small fragments of it were continually occurring entangled with almost every specimen. In the primary branches the pinnæ are close together, a pair proceeding from every joint; but in the ultimate branchlets, a pair proceeds only from every alternate joint. No separate specimens were observed; but very satisfactory fragments were found among a mass of rubbish washed up at high-water mark, at Godhavn harbour, with other algæ and fresh-water plants.

13. *Ectocarpus siliculosus*, Lyngb.

Very dwarfish, scarcely an inch in height, and barren; floating in the sea off Holsteensborg, &c. May.

14. *E. crinitus*, Carm.

In rock-pools, Jakobshavn, common; also found at Ritenbenk and Godhavn. The specimens referred to this species are sufficiently numerous, but without fruit; if not identical with this species, they are certainly very closely allied, at least in structure; the ramuli being even more distant than those of *E. crinitus*, in Harvey's "Phycologia Britannica," and more patent, being mostly set at nearly right angles; and are either opposite or solitary, long, simple, or again branched in a similar manner. One of the pinnæ is often wanting, or abbreviated into a short spine-like branchlet. It cannot be a very uncommon species, as fragments

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of it were occurring with almost every specimen, often much decomposed, and covered with Diatomaceæ.

RHODOSPERMEÆ.

RHODOMELACEÆ

15. *Polysiphonia urceolata*, Grev.

Most of the sections exhibit five siphons, occasionally four, while *P. arctica* is said to have seven. The specimens were parasitical on the stems of Laminariæ, from a depth of 3 fathoms (Jakobshavn); also in rocky pools at Egedesminde, &c.

16. *Melobesia polymorpha*, L.

A very characteristic specimen of this species, smooth, rounded; the upper surface covered with the dot-like punctures of the Ceramidia; the margin free, and somewhat curved upwards. A fracture shows that only the upper surface, forming a narrow zone of about $\frac{1}{6}$th of an inch in depth is alive, being still filled with the colouring matter of the cells, the rest being pure white.

17. *Delesseria angustissima*, Griff.

A small fragment of this only was detected entangled among the filaments of *Conferva Melagonium*, without fruit, but sufficiently characteristic of the species. Jackobshavn, 5 fathoms; plentiful. July.

18. *Hypnea purpurascens*, Harv.

Small fragments of this species only were observed, mixed up with others, also without fruit. Egedesminde. June.

19. *Euthora cristata*, J. Ag.

A small but very distinct specimen of this was found growing on a fragment of *Tubularia indivisa*, L.

20. *Rhodophyllis veprecula*, J. Ag.

A single small specimen of this was dredged from 12 fathoms. Most of the ciliæ contain tetraspores. The frond at first appears to be obovate, entire at the base, becoming toothed upwards, more decidedly so at the extremity. These teeth appear ultimately to elongate into cilia, laciniæ, or even new fronds, and are generally about $\frac{1}{6}$th of an inch in length; but occasionally extend to 2 inches, and are spathulate at the extremity. Those bearing tetraspores are generally spathulate, but at times become much acuminated, and lengthened to half-an-inch or more. Egedesminde, June, with *Flustra avicularis*, and *Callithamnion americanum.*

21. *Dumontia filiformis*, Grev.

Just below high-water mark at the "Kirke" of Jakobshavn, June, plentiful; Ritenbenk shore, August.

22. *Kallymenia reniformis*, Turn.

We have some hesitation in referring the specimens to this species, not from any doubts entertained as to their identity, but

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from the circumstance of the specimens of previous collections having been referred to a different species, or at least designated by a different name (*Kallymenia Pennyi*, Har.) It is a rare occurrence to find these delicate fronds perfect in the outline, being generally more or less torn and eroded by marine animals, as well as by the action of the waves. Without fruit, and without the outline of the fronds, the structure is our only guide in identifying species. We have placed sections of the present on the table of the microscope, side by side with those from a specimen gathered by the late Mrs Griffiths on the west coast of England, and we can discover no perceptible difference, either in thickness or structure. Of *K. Pennyi* we have seen no specimens; but in Harvey's "Nereis Boreali-Americana," it is said to be "only of half the thickness, the medullary network more lax, and the cortical cellules larger."

23. *Holosaccion ramentaceum*, J. Ag.

There are numerous examples of this, many of them quite simple, and others abundantly branched, and from 3 to 7 inches in length. Jakobshavn, Sakkak (2 fathoms), &c., v.c.

24. *Rhodymenia palmata*, L. Jakobshavn, in 3 fathoms, July.

CERAMEACEÆ.

25. *Ceramium rubrum*, J. Ag.

A rather slender form, the main stems opaque, the branches sub-diaphanous. It may prove a distinct species when this puzzling genus is better understood. Washed up on the beach at Godhavn. September.

26. *Ptilota serrata*, Kutz.

Another intermediate form, and equally puzzling. Only a few fragmentary specimens were observed mixed with other species; the smallest of these, however, exhibit the doubtful character of the species. Jakobshavn, 3 fathoms; just below high-water mark at Claushavn, covered with *Cellularia reptans.*

27. *Callithamnion americanum*, Harv.

Only a few fragments of what seems referable to this species were detected among *Rhodophyllis veprecula.* It is remarkable for the length of the joints, and the patent and attenuated branches.

28. *C. Rothii*, Lyngb.

Scarcely differing even in luxuriance from well-grown specimens on our own shores.

CHLOROSPERMEÆ.

SIPHONACEÆ.

29. *Bryopsis plumosa*, Ag.

Specimens small, but characteristic of the species. The size

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may depend partly upon the season (June), and partly on the locality (in rock pools).

CONFERVACEÆ.

30. *Cladophora arcta*, Kutz.

In the collection there are numerous specimens exhibiting the plant both in the spring and summer form, some of them in a beautifully sporiferous condition. Pools on shore off Jakobshavn, June; Egedesminde, sandy shore close to high-water mark, June 10; Sakkak, 2 fathoms, August. Godhavn, washed on beach, September.

31. *Conferva arenosa*, Carm.

Agrees in structure, but the filaments finer than usual in this species. Jakobshavn, rocks on shore. July.

32. *C. melagonium*, Web. et Mohr.

The specimens agree well in structure, but their luxuriance is remarkable; from 18 to 24 inches being the average size. They are thus much less rigid than if they were more dwarfish and stunted in their growth. Jakobshavn harbour, 5 fathoms, July, plentiful; and outside of the harbour, in 3 fathoms, not so common.

33. *C. Youngeana*, Dillw.

To this species we refer a few filaments apparently attached to a slice from the stem of *Laminaria longicruris*, being unable satisfactorily to refer them to any other. Found floating in Davis' Straits, off Refkol, mixed with *Schizonema obtusum*. June.

ULVACEÆ.

34. *Enteromorpha compressa*, Grev.

As plentiful and as polymorphous apparently as on our own shores. All the forms, however, seem easily referable to the present species. Jakobshavn, 3 fathoms, July; Sakkak, August.

35. *Ulva latissima*, L.

Equally abundant with the last. Jakobshavn, 3 fathoms. August, &c.

36. *Porphyra vulgaris*, Ag.

Sakkak, 2 fathoms. August.

37. *Bangia fusco-purpurea*, Lyngb.

The colour has faded to a brown, but the structure of this curious and singular plant is readily recognised. The granules in each transverse series are 18–20, with smaller ones occasionally intercallated, and the series appear to be more or less binate or arranged in pairs. Floating in the sea, Davis' Straits. May.

OSCILLATORIACEÆ.

38. *Lyngbya Carmichaelii*, Harv.

Filaments of this species are frequently entangled among other

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specimens, so that the species does not appear to be uncommon, but they are very variable in thickness, and several species may be included. Floating in the sea, parasitic on the stem of *Laminaria longicruris*, in Davis' Straits, off Holsteensborg. May.

39. *L. flacca*, Harv.

Only a few filaments of this were observed mixed with the last and others.

40. *L. speciosa*, Carm.

A fine specimen of this beautiful species was picked up floating in Davis' Straits, north of Holsteensborg. May.† †

(VI.) *Fresh-water Algæ.* By G. Dickie, M.A., M.D., F.L.S., Professor of Botany in the University of Aberdeen.

ULVACEÆ.

1. *Prasiola fluviatilis*, Sommerfeldt.

This was first described as a native of Norway by Sommerfeldt in 1828. Meneghini has more recently published it as *P. Sauteri*, and Grunow has constituted var. β, *Hausmanni*; it is, however, right to retain the name first given it. Both forms are in this collection, gathered "close to high-water mark in fresh-water pools, visited by the spray, at Christianshaab, August; and dried up pools near the sea, Jakobshavn, June. The large form, var. β, in fresh-water pools, Egedesminde," &c.* The plant varies considerably in size. In places only partially moist, it is small; and when superficially examined in the dry state, it might be mistaken for the large forms of *P. crispa.* This error I committed in a list of species collected by Dr P. C. Sutherland in the summer of 1858.‡ It is reported, on the authority of Vahl, as a native of Spitzbergen. Mr Brown's specimens comprehend various stages. At first it is linear with narrow stipes, subsequently oblong-ovate with undulate and crenate margin, and finally very broad and irregular in outline.

2. *Enteromorpha compressa*, Linn.

The specimens might be referred to the smaller and simpler

* Brown's MS. Notes.

† Many of the specimens were encrusted with various species of Foraminifera, Bryozoa, and other zoophytes. Among the latter were observed *Cellepora pumicosa*, *C. ramulosa*, *Cellularia reptans*, *Crisia eburnea*, *Flustra avicularis*, *Tubulipora patina*, *Tubularia indivisa*, &c. Doubtless a careful search would have brought many more to light; but they were not looked for, nor, except when casually met with on the specimens under examination, examined with care. The special collection of Hydrozoa, &c., made by me was, however, large; the larger Fuci, Laminariæ, &c., affording, as in our seas, habitats for many species.

‡ Appendix to Inglefield's "Summer Search for Sir John Franklin."

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forms of this variable species. "Jakobshavn (June), in a rock pool within high-water mark; but the same pools during slack water fill by influx of fresh-water streams, so that the plants grow half the time in fresh, and the other half among salt water."*

3. *E. percursa*, J. Ag.

"Lyngemarken, Disco Island (September); and a few specimens mixed with *Prasiola fluviatilis*, at Jakobshavn, in slightly brackish pools, out of reach of the tide, but visited by sea spray, June 1867." *

CONFERVACEÆ.

4. *Conferva bombycina*, Ag.

"Stagnant pools of fresh water, among the rocks near the sea, Jakobshavn, Egedesminde, and Lyngemarken. (July, June, and September.") *

5. *C. floccosa*, Ag. (*Microspora floccosa*, Kutz.)

The specimens were not in very good condition, but cannot be referred to any other genus or species. "Pools of fresh water near the sea, Jakobshavn (July), and Egedesminde (June)." *

ULOTHRICACEÆ.

6. *Ulothrix mucosa*, Thunb.

There are only two small specimens, which, however, may be referred to this species. "Moist places near running water, Egedesminde (June), and in streams, Jakobshavn (June)." *

7. *U. minutula*, Kutz. ?

Certainly distinct from the former, judging from the diameter of the filaments; but in a genus where the length of the joints and the diameter vary so much, it is not easy to name from dried specimens. Very much entangled and mixed with *Conferva bombycina*, "as a floating scum on fresh-water pools close to the sea and within reach of the spray. June 1867." *

PALMELLACEÆ.

8. *Hydrurus penicillatus*, Ag., var., *parvulus*.

"In filaments (attached to small stones) in the current flowing from the spring at Lyngemarken; Sept. This spring maintains a uniform temperature all the year round, and remains unfrozen during the winter." * The specimens, in the dry state, were not in a condition to show general outline; but there can be no doubt about the genus, a comparison with an authentic specimen having been made. The cells ("gonidia," Kutz.) are in lineal series, ovate or oblong-ovate, and with one end, usually the narrower, colourless. I have little doubt that it is a small variety of the above species, which is widely diffused, and varies much in size and branching. In "Nereis Americana," by the late Professor

* Brown's MS. Notes.

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Harvey, it is reported as attaining a length of one or two feet at Santa Fe, New Mexico; in Northern Europe its size is very much less, and in every respect liable to great variation. In Fries' "Summa Vegetabilium Scandinaviæ," it is reported as found in Norway and Lapland. Mr Brown's discovery of it in a portion of Greenland, in nearly lat. 70° N., is of some interest, when the circumstances are so peculiar.

OSCILLARIACEÆ.

9 *Lyngbya cincinnata*, Kutz.

Abundant in "Lyngemarken Spring. Sept."* After careful examination, I am constrained to refer this to the above species, which appears to be widely diffused in North Europe.

10. *Oscillaria.*

There are two species (mere fragments), and mixed up with the last, but they are too imperfect for specific recognition.

CHROOESCCACEÆ.

11. *Microcystis*, sp.

Mr Brown found this on the petrous bone of a seal lying on damp ground at Egedesminde, in the form of a faint green crust. It may be referred to the above genus, but further I cannot venture to decide.

During examination of portions of the species already enumerated, the following Desmidieæ and Diatomaceæ were incidentally noted:—

DESMIDIEÆ.

Cosmarium undulatum, Corda.
C. connatum, Breb. ?
Staurastrum pygmaeum, Breb.?
Penium truncatum, Breb.
Closterium Cornu, Ehr.

DIATOMACEÆ.

Epithemia ocellata, Kutz.
Eunotia monodon, Ehr.
Synedra ulna, Ehr.
Navicula dicephala, Kutz.
Stauroneis anceps, Ehr.
S. gracilis, Ehr.
Cocconema lanceolatum, Ehr.
Meridion circulare, Ag.
Odontidium mesodon, Kutz.
Tabellaria flocculosa, Kutz.
Himantidium majus, W. Sm.

In conclusion, it may be remarked, that while greater special attention to the fresh-water forms would probably have produced a few more species, nevertheless that department of the flora of Danish Greenland cannot be otherwise than limited, on account of the peculiar conditions of the region—the interior being at all seasons a frozen waste, and merely a narrow line along the shores presenting streams and pools of fresh water, with here and there a few springs.

* Brown's MS. Notes.

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(VII.) *Fungi*. By WORTHINGTON GEORGE SMITH, F.L.S., London.

[The species of Fungi found in an arctic country like Greenland can be but few, and the almost impossibility of preserving them in a condition fit for after study and determination caused me to be less anxious than otherwise I might have been to pay much attention to their collection. The extraordinary heat and dryness of the summer of 1867 were not favourable for the growth of this order of plants. Mr Smith has, however, been able to identify with some certainty nearly all of the species which I brought home.]

1. *Agaricus* (*Amanita*) *vaginatus*, Bull. Mossy bank opposite the settlement at Godhavn. Not uncommon. Sept.
2. *A.* (*Clitocybe*) *infundibuliformis*, Schaeff. Godhavn, &c. Sept.
3. *A.* (*Clitocybe*) *brumalis*, Fr. Jakobshavn, &c.
4. *Hygrophorus virginius*, Fr. This common esculent species I found at Jakobshavn, &c.
5. *Boletus scaber*, Fr. Jakobshavn. July.
6. *Uromyces intrusa*, Lev. Parasitic on leaves of *Alchemilla vulgaris*, L., at Lyngemarken, Disco Island. Sept.

IV. *Notes of Algæ collected on the Coast of North-West America, by Mr R. Brown*. By Professor DICKIE, Aberdeen.

Mr Brown's attention having been specially directed to other departments, the few species noted here are to be considered as merely supplementary to the very complete account of Dr Lyall's Algæ recorded by the late Prof. Harvey in the sixth volume of the Proceedings of the Linnean Society. A larger collection, left to be forwarded to Mr Brown's address in Britain, has never been received.

MELANOSPERMEÆ.

Fucus vesiculosus, var. *evesiculosus*, J. Ag. Very small; on the shores of Skedegate Bay, Queen Charlotte Island.
Cystophyllum Lepidium, Rupr. Fort Rupert, Vancouver Island.
Desmarestia aculeata, Lamour. Fort Rupert and Skedegate Bay.
Carpomitra Cabrerae, Kutz. Fort Rupert.
Asperococcus sinuosus, Bory. Of small size; upon other algæ shores of Pitt's Island, &c.

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Ectocarpus . Growing on *Fucus vesiculosus*, but so imperfect that the species could not be determined.

RHODOSPERMEÆ.

Rhodomela Larix, Ag. Barclay Sound, Vancouver Island.

R. floccosa, Ag. Shores of Pitt's Island, north-west coast of British Columbia.

R. pilulifera, Grev. Shores of Pitt's Island.

R. Lyallii, Harvey. Shores of Pitt's Island.

Polysiphonia dendroidea, Mont. Near Victoria and Fort Rupert, Vancouver Island.

P. ceratoclada, Mont. ? A solitary specimen, not much more than an inch in height, referred with some doubt to the above, as in that species the main stems have twelve siphons. The species in question is recorded as found at Auckland Island, New Zealand, and Valparaiso. Mr Brown found the specimen at Fort Rupert.

P. urceolata, Grev. Shores of Pitt's Island.

Amphiroa californica, Deane. Near Victoria and Skedegate Bay.

A. epiphlegnoides, J. Ag. Near Victoria.

Melobesia verrucata, Lamour. On *Rhodomela Larix*, at Barclay Sound.

Plocamium coccineum, Lyngb. Shores of Pitt's Island, and at Fort Rupert.

Ahnfeldtia plicata, J. Ag. Shores of Pitt's Island.

Calophyllis variegata, Kutz. Near Victoria.

Gigartina Radula, J. Ag. At Mayne's Island.

Chondrus affinis, Harv. Skedegate Bay.

CHLOROSPERMEÆ.

Cladophora arcta, Kutz. Koskeemo, north-west coast of Vancouver Island.

Hormotrichium speciosum. Skedegate Bay.

DIATOMACEÆ.

Several of the species above recorded were infested with various Diatomaceæ, of which the following is a list:—

Arachnoidiscus Ehrenbergii	Podosphenia Ehrenbergii
Actinocyclus undulatus	P. gracilis
Biddulphia Roperiana	Podosira hormoides
Cocconeis scutellum	Rhabdonema arcuatum
C. Grevillei	R. minutum
C. undulata ?	Synedra affinis
Coscinodiscus eccentricus	S. investiens
Grammatophora marina	Nitszchia
Isthmia nervosa	Triceratium arcticum.

A list of Diatomaceæ found among Dr Lyall's Algæ, from the same quarter, is given by Mr Kitten in the ninth volume of the

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Journal of the Linnean Society. On comparison, it will be seen that, with some exceptions, the species are mostly the same, and the greater proportion European.

Chroolepus aureus, Haw. An organism in general aspect like the above, the joints rather indistinct, "giving a crimson or yellow appearance to some wet rocks near Friendly Cove, Nootka Sound, Vancouver Island."

V. *On the Numerical Law of Flowers.* By Joseph Bullar, M.D.

All botanists agree as to the numerous genera as well as natural families of plants in whose flowers the stamens, and the divisions of the corolla and calyx, are of the same number, or multiples of it; and that in the great monocotyledonous class, this holds good of both the male and the female parts of their flowers.

So many and so minutely accurate and uniform are these numerical arrangements of flowers, that the question forces itself on the inquirer, Whether this must not be a general law, to which the variations are merely exceptions?

There is all the difference between this numerical statement being true of some plants and some families, and its being a law of all plants. If it is the law of flowers, then it must be a great natural law, and the foundation of natural divisions of plants of primary importance.

Seeds have been long divided by a numerical law into Mono- and Di-cotyledons, and this numerical law of the seed has been found to be associated with profound anatomical differences of the whole plant.

If a numerical law is the law of all flowers, then doubtful numbers of important parts, as four *or* five stamens, two *or* three sepals, *or* carpels, will be substituted by fixed numbers. The flower must then belong to one numerical division, and the exceptions stand as exceptions, or variations, but not as if they were of the same importance as the legal number. To refer a flower to two different numbers would then be as unscientific as to state that a chemical element might have one equivalent number *or* another. If the numerical law holds good normally, there are no indefinite numbers of stamens, petals, pistils or carpels, no polyandrous or polypetalous flowers, except as

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exceptions or unascertained numbers, from the parts being so numerous that their exact number on an average has not been fixed. There would then be normally no indefinite numbers of parts. The normal number must then be decided by a general estimate of the numbers of every part of the flower and its natural relations. When it is considered how great a tendency there is in flowers to increase the number of their petals and stamens beyond their regular number when this number is known; and the tendency, from high culture, for stamens to become petals; and how varieties, under similar circumstances are propagated, a very large allowance must be made for polypetalous and polyandrous plants, without these exceptions being allowed to disprove the general law. Again, as the best ascertained natural families tend to meet each other, so that some of their genera approach in structure the family with which they are in alliance, the same approximation may be expected, and will be found in the great numerical divisions of flowers, and will explain apparent exceptions of single parts.

As Robert Brown, by fixing the Ternary arrangement, as the true law of grasses, explained their typical form, and thus determined the nature of many imperfectly developed and aborted parts of their flowers; so in other instances, where there is now obscurity, the numerical law, if proved to be the law of flowers, will fix types which are now vague, and explain the nature of parts which, from abortion, cohesion, and multiplication, may be of doubtful nature or number. Robert Brown did not allow the numerous apparent exceptions in grasses to divert his attention from the numerical law he saw presiding over the whole great family. The decision would tend to harmonise the Linnean and Natural arrangements. To a certain extent, the Linnean arrangement, as it depended on the number of the stamens and pistils in each genus, and did not include their multiples, or the divisions of the calyx and corolla, was artificial. But when all the numerical divisions of the flower are taken into account, and brought under one number and its multiples, the limited and purely artificial element is generalised in a higher law comprehending the lower, and makes the numerical law a highly natural one.

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A numerical law applied to flowers must, from the varying nature of flowers, have numerous exceptions, without their destroying the proof of the law. For what other vital organisms change their form and their number of parts like flowers? Many circumstances in growth may change the shape of the flower, whilst its type or pattern remains concealed in the flower, as is proved by reversion, so it must often be with the numbers of its parts. Excess of food with warmth will increase numbers of the parts; it makes single flowers double, by developing the stamens into petals; and the flowers from the seeds of these plants, when grown in their natural soil and climate, revert to the old type. In hot-houses the same species of flowers vary much in the number of their parts. But these variations do not remove the plant out of its fixed Linnean genus or species. The numerical type is known, and the variation in number of its stamens or pistils is explained and accounted for. And these exceptions may be propagated as varieties, and seem to be exceptions to any numerical law, when in fact they are abnormal, and would return under different circumstance to their old standard. As botanists, when they have satisfied themselves as to the typical form of the well-marked natural families, do not allow apparent exceptions of the number of parts to disturb their arrangement, but explain the apparent differences by abortion or excess, a similar consideration of the value of exceptions must hold in determining a great numerical law. Having proved on a sufficiently wide generalisation the law of vegetable growth, numerous exceptions are expected. For a numerical law of organic structure is not like a numerical physical law which admits of no exceptions, as growth is a vital action of a very complex nature carried on, not by one physical law, but by many physical laws combined and superadded to these higher and more complex forces called vital, with whose laws we are very imperfectly acquainted. The numerical law of gravitation is a simple force of attraction to be experimented upon and calculated by figures, and is unvarying; but how simple in its action, compared with those numerous powers combined into one whole which constitute the life of a flower.

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In order to determine if this numerical law of flowers is a general law, I examined in detail the British flora; for if this law holds good in reference to these plants, it will hold good of all plants.

I have arranged, in a chart,* all the Linnean genera of British flowering plants with distinct columns for the number of the parts of the calyx, corolla, stamens, pistils, styles, and ovaries of each; and I find they can (with one exception) be divided into the three simple numerical divisions of—

Two, and its multiples four and eight, or Binary.
Three, and its multiples six, nine, and twelve, or Ternary.
Five, and its multiples ten and twenty, or Quinary.

The Binary division, comprehending the Linnean orders of—

Diandria, Tetrandria, Octandria, Didynamia, Tetradynamia, with some genera of Polyandria, Monœcia, and Diœcia.

The Ternary division, including—

Triandria, Hexandria, Enneandria, Dodecandria, and part of Monœcia, and Diœcia.

The Quinary division, embracing—

Pentandria, Decandria, Icosandria, Diadelphia, Syngenesia, and part of Polyandria, Monœcia, and Diœcia.

The Septenary contains one genus, Trientalis.

There can be no theoretical reason why there is not a Unary division. The two British genera of Monandria Monogynia are Salicornia and Hippuris. Salicornia has one or two stamens, and a bifid stigma, and belongs to Chenopodiaceæ, a family with inconspicuous flowers. Hippuris belongs to Haloragaceæ, which is Binary, and is considered a degeneration of Onagraceæ, a most marked Binary family. So that both these genera of Monandria are probably Binary.

ANALYSIS OF THE TABULAR ARRANGEMENT.

Binary Division.

	Genera.		Genera.
Diandria, ...	8	Diœcia Diandria, . .	1
Tetrandria, ...	23	Tetrandria, . .	3
Octandria, ...	10	Octandria, . .	2
Monœcia Tetrandria, .	4	Polyandria Monogynia,	5

* This chart was laid on the table at the meeting of the Society.

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	Genera.		Genera.
Polyandria Polygynia,	2	Diœcia, ...	1
Diadelphia Hexandria,	2	Monœcia Polyandria, .	5
Hexandria Digynia, .	1		

In these sixty-seven genera there are no exceptions to the Binary division. There are either two, four, or eight parts or divisions of the calyx and corolla, and two, four, or eight stamens; and when there is only one pistil, the stigma, if divided, is Binary, and the ovaria have a Binary division.

[Acer is removed to Quinary. Salicornia (Monandria), as it has one or two stamens and a bifid stigma, is placed here.

The seven genera of Polyandria have binary flowers. Corydalis and Fumaria are "Diadelphia Hexandria," but both have two sepals, four petals, and the six stamens are in *two* bundles, and the capsules are 2-valved and 2-seeded. Corylus and Myrica, with two styles, are said to have a one-seeded nut or cell. Oxyria, with two sepals, two petals, has six stamens, two styles, and a triquetrous nut.]

Didynamia Gymnospermia, 20 genera.
Angiospermia, 13 ,,

The twenty genera of Didynamia Gymnospermia belong to Labiatæ. The Binary division is a character of this highly natural family, having two-lipped calyx, two-lipped corolla, four stamens, 2-celled anthers, bifid stigma, and 4-lobed ovarium; but the two lips of the calyx often have five teeth, three to one and two to the other, and in some genera the two lips are so obscurely divided that the calyx appears simply five toothed. But the marked Binary division in all other respects indicates that this is either the approach of Binary to Quinary, or a variation propagated.

The thirteen genera of Didynamia Angiospermia are equally binary, but in a few the two-lipped calyx becomes five cleft.

Tetradynamia Siliculosa, 14 genera.
,, Siliquosa, 14 ,,

The twenty-eight genera of Tetradynamia all belong to "Cruciferæ" and both the names Tetradynamia and Cruciferæ indicate the Binary form to which there are no exceptions in these twenty-eight genera. In all are four

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sepals, four petals, two stigmas, two cells, or four carpels; and although there are six stamens, the Binary arrangement is still marked, as four are long and two are short—not in two threes, but in twos. The four long ones in two pairs, the two short ones between them, in the shape of a cross—the quaternary form giving the name to Cruciferæ.

The Binary division contains 128 genera, and in all, the calyx, the corolla, the stamens, the stigmas (when divided), and the seed-vessels, have the Binary arrangement.

The seed-vessels are either two or four celled, or two or four valved, or four or eight pores, or two or four seeded, or the cells opening by eight teeth or eight-celled, the only exceptions being in Parietaria, which has one carpel, one seed, and one style. In Buxus, the female flower has three styles, and a three-celled ovarium. Myrica, one cell, and Oxyura, three carpels.

Ternary Division.

	Genera.		Genera.
Triandria Monogynia,	12	Dodecandria Dodecagynia,	1
Digynia,	40	Gynandria Monandria,	1
Trigynia,	1	Hexandria,	1
Hexandria Monogynia,	20	Monœcia Triandria,	5
Trigynia,	5	Hexandria,	1
Hexagynia,	1	Polyandria,	4
Polygynia,	1	Diœcia Triandria,	2
Enneandria Hexagynia,	1	Hexandria,	1
Dodecandria Monogynia,	1	Enneandria,	2
Trigynia,	1	Dodecandria,	1

This includes forty grasses and seven sedges, and all Gramineæ have been settled by Robert Brown to be Ternary.

This Ternary division contains 102 genera. The perianths, stamens, stigmas, and ovaria, are all Ternary.

[In Montia, which seems between Quinary and Ternary, there are two sepals, and a five-parted corolla. In Alisma, the pistils and capsules are numerous. In Mercurialis, two pistils and a two-celled capsule. Amaranthus (Diœcia Pentandria) has 3–5 divisions of the perianth, 3–5 stamens, three styles, and one cell.]

All Monocotyledons belong to the Ternary division. The genera in this division which do not belong to Monocotyledons are very few.

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Thus the Binary and Ternary divisions, which contain 229 genera, conform to this numerical law, both in the male and female flowers, with few and insignificant exceptions.

Quinary Division.

	Genera.		Genera.
Pentandria Monogynia, .	42	Polyandria Monogynia,	4
Digynia, .	38	Hexandria Monogynia (*Frankenia*), . .	1
Trigynia, .	6	Polyandria Pentagynia,	4
Tetragynia, .	1	Polygynia,	8
Pentagynia, .	3	Diadelphia Decandria,	18
Hexagynia, .	1	Polyadelphia Polyandria,	1
Polygynia, .	1	Syngenesia, . .	48
Decandria Monogynia, .	5	Monœcia Pentandria, .	1
Digynia, .	5	Diœcia Pentandria, .	1
Trigynia, .	4	Polygamia Monœcia, .	1
Pentagynia, .	7	Monadelphia Pentandria,	1
Dodecandria Digynia, .	1	Decandria,	1
Icosandria Monogynia, .	1	Polyandria,	3
Pentagynia, .	5		
Polygynia, .	7		

In all these 219 genera there are Quinary divisions of the calyx, corolla, and stamens.

With regard to the female parts of the flowers—

37 are Quinary throughout, Quinary pistils and carpels, as well as calyx and corolla.
32 have Quinary ovaria, with one pistil.
19 have Ternary females.
56 have Binary females.
51 have Unary females, one pistil, and one cell.
20 have numerous or indefinite pistils and carpels.

It appears from this that the females often follow their own numerical law, and when they do not they follow the male number. In thirty-seven instances are the numbers of the parts, throughout the male and female parts, the same; but when there is but one pistil, and the ovarium is divided, then it follows the numerical law of the male. This is the case in 32 genera.

[Viola is Pentandria Monogynia, with one cell and three valves.

Viburnum, three pistils, and one seed.

Chenopodium, Beta, Salsola, and Herniaria, two pistils and one seed.

All explicable by abortion of the dissepiments.]

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INFERENCES FROM THESE TABLES.

Male part of the Flower.—The sepals and petals (or the divisions of the calyx and corolla) are either the same number as the stamens or its multiple, and are Binary, Ternary, Quinary, or Septenary.

Female part of the Flower.—The divisions of the ovaria are either of the same number (or its multiple) as the style or stigmas, when these are more than one; or when the style is single, and the stigma undivided, the seed-vessels are either single celled, or follow the numerical law of the stamens, calyx, and corolla. In other words, if the divisions of the ovaria do not follow the numerical law of the female, they do that of the male.

The exceptions are not more numerous than are to be expected in vegetable growth, where, from the law of morphology, and from the simplicity of organisation, one part is easily converted into another, where by cultivation the various parts of flowers tend to multiply in number, and where the various natural families pass into each other by gentle gradations. Taking into consideration these native tendencies to irregularity, the exceptions to a definite numerical law are very few.

It follows that the simplest natural division of flowering plants is into Binary, Ternary, Quinary, and Septenary groups, depending on the parts or divisions of the calyx, corolla, and stamens, and that in the Binary and Ternary groups the female organs correspond in number to those of the male.

VI. *Notes of a Visit to Strath Glass and its Tributary Glens.* By the Rev. JAMES FARQUHARSON, A.M., Selkirk.

In company with the Rev. Thomas Fraser, minister of Croy, I made an excursion last autumn to Strath Glass, and the glens connected with it, which occupy the north-western corner of the mainland of Inverness-shire. In asking the members of the Society to receive a few notes of this excursion, I must premise, that I have not to offer a full account either of the topography or of the botany of the district in question. Our time did not admit of a thorough search for plants; and it would serve no good end to occupy the Society's attention with descriptions of

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scenery, much of which, however, is very fine, and well worthy of being better known than it is. My object is, to direct attention to a group of glens which, so far as I know, have not been thoroughly explored by any botanist, and which, both from the height of their bounding mountains, from the extent of their lakes, marshes, and natural forests, and from the broken and moist corries which abound, may be expected to yield a rich flora.

Strath Glass itself is a tolerably wide, and not very interesting strath, along which a sluggish river flows, and, after receiving its last considerable tributary, the Farrar, takes the name of Beauly, traverses the well-known Pass of The Dhruim, forms the Falls of Kilmorack, and enters the Beauly Firth at the village of Beauly. Its direction is from south-west to north-east. On Strath Glass open out from the west three glens, narrower than itself, bounded by loftier ranges, and more romantic in character. Glen Strath Farrar is the most northerly of the three; Glen Cannich occupies the centre; and Strath Affrick is farthest south. They run more directly west and east than Strath Glass; but there is an increasing tendency, as we pass towards the south, to assume the oblique direction, characteristic of the part of Scotland in which they lie, until we find Strath Affrick rnnning out almost in the line of Strath Glass. Each glen has its river bearing its name. Lochs, some of good size, occur in the course of the rivers, and the glens are separated from each other by ridges of great height. The highest summit between Glen Strath Farrar and Glen Cannich is Scour-na-Lapich, 3772 feet in height; the highest between Glen Cannich and Strath Affrick, Mam-Soul, 3867 feet; while to the south-west of Strath Affrick rises Ben Attow, to the height (by Keith Johnston's map) of 4000 feet. On Scour-na-Lapich and Mam-Soul snow lies throughout the summer. On both of them, and on the neighbouring heights, are numerous great corries, and many broken precipitous slopes. The rock is gneiss and mica slate, and the surfaces are very moist. They remind one of the Forfarshire hills, and may have botanical treasures in store for any one who visits them with time for a thorough examination.

We left Fort George Station on the morning of Mon

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day, August 19, and travelled by railway to Beauly. From that we drove, forming members of a party, and therefore unable to botanise, to The Dhruim. Leaving our friends early in the afternoon at Teannassie, we struck up the slope to the north of the pass, searching the birch wood for *Linnœa*, &c., but finding nothing noteworthy. We soon reached an irregular table-land, and made across it towards Benevachart, which we proposed to climb that evening. We found several interesting plants as we advanced, but none worthy of special notice here, until by a small loch we came upon a quantity of *Malaxis paludosa*, *Utricularia minor* in flower, *Carex limosa*, *Vaccinium Oxycoccos*, *Nymphœa alba*, &c. *Cornus suecica*, and *Arctostaphylos alpina* (neither, however, in fruit), were found as we rose to a higher level on the shoulder of the mountain. We were unable to accomplish our object, and reach the summit, as the sun set while we were yet about two miles distant from it. We had satisfied ourselves by the aid of a glass that it was not a very promising botanical field, there being few rocky places, and those seemingly very dry. So we turned southward to regain the valley of the Beauly, and made for Bridge of Struy Inn, not much disappointed at our failure to ascend Benevachart. This hill is not very lofty, and has a barren appearance, and I would not recommend any botanist to turn aside to explore it, unless he has abundance of time, and may wish to satisfy himself as to its flora.

At Bridge of Struy Inn we found a reading party of Cambridge students installed in comfortable quarters. But the landlord had room for us also; and we can recommend the inn to any wandering naturalist.

Tuesday, the 20th, we proposed to devote to an excursion in Glen Strath Farrar, and a search for *Moneses grandiflora*, which the Hon. Miss Fraser of Lovat has found there. (She is unwilling to disclose the habitat, lest the plant should be extirpated by rapacious hands). But it proved a day of continuous and heavy rain; and we had to content ourselves with keeping to the road up Strath Glass, on which, after a dreary seven miles' walk, we reached the inn at the mouth of Glen Cannich, rejoicing in the title of Invercannich Hotel. We found its only

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furnished apartments occupied by The Chisholm, who owns much of the land in the Strath, and to the west; and with great difficulty we obtained a place in which to rest for the night. In a pool by the roadside, a deserted bed of the river, we gathered *Nuphar pumila* in fine condition.

Invercannich Inn is about the most cheerless and uncomfortable inn I ever visited; but its shelter was welcome, and all the more that it was the last inn we should find in this direction. Henceforth we must depend on the chance of getting shelter in a shepherd's or gamekeeper's house. With a better landlord—a man possessed of sufficient means to furnish the house—Invercannich would make an excellent Highland inn, and be a good centre for tourists and botanists.

Wednesday, the 21st, after a lowering morning, turned out a fine day. Our object was the summit of Scour-na-Lapich, which rises near the head of Glen Cannich, and is conspicuous in the neighbourhood of Fort George, from the large masses of snow in its corries. We passed up Glen Cannich, a beautiful glen, traversed for a considerable distance by a good road, after which comes a path which cannot be called good, but is one of the paths leading to the west coast at Kintail, or by the Falls of Glomach (300 feet high) to Loch Alsh. The glen is full of beautiful scenery. The river forms at one point a fine fall, and there are endless forests of native pine and birch. We did not deviate much from the road, having a stiff climb awaiting us at the close of the day. We hoped to find accommodation at the house of a shepherd named Campbell, fifteen miles from Invercannich, and accordingly made for it. The last seven or eight miles of the path ran along the north shore of Loch Mulardich (not Longard or Moyley, as in Johnston's Royal Atlas), a beautiful Highland loch, the river issuing from which shows a peculiarity which might have been usefully referred to some years ago, when Speke asserted that the Nile issues from Victoria Nyanza by two channels, which unite some way below the lake—a mode of issue declared by some geographers to be impossible. From Loch Mulardich the water flows in *two* streams, separated from each other by a lofty tree-crowned island of many acres in extent, and uniting to form the Cannich River, nearly a quarter of a mile from their source in the loch.

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From Campbell's house, where we found we could be accommodated (of course in the very plainest way), we started late in the afternoon for the summit of Scour-na-Lapich, some three miles off, and given in the map as 3772 feet high. It was a stiff pull, but we were rewarded by the fine evening view of the sea of mountains around; and besides finding the commoner alpines in great abundance, *e.g. Saxifraga hypnoides* and *stellaris, Thalictrum alpinum, Epilobium alpinum, Salix herbacea, Gnaphalium supinum, Sibbaldia procumbens*, &c., had the satisfaction of gathering, in fine condition, two plants new to us, *Cerastium trigynum* (*Stellaria cerastoides*), and *Polypodium alpestre*, in great quantity and in splendid fruit. We also picked up a few good specimens of *Hieracium alpinum*. A most enticing long range of broken cliffs, with snow resting in the deeper crevices, stretched away to the south-east of the summit, but we had not time to search it. It will be surprising if these rocks are not found to produce good plants. We got back to Campbell's as darkness was coming on.

Thursday, the 22d, showed dense mist on the hills, descending in great masses, and trailing along the lower slopes. It was out of the question to attempt Mam-Soul, the highest point between Glens Cannich and Affrick, as we had proposed. Having got minute instructions regarding the path, which on the heights is indicated by large flat stones set on edge at considerable intervals, we were ferried across the river, some way above Loch Mulardich, and began the very steep ascent of the southern side of the glen. We were soon deep in the mist, but were able to keep the path until we got to the summit of the ridge, which must be fully 3000 feet in average height. Then just when we had gone too far eastward to return and climb Mam Soul, the mist cleared off, and a magnificent panorama opened up on all sides—the view extending from far beyond Ben Nevis to the Loch Maree heights, and from the Cuchullins in Skye to the Cairngorm and Ben Macdhui group. As we passed on, we found all the commoner alpines, and literally acres covered with *Arbutus alpina* in fine fruit, and *Azalea procumbens*. *Polypodium alpestre* again occurred near some large patches of snow.

We walked for several miles along this elevated ridge, and

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then by a steep zig-zag descended into Glen Affrick. We were too tired for much plant-searching here; but the *Chisholm's Pass*, at the mouth of the glen, worthy of ranking with the Trossachs and Killiecrankie, rewarded us for our long walk.

Late in the evening, after a walk of about twenty miles, we reached Tomich, a *model* village, erected by Sir Dudley Coutts Marjoribanks, on the site of an old tumble-down Highland clachan, and got accommodation in the house of the merchant and baker of the village. A good hotel has been built at Tomich by Sir Dudley (whose seat, Geusachan, is about a mile and a half farther up the strath), but he had not then found a tenant for it.

Next day, Friday 23d, we proposed to walk to Drumnadrochet, on Loch Ness, and join the steamer there. We left early, about seven o'clock, with this intention; but a gentleman overtaking us on the road, kindly drove us to Drumnadrochet, thus saving us a walk of fourteen miles from Tomich through Glen Urquhart to Loch Ness. Instead of waiting for the steamer, we walked on to Inverness, fourteen miles, and arrived in time for the evening train to Fort George.

Dr Dickie of Aberdeen informs me that the district we thus hastily traversed has not, to the best of his knowledge, been botanically explored; but that he believes, from the description given of it, it is likely to be productive of good plants, especially mosses and lichens. I have made inquiry, but cannot discover that any one has visited and described it. These hasty notes are written with the view of directing attention to a promising field; and I trust that some one, with time at his command, not afraid of long walks, nor incapable of flourishing for some days on oatmeal, and not unwilling to put up with very indifferent accommodation, will visit Strath Glass and its tributary glens, and report to the Society whether they contain treasures, or belie their appearance.

VII. *Notes on Vegetable Morphology.* By Colonel COLLINSON, R.E., Malta. Communicated by Dr CLEGHORN.

Dr C. stated that Colonel Collinson, a distinguished engineer, had recently occupied himself with measuring the

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periodic increase of many plants in the island of Malta, with a view to discover the laws regulating their growth, following up the observations of Bravais and Schimper, subsequently carried on by Dickie and M'Cosh. He proposes to continue these researches, and solicits suggestions as to the best plants to be observed, and the method of procedure.

VIII. *Notice of Plants collected during recent Excursions with Pupils.* By Professor BALFOUR.

On 16th May a party of ninety-six visited Arniston, by the kind permission of Mr Dundas. Among the plants collected, worthy of notice, were,—*Aconitum Napellus, Lathræa squamaria, Pulmonaria officinalis, Allium paradoxum* (being a new station for this plant round Edinburgh), and *Arum maculatum.*

On 23d May a party of eighty visited Burntisland and Aberdour. Among the plants collected were,—*Cochlearia danica, Lepidium Draba, Geranium phæum, Centranthus ruber, Hippophäe rhamnoides, Sclerochloa loliacea, Botrychium Lunaria, Ophioglossum vulgatum, Exidia auricula.*

On 30th May a party of eighty-four visited Prestonpans and Long Niddry. Among the plants noticed were,—*Chelidonium majus, Viola canina, Cerastium arvense, Potentilla verna, Sempervivum tectorum, Saxifraga tridactylites, Leontodon lævigatum,* and *Botrychium Lunaria.*

On 6th June a party of forty visited Tynninghame, by the permission of the Earl of Haddington, when the following plants were collected:—*Sinapis alba, Lepigonum marinum, Geranium sanguineum, Lonicera Caprifolium, Artemisia maritima, β gallica, Hyoscyamus niger, Salicornia herbacea, Neottia Nidus-avis, Ruscus aculeatus, Scirpus maritimus, Botrychium Lunaria, Ophioglossum vulgatum.*

On 13th June a party of forty-one visited Niddry Castle, Binny Crag, and Uphall. The more important plants collected were,—*Aconitum Napellus, Viola lutea, Rosa canina,* var. *lutetiana, Mentha sylvestris, β velutina, Lamium maculatum,* var. *lævigatum, Habenaria chlorantha, Convallaria majalis, Allium paradoxum, Omphalodes verna.*

On 20th June a party of seventy-four visited Jedburgh,

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and botanised on the banks of the Jed, under the direction of Mr Archibald Jerdon and the Rev. George Ritchie. Some also visited the Jedburgh Museum, under the guidance of Mr Adam Matheson. The following were some of the principal plants collected during the trip:—*Chelidonium majus*, *Cardamine amara*, *Sinapis alba*, *Trifolium hybridum*, *Carduus heterophyllus*, *Campanula latifolia*, *Veronica montana*, *Paris quadrifolia*, *Carex paniculata*, *remota*, *stellulata*, *ovalis*, *pallescens*, *panicea*, *flava*, *sylvatica*, *hirta*, *paludosa*, *Lastrea Oreopteris*, *Polypodium Dryopteris*, *Calicium furfuraceum*, *Neckera complanata*, *Sticta pulmonaria*.

On 27th June a party of fifty visited Selkirk, and by the permission of Mrs Pringle Douglas, Sir John Murray, and His Grace the Duke of Buccleuch, were allowed to botanise in the grounds of Haining, Philiphaugh, and Bowhill. The party was conducted by the Rev. James Farquharson. Among the interesting plants collected may be noticed the following:—*Ranunculus Lingua*, *Nymphæa alba*, *Nuphar lutea*, *Potentilla fruticosa* and *reptans*, *Sedum Rhodiola*, *villosum*, and *Telephium*, *Valeriana pyrenaica* and *dioica*, *Hieracium aurantiacum*, and *H. collinum* (the latter species being new to Britain, the first specimen being picked by Mr Mawson, and the plant found in considerable quantity in a thoroughly wild spot on the sandy banks of the Ettrick, far from any house), *Carduus heterophyllus*, *Solidago Virgaurea*, *Doronicum Pardalianches*, *Vaccinium Vitis-Idæa*, *Pyrola minor*, *Veronica scutellata*, *Scutellaria galericulata*, *Lysimachia Nummularia* (in a marshy and thoroughly wild spot), *Trientalis europea* (on a hill above Bowhill), *Empetrum nigrum*, *Listera ovata* and *cordata*, *Habenaria chlorantha*, *Potamogeton pectinatus* and *prælongus*, *Carex disticha*, *curta*, *teretiuscula*, *ampullacea*, *Avena pratensis*, *Botrychium Lunaria*, *Ophioglossum vulgatum*, &c.

On July 4th, a small party visited Perth, and the neighbourhood of Scone, and gathered *Linnæa borealis*, *Moneses grandiflora*, *Trientalis europæa*, *Listera cordata*, *Lastrea spinulosa*, *Sedum reflexum*, *Rubus nitidus*, *Rosa arvensis*, *Poterium Sanguisorba*, *Potentilla argentea* and *hirta*, *Malva moschata*, *Antirrhinum majus*, *Trifolium striatum*, &c.

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IX. *Physiological Effect of the Juice of* Scopolia lurida, *Dun.* (Anisodus luridus, *Link.*). By Professor CHRISTISON.

Dr C. stated that the juice of this plant had the effect of dilating the pupil of the eye to a great extent. He had experimented upon it himself, and found that the dilatation was visible for eight days afterwards. Professor Balfour remarked that he had also tried the effect of the juice, with the same result. The discovery promises to be important, and a valuable addition to the Indian pharmacopœia.

X. *Miscellaneous Communications.*

Mr Anderson-Henry exhibited a plant of a shrubby Solanum from South Pacific, with white inconspicuous flowers; also a plant, in fruit, of *Tacsonia eriantha*, Benth., from the Andes of Pichincha, at 12,000 feet above the sea. It bears flowers nearly double the size of *T. mollissima*. Both are climbers, and grow at the upper boundary of the forest, within the limits of 11,500 and 13,000 feet. This Tacsonia is apparently the hardier of the two. The native climate of these plants is cold and foggy.

A letter was read from Dr F. B. W. White, in which he stated that he had recently collected in the neighbourhood of Achilty, Ross-shire, *Pinguicula lusitanica*, *Utricularia intermedia*, *Drosera intermedia*, *Arctostaphylos alpina*, *Lycopus europæus*, *Ajuga pyramidalis*, &c.

Mr M'Nab placed on the table plants of eight varieties of Thea, raised from seeds sent to the Botanic Garden, by Mr Wm. Bell, Saharunpore.

Professor Balfour exhibited a fungus which had grown between two plates of glass in a damp room; he also exhibited several coiled stems of a plant belonging to Bignoniaceæ, which are used as ropes to bind the bales of cotton bought from Paraiba. They had been sent to the Museum by R. H. Alcock, Esq.

Professor Dickie sent to the Museum several microscopical slides containing Diatomaceæ and Desmidiæ from North-West America, collected by Robert Brown.

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INDEX.

Adie, Alex. J., on *Taxus baccata variegata* Seedlings, 52
Akazga Plant of Western Africa noticed, 403
Albizzia anthelmintica noticed, 238
Algæ, Marine, of Greenland, 456
——— Freshwater, of Greenland, 462
——— of North-West America, 465
Alpine Botanical Club, 323
Amblystegium confervoides, a new British Moss, 272
Anderson, Dr Thomas, on Cinchona Cultivation, 56
——— on the Botanic Garden of Calcutta, 54
——— on the Introduction of the Mahogany Tree into Bengal, 162
Anderson-Henry, Isaac, on the Hybridisation or Crossing of Plants, 101
——— on *Solanum caripense*, 128
——— on Pure Hybridisation, 206
Andromeda, Poisonous Properties of certain Species of, 410
Anemone ranunculoides, 398
Arboretum at Botanic Gardens, Edinburgh, 397
Arctic Seas, Discoloration of the, 244

Baddeley, John, Obituary Notice of, 304
Balfour, Professor, Excursion to Braemar in 1866, 51
——— Notice of *Passiflora quadrangularis*, 60
——— on *Trichoscypha Mannii*, 78
——— on *Sarcocephalus esculentus*, 79
——— on a New Species of *Vellozia*, 79
——— Obituary Notices of James Smith, Dr G. A. Martin, and G. U. Skinner, 85
——— Obituary Notice of Professor Goodsir, 118
——— on Cinchona Cultivation in India, 133
——— on Nature and Structure of Pod of Cruciferæ, 194
——— Obituary Notices of Professor Daubeny, Rev. Dr Hamilton, and Dr Schultz, 267
——— Notice of Botanical Excursions in the Highlands of Scotland in 1867, 293
——— on Species of Elymus, Triticum, and Phleum from Vancouver's Island, 301
——— Obituary Notice of John Baddeley, M.B., 304
——— Obituary Notice of Mr N. B. Ward, 426
Balfour, Professor, Notice of Botanical Trips, 480
——— Obituary Notices of John Stewart, P. J. Selby, and David Tennant, 129
Bell, William, on the Reproductive Organs of Mosses, 52
——— on the Forests of Dera-Doon, 274
Bishop, John, on a Supposed Fungoid Disease of the Human Hair, 199
Bisset, John, on Rare Scotch Plants, 49
Botanic Garden, Calcutta, Notice of, 54
Botanic Garden at Inverness, 62
Botanical Correspondence, 53, 143, 239
——— Excursions in the Highlands of Scotland in 1867, 293
——— Excursion to Strath Glass, 474
——— Intelligence, 319
——— Trips, 480
British Plants, Notices of, 241
Brown, Robert, Notice of Botanical Travels in Oregon, 95
——— on the Economic Uses of Coniferæ, 337
——— on Greenland Plants, 239
——— on the Nature of the Discoloration of the Arctic Seas, 244
——— Florula Discoana, 430
——— Monograph of the Coniferous Genus *Thuja*, 358
——— on the Vegetable Products used by the North-West American Indians, 378
Bullar, Dr Joseph, on the Numerical Law of Flowers, 467
Bunch Grass of California, 164, 339
Buxbaumia indusiata noticed, 128, 142, 192, 340

Calvert, Henry H., Notice of Mussana Bark, 238
Carduus, New Species, from Ross-shire, 257
Carrington, Dr, on the Hepaticæ of Greenland, 453
Centunculus minimus in Arran, 240
Christison, Professor, on the Action of the Juice of *Scopolia lurida*, 482
Cinchona Cultivation, 133, 136, 320
Cladoniæ of the Arctic Regions, 166
Cleghorn, Dr, on the Supply of Wood-Fuel to the Punjaub and Delhi Railways, 56
——— on the Poisonous Properties of Certain Species of Andromeda, 410
——— Obituary Notice of Professor Walker-Arnott, 414

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Coldstream, William, on Cinchona Planting in Kangra, 136
Collinson, Colonel, Notes on Vegetable Morphology, 479
Compositæ of the Andes, Notice of, 115
Coniferæ, Economic Uses of, 337
Connal, Michael, on Beet-Root Sugar, 98
Constable, Mr, on Blight affecting the Orange Trees in the Sandwich Islands, 83
Cooke, M. C., on the *Genus Lophiostoma* of British Fungi, 325
Croall, Alex., on Marine Algæ of Greenland, 456
Cruciferæ, Structure of Pod of, 194
Cucurbitaceæ, Tendrils of, 189
Cunningham, Dr Robert O., Report on Plants seen during a Voyage to South America, 234

Daubeny, Professor, Obituary Notice of, 267
Delphinium, British Species of, 332
Diatomaceæ from Iceland, 95
Dickie, Professor, on *Buxbaumia indusiata*, 142, 192
——— on Mosses and Hepaticæ found on the North-West Coast of America, 355
——— on the Freshwater Algæ of Greenland, 462
——— on Algæ collected on the North-West Coast of America, 465
Dickson, Dr Alex., on Abnormal Flowers in *Tropæolum majus*, 54
Dickson, Dr G., on the Preparation of Skeleton Leaves, 48
Didymodon Jenneri described, 314
Discoloration of the Arctic Seas, 244
Druidical Stones, Lichen Flora of, 154

Elymus condensatus noticed, 302
Excursion to Braemar in August 1866, 51

Farquharson, Rev. James, Notes of a Visit to Strathglass and its Tributary Glens, 474
Ferns, Lycopods, and Marsileas, collected in Otago, New Zealand, 27
Ferns and their Allies, 321
Florula Discoana, 430
Forest Department of India, 187
——— of Dera-Doon, 274
Fontainbleau, Flora of Forest of, 163
Fraser, Dr John, on *Amblystegium confervoides*, a new British Moss, 272
Fraser, Dr Thos. R., on the Characters of the Akazga Plant, 403
Frodsham Marshes, Cheshire, Flora of, 265
——— Plants noticed by Mr J. T. Robinson, 323
Fungi Collected in Otago, New Zealand, 13
——— Sexual Organs of, 189
——— of Greenland, 465
Fungoid Disease of the Human Hair, 199

Gases in Plants, 192
Glumaceæ of Otago, New Zealand, 63
Goodsir, Professor, Obituary Notice of, 118
Goodyera repens, near Melrose, 240
Gorrie, Wm., on Fruit of *Passiflora laurifolia*, 48
——— on a Rose found near Edinburgh, 84
——— on *Narcissus Pseudo-Narcissus*, 339
Grasses from Vancouver's Island, 301
Gray, John, Obituary Notice of, 145
Greenland, Flora of, 430
——— Phanerogamia and Vascular Cryptogamia, 447
——— Mosses of, 452
——— Hepaticæ of, 453
——— Lichens of, 454
——— Marine Algæ of, 456
——— Fresh-Water Algæ of, 462
——— Fungi of, 465
Grimmia subsquarrosa noticed, 142

Hamilton, Rev. Dr James, Obituary Notice of, 269
Hay, George W. R., Excursion to the Forest of Fontainbleau, 163
Hedera Helix, Peculiar Structure of the Stem of, 316
Hepaticæ of Greenland, 453
Herbarium of the University of Edinburgh, Donations to the, 2, 51, 100, 130, 164, 203, 206
Howie, Charles, on a New Species of British Carduus, 257
——— on New and Rare Mosses gathered in Ross-shire and Inverness-shire, 312
Hybridisation, or Crossing of Plants, 101
——— of Distinct Species of Plants, 206
Hypnum bambergeri, 413
Hypnum rupestre and *H. Breadalbanense* noticed, 198

Inzenga, Professor, on the Cultivation of Sumach, near Palermo, 341
Ivory, William, Notice of his Death, 399

Jameson, Professor, on some Compositæ of the Andes, specially on *Chuquiraga insignis*, 115
Jardin of Mont Blanc, Botany of, 140
Jardine, Sir Wm., on the Fruit of *Passiflora*, 48
Jenner, Charles, on a New Species of British Carduus, 257

Lauder Lindsay, Dr W., List of Fungi, collected in Otago, New Zealand, 13
——— List of Mosses and Hepaticæ, collected in Otago, New Zealand, 22
——— List of Ferns, Lycopods, and Marsileaceæ, collected in Otago, New Zealand, 27
——— on the Glumaceæ of Otago, New Zealand, 63
——— on New Zealand Carrageen, 137
——— on the Lichen-Flora of Druidical Stones, 154

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Lauder Lindsay, Dr W., on Arctic Cladoniæ, 166
——— Addenda to the Cryptogamic Flora of New Zealand, 201
——— Abstract of Observations on New Zealand Plants, 231
——— on the Lichens of Greenland, 454
Lawson, Professor M. A., on the Mosses of Greenland, 452
Libocedrus, Notice of, by Mr Robert Brown, 358
Library, Donations to the, 1, 51, 63, 84, 100, 130, 165, 191, 205, 243, 267, 325
Lichen-Flora of Druidical Stones, 154
——— of Greenland, 454
Light as affecting Plants, 319
Lophiostoma, a genus of British Fungi, 325
Lowe, Dr John, on Silicified Vegetable Structures from the Zambesi, 131
——— on the Flowering of Plants at Lynn, 323

Mackintosh, R. T., on *Rhododendron Falconerii*, 128
M'Nab, James, on a new Dwarf Arbor Vitæ, 61
——— on Variegated Greens as Ornamental Plants, 81
——— on Open-air Vegetation in the Botanic Garden, 82, 96, 127, 144, 303, 321, 336, 396
——— on a late Flowering Cratægus, 202
M'Nab, Dr W. R., on the Selaginellas cultivated in the Royal Botanic Garden, Edinburgh, 3
——— on Diatomaceæ from Iceland, 95
——— on a Peculiarity in the Structure of the Stem of *Hedera Helix*, 316
——— on the British species of Delphinium, 332
Mahogany Tree in Bengal, 162
Martin, Dr G. A., Obituary Notice of, 85
Milne, W. G., on the Palm Trees of Old Calabar, 195
——— on Plants used for Food in Old Calabar, 300
Miscellaneous Botanical Notices, 324, 337, 482
Mosses and Hepaticæ collected in Otago, New Zealand, 22
——— Rare British, collected near Edinburgh, 163
——— New and Rare, gathered in Ross-shire and Inverness-shire, 312
——— and Hepaticæ of North-West America, collected by Mr Robert Brown, 355
——— of Greenland, 452
Munro, Robertson, on the Reproduction and Cross Fertilisation of Passifloras, 399
Museum at the Edinburgh Botanic Garden, Addition to the, 85
——— Donations to the, 2, 100, 130, 164, 192, 203, 206, 243, 398, 413
Mussana Bark, Remarks on, 238

Narcissus Pseudo-Narcissus noticed, 339
New Zealand Fungi, 13
——— Mosses and Hepaticæ, 22
——— Ferns, Lycopods, and Marsileas, 27
——— Carrageen, 137
——— Cryptogamic Flora of, 201
——— Plants, noticed, 231
Notices of Plants, 292, 482
Number of Members on Roll, 3
Numerical Law of Flowers, 467

Office-Bearers of the Society for 1866–67, 50
——— of the Society for 1867–68, 242
Oliver, Professor, on Phanerogamia and Vascular Cryptogamia of Greenland, 447
Orange Trees, Blight affecting, 83
Orkney, Submarine Forests of, 146
Orthotrichum phyllanthum near Edinburgh, 190

Palisota Barteri, 340
Palm Trees of Old Calabar, 195
Passifloras, Fruit of, 48, 60
——— Fertilisation of, 399
Photographs of Plants, coloured, 292
Plants used for Food in Old Calabar 300
Plants, Notices of, 303
Polypodium calcareum, Notice of, 95
Prizes offered by Mr Jenner, 412
"Puttoo Manga," found in White Ants' Nests in Travancore, 80

Rannoch, Flora of, 252
Rare Plants, Notices of, 47, 49, 53, 84, 99, 100, 143, 203
Rhododendrons, Poisoning of Goats by, 409
Rhus Coriaria, Cultivation of, near Palermo, 341
Roberts, D. W., on Nature-printed Leaves and Flowers, 99
Robertson, P. S., on Poisoning of Goats by Rhododendrons, 409
Robinson, J. F., on some rare British Plants, 239
——— on the Botany of Frodsham Marshes, Cheshire, 265

Sadler, John, on New Localities for Rare Plants round Edinburgh, 47
——— Notice of *Polypodium calcareum* as a Scottish Plant, 95
——— on *Buxbaumia indusiata*, 128
——— on Rare British Mosses collected near Edinburgh, 163
——— on *Orthotrichum phyllanthum*, 190
Sarcocephalus esculentus, Notice of, 79
Schultz, Dr, Obituary Notice of, 272
Scopolia lurida, Physiological Action of the Juice of, 482
Selaginellas cultivated in the Edinburgh Botanic Garden, Remarks on, 3
Shortt, Dr J., on "Puttoo Manga," 80
Silicified Vegetable Structures from the Zambesi, 131

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Skeleton Leaves, Preparation of, 48
Skinner, George Ure, Obituary Notice of, 85
Smith, James, of Jordanhill, Obituary Notice of, 85
Smith, W. G., on the Fungi of Greenland, 465
Solanum, Species from Peru, 324
——— from the North Pacific, noticed by Mr Anderson-Henry, 482
Spirogyra orthospira noticed, 319
Submarine Forests in Orkney, 146
Sumach, Cultivation of, near Palermo, 341

Talbot, H. Fox, on *Vellozia elegans*, 79
Talbotia elegans, 192
Taxus baccata variegata Seedlings, 52
Thuja, Monograph of, 358
Traill, Dr Wm., on Submarine Forests and other remains of Indigenous Wood in Orkney, 146
Trichoscypha Mannii, Notice of, 78
Tropæolum majus, Abnormal Flowers of, 54

Variegated Greens, Notice of, 81
Vegetable Products used by American Indians, 378
Vellozia elegans, Notice of, 79
——— *Talbotia* noticed, 189

Walker-Arnott, Professor, Obituary Notice of, 414
Ward, N. B., Obituary Notice of, 426
Wellingtonia Stem, Notice of, by Mr M'Nab, 241
White, Dr F. Buchanan, on the Botany of the Jardin of Mont Blanc, 140
——— on *Grimmia subsquarrosa*, 142
——— on Two New Species of *Hypnum*, 198
——— On the Flora of Rannoch, 252
Wood Fuel in the Punjaub, 56

Yule, Colonel H., on the Cultivation of Sumach, 341

Zygodon Stirtoni, 340

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Extracts from the Laws relative to the Admission of Members, &c.

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A Candidate for admission into the Society as a Resident Fellow must present an application signed by at least two Resident Fellows. The application shall be read at the proper time during private business, and at the next Ordinary Meeting shall be determined by ballot.

Resident Fellows shall, on admission, sign the Laws, and pay the sum of 12s. 6d. to the Funds of the Society; and shall contribute 12s. 6d. annually thereafter at the November meeting. Resident Fellows are entitled to receive the "Transactions" yearly as published.

Resident Fellows may at any time compound for their annual contributions, by one payment of Five Pounds. They shall be entitled to receive the "Transactions."

Resident Fellows leaving Edinburgh within eight years from the date of their admission, may be enrolled as Non-Resident Fellows, if they have paid, besides their Entry-Money, eight annual contri-

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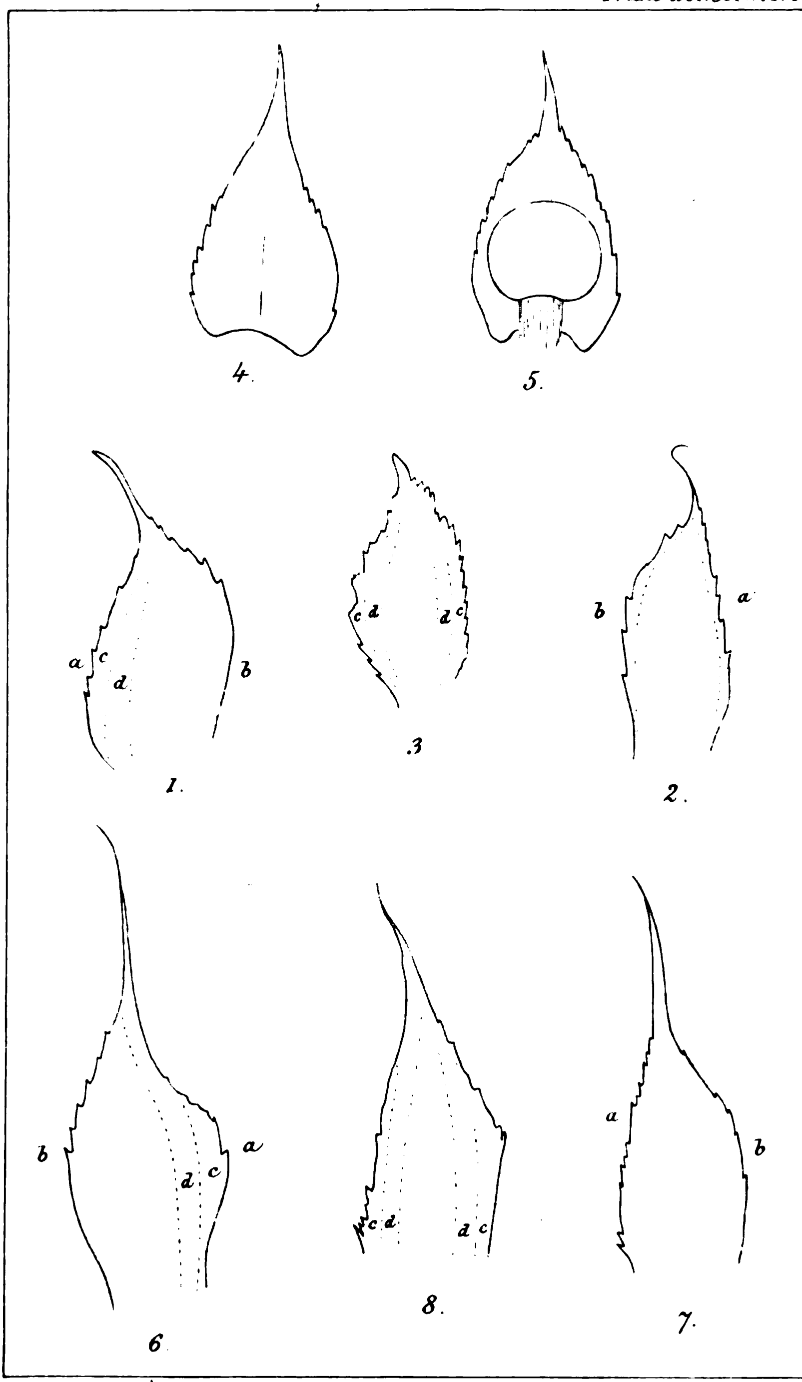
PLATE I.



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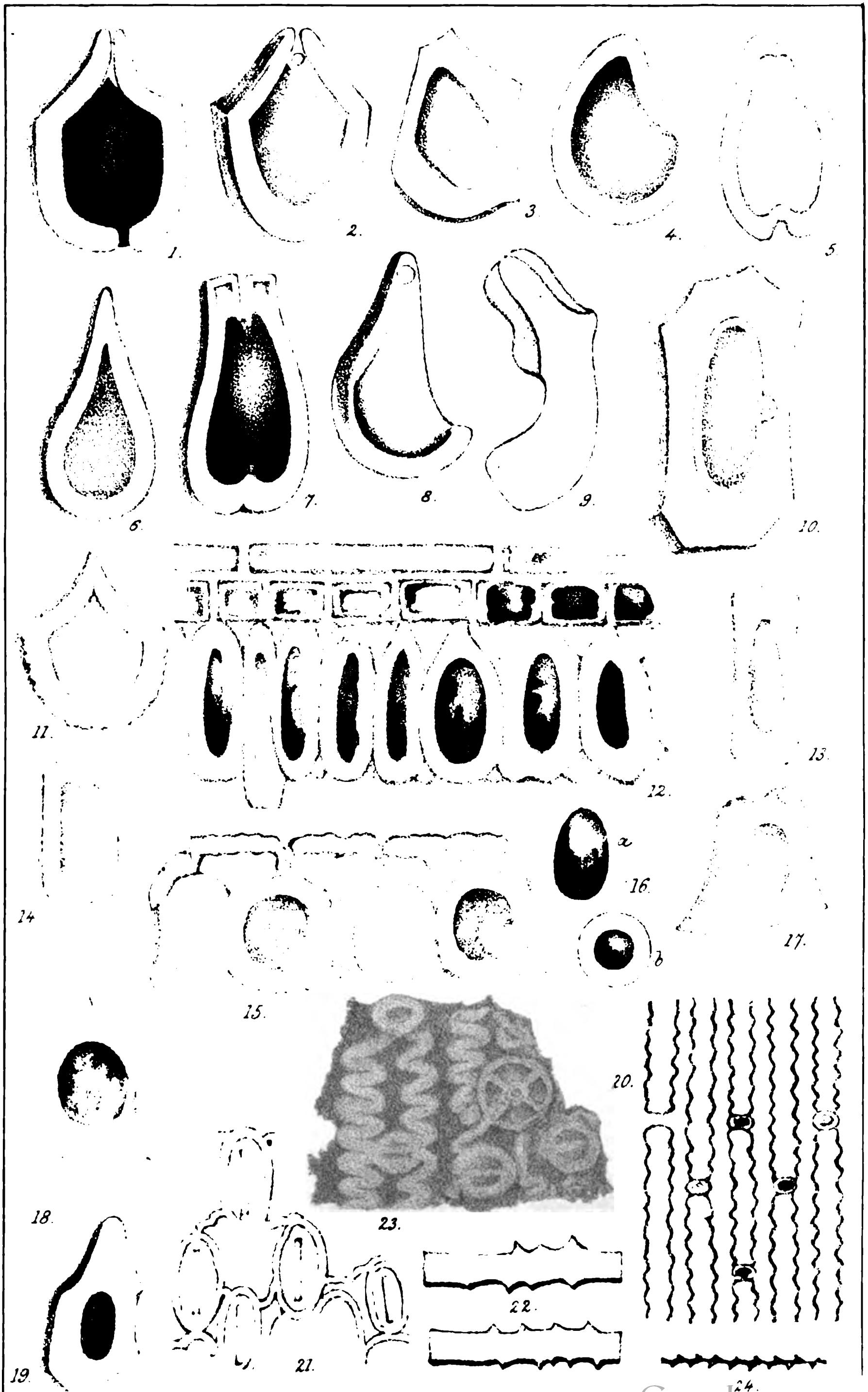

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SILICIFIED VEGETABLE STRUCTURES FROM THE ZAMBESI.

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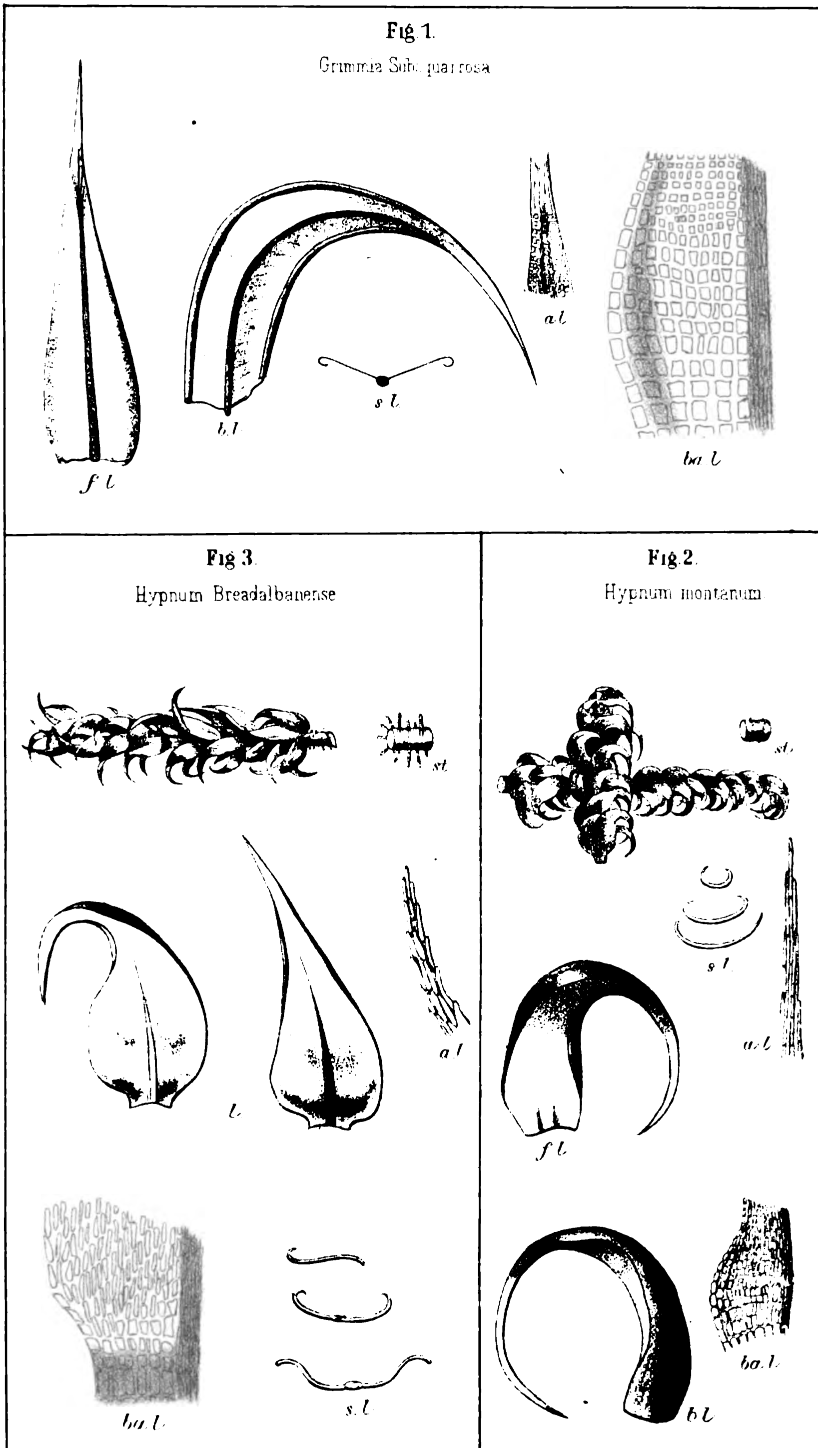
PLATE III.



F. Buchanan White, M.D. Delt

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AMBLYSTEGIUM CONFERVOIDES.

Fig. 1. Plant, natural size.
„ 2. Capsule, (dry,) (14 diam.)
„ 3. The same while moist.
„ 4. Calyptra.

Fig. 5. Portion of a branch, (49 diam.)
„ 6. Leaf.
„ 7. The same magnified, (195 diam.)
„ 8. Perichætium, (14 diam.)

W Wilson, Del.

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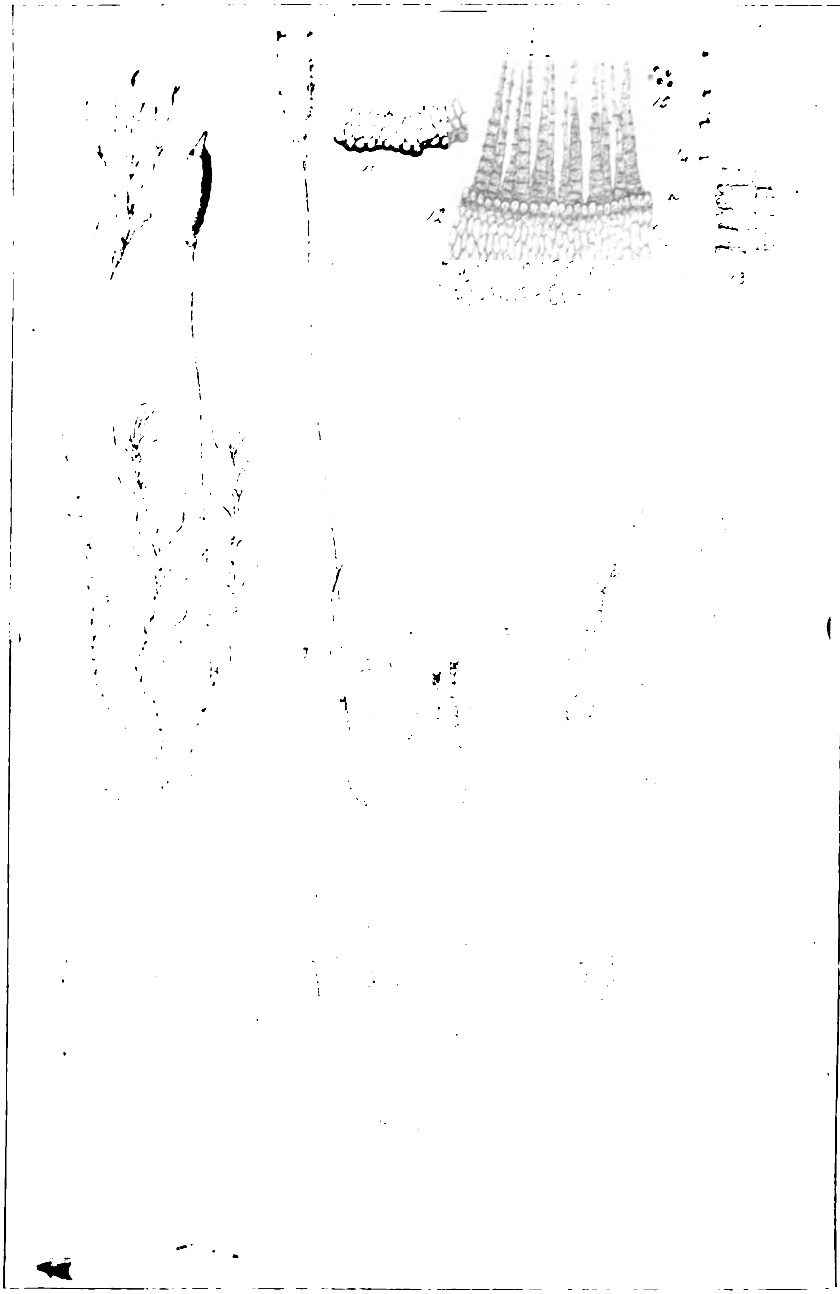

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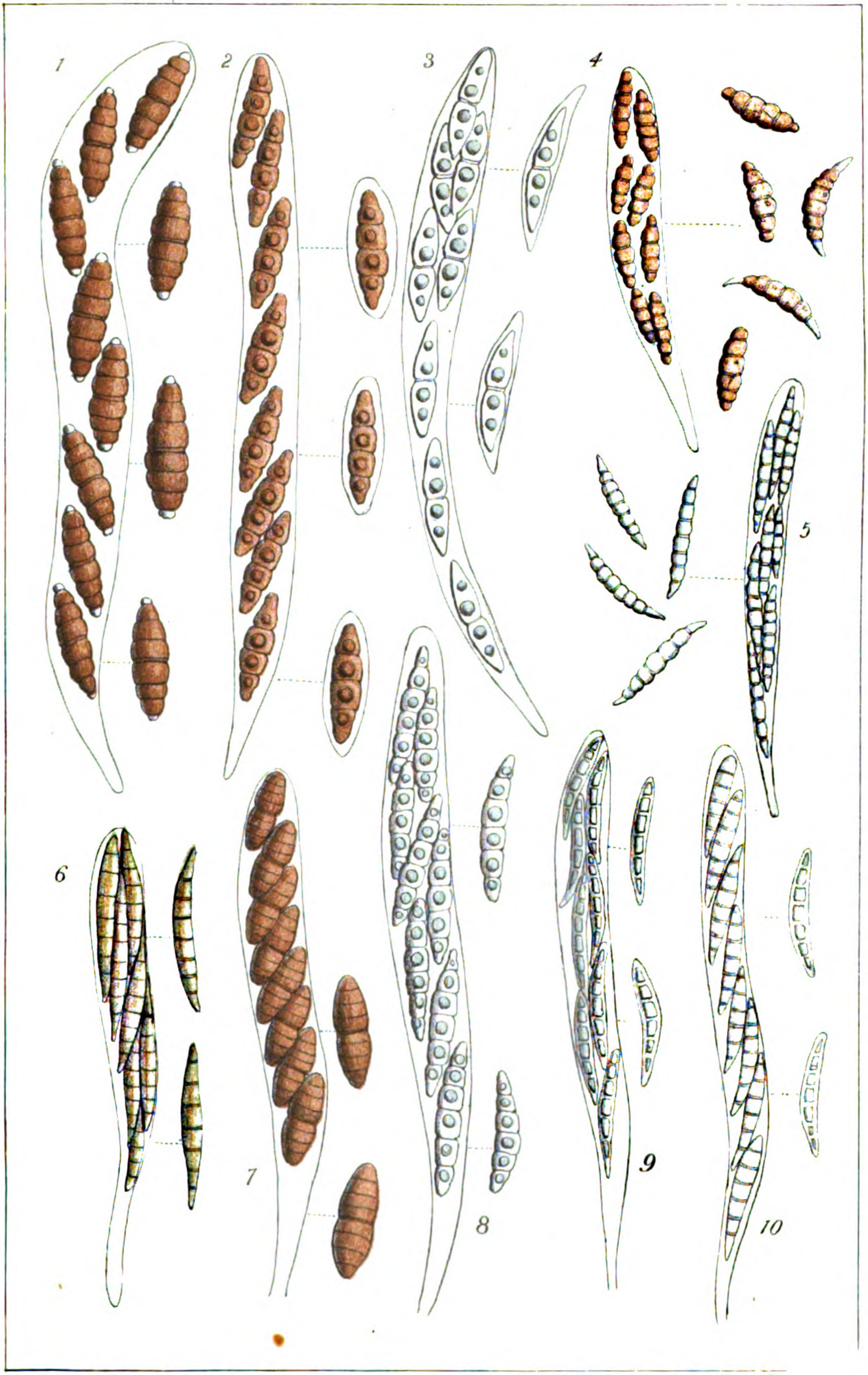

Lophiostoma.

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Fig. 1.

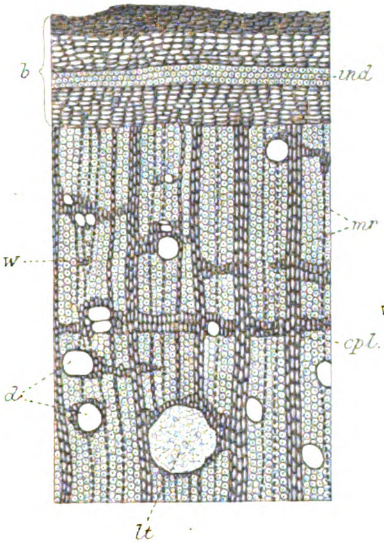

Fig. 4.

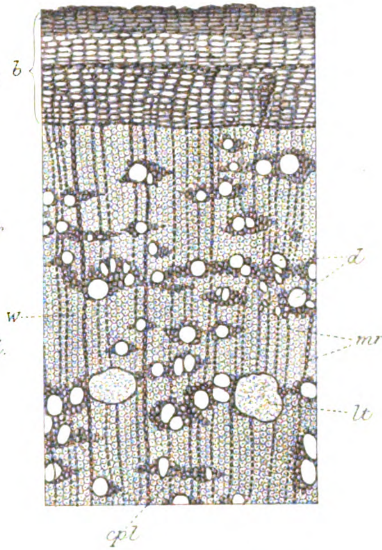

Fig. 2.

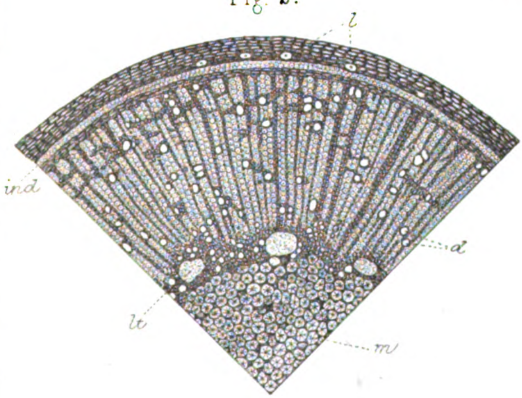

Fig. 3.

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CONTENTS.

PROCEEDINGS FOR NOVEMBER 1866.

Page

Obituary Notices........ 3
I. On the Selaginellas cultivated in the Royal Botanic Garden, Edinburgh. By W. R. M'NAB, M.D. (Plate I.)........ 3
II. List of Fungi collected in Otago, New Zealand. By W. LAUDER LINDSAY, M.D........ 13
III. List of Mosses and Hepaticæ collected in Otago, New Zealand. By W. LAUDER LINDSAY, M.D........ 22
IV. List of Ferns, Lycopodiaceæ, and Marsileaceæ collected in Otago, New Zealand. By W. LAUDER LINDSAY, M.D........ 27
V. New Localities for Rare Plants round Edinburgh. By Mr JOHN SADLER. 47
VI. On the Preparation of Skeleton Leaves. By Dr G. DICKSON........ 48
VII. Miscellaneous Botanical Communications........ 48

PROCEEDINGS FOR DECEMBER 1866.

I. Notes of an Excursion with Pupils to Braemar, in August 1866. By Professor BALFOUR........ 51
II. On the Reproductive Organs of Mosses. By WILLIAM BELL........ 52
III. On Seedlings of *Taxus baccata variegata*. By ALEX. J. ADIE, Esq........ 52
IV. Extracts from Botanical Correspondence. By Mr JOHN SADLER........ 53
V. On Abnormal Flowers in *Tropæolum majus*. By Dr ALEX. DICKSON........ 54
VI. Botanical Intelligence........ 54
VII. Report on Botanical Garden of Calcutta. By Dr THOMAS ANDERSON.... 54
VIII. Dr Cleghorn on the Supply of Wood-fuel to Indian Railways........ 56
IX. Dr Balfour on the Fruit of Passifloras........ 60
X. Mr M'Nab on a new Dwarf Arbor Vitæ........ 61

PROCEEDINGS FOR JANUARY 1867.

I. On the Glumaceæ of Otago, New Zealand, including Restiaceæ and Glumaceæ. By W. LAUDER LINDSAY, M.D........ 63
II. Notice of a Species of Trichoscypha, and of a Species of Sarcocephalus from Old Calabar. By Professor BALFOUR........ 78
III. Note on *Vellozia elegans* from the Cape of Good Hope. By H. FOX TALBOT, Esq........ 79
IV. Remarks on a Substance called "Puttoo Manga," found in the White Ants' Nests in Travancore. By Dr J. SHORTT........ 80
V. On the Varieties of Variegated Greens, &c., as Ornamental Plants. By Mr M'NAB........ 81
VI. Notice of the State of Open-Air Vegetation in the Royal Botanic Garden. By Mr M'NAB........ 82
VII. Effects of Blight on Orange Trees. By Mr M'NAB........ 83
VIII. Botanical News........ 84

PROCEEDINGS FOR FEBRUARY 1867.

I. Obituary Notices of James Smith, Esq. of Jordanhill; of Dr G. A. Martin, Isle of Wight; and of George Ure Skinner, Esq. of Guatemala. By Professor BALFOUR........ 85
II. Notice of some Diatomaceæ from Iceland. By Dr W. R. M'NAB........ 95
III. Some Account of Botanical Travels in Oregon. By Mr ROBERT BROWN.. 95
IV. Notes regarding *Polypodium calcareum* as a Scottish Plant. By Mr J. SADLER........ 95
V. Report on the State of the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'NAB........ 96
VI. Remarks on Beet-root Sugar. By MICHAEL CONNAL, Esq........ 98

Digitized by Google

PROCEEDINGS FOR MARCH 1867. Page

I. On the Hybridisation or Crossing of Plants. By ISAAC ANDERSON-HENRY, Esq. ... 101
II. Notes on some of the Compositæ of the Andes, and more particularly on *Chuquiraga insignis*. By Professor JAMESON, of Quito ... 115
III. Obituary Notice of Professor Goodsir. By Professor BALFOUR ... 118
IV. Report on the State of the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'NAB ... 127

PROCEEDINGS FOR APRIL 1867.

I. Obituary Notices. By Professor BALFOUR ... 129
II. On Silicified Vegetable Structures from the Zambesi. By Dr JOHN LOWE. (Plate II.) ... 131
III. On the Progress of Cinchona Cultivation in India. Communicated by Professor BALFOUR ... 133
IV. Notice of Cinchona Planting in the Kangra Valley. By WILLIAM COLDSTREAM, B.A. ... 136
V. On New Zealand Carrageen. By W. LAUDER LINDSAY, M.D. ... 137
VI. On the Botany of the "Jardin" of Mont Blanc. By Dr BUCHANAN WHITE ... 140
VII. Notes on *Grimmia subsquarrosa* of Wilson's MS. By Dr BUCHANAN WHITE. (Plate III.) ... 142
VIII. Note on the Occurrence of *Buxbaumia indusiata* in Aberdeenshire. By Professor DICKIE ... 142
IX. Extracts from Botanical Correspondence. By Mr JOHN SADLER ... 143
X. Report on the State of the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'NAB ... 144

PROCEEDINGS FOR MAY 1867.

I. Obituary Notice ... 145
II. On Submarine Forests, and other Remains of Indigenous Wood in Orkney. By Dr WM. TRAILL ... 146
III. On the Lichen-Flora of Druidical Stones in Scotland. By Dr W. LAUDER LINDSAY ... 154
Botanical Intelligence. By Professor BALFOUR ... 162
V. On the Introduction of the Mahogany Tree into Bengal. By Dr THOMAS ANDERSON ... 162
VI. Notice of some rare British Mosses recently collected near Edinburgh. By Mr JOHN SADLER ... 163
VII. Notice of an Excursion to the Forest of Fontainbleau. By Mr G. W. R. HAY ... 163
VIII. Notice of the Bunch-Grass of California. By Mr M'NAB ... 164

PROCEEDINGS FOR JUNE 1867.

I. On the Arctic Cladoniæ. By Dr W. LAUDER LINDSAY ... 166
II. Recent Regulations regarding the Forest Department of India. By Professor BALFOUR ... 187
III. Recent Botanical Intelligence. By Professor BALFOUR ... 189
IV. On a supposed New Species of Vellozia, or probably a New Genus of the Order Hæmodoraceæ. By Professor BALFOUR ... 189
V. On the Discovery of *Orthotrichum phyllanthum* near Edinburgh. By Mr JOHN SADLER ... 190

PROCEEDINGS FOR JULY 1867.

I. On the Discovery of *Buxbaumia indusiata* near Aboyne. By Professor DICKIE ... 192
II. Botanical Intelligence. By Professor BALFOUR ... 192
III. On *Talbotia elegans*. By Professor BALFOUR ... 192
IV. On Gases found in Plants. By Messrs FAIVRE and DUPRÉ ... 192
V. On the Nature and Structure of the Pod of Cruciferæ. By Professor BALFOUR ... 194
VI. On the Palm Trees of Old Calabar. By the late WM. GRANT MILNE ... 195
VII. Notice of Two Mosses new to Science. By Dr BUCHANAN WHITE. (Plate III.) ... 198
VIII. On a supposed Fungoid Disease affecting the Human Hair. By JOHN BISHOP, Esq. ... 199
IX. Addenda to the *Cryptogamic Flora* of New Zealand. By Dr W. LAUDER LINDSAY ... 201

Digitized by Google

CONTENTS.

Proceedings for November 1867.

Page

Opening Address by the President (ISAAC ANDERSON-HENRY, Esq.)............ 206

I. Abstract of Observations on New Zealand Plants. By W. LAUDER LINDSAY, M.D. 231

II. Letter from Dr ROBERT O. CUNNINGHAM, H.M.S. "Nassau," Rio de Janeiro, to Professor BALFOUR 234

III. Notice of Mussana Bark (*Albizzia anthelmintica*) from Abyssinia. By HENRY HUNTER CALVERT, Esq., British Vice-Consul, Alexandria. Communicated by Professor BALFOUR.... 238

IV. Extracts from Botanical Correspondence. Communicated by Mr SADLER. 239

Miscellaneous Notices........................ 241

Proceedings for December 1867.

I. On the Nature of the Discoloration of the Arctic Seas. By ROBERT BROWN, F.R.G.S........................ 244

II. Notes on the Flora of Rannoch. By Dr F. BUCHANAN WHITE.............. 252

III. Notice of a New Carduus gathered during a botanical visit to Ross-shire. By Mr CHARLES HOWIE and Mr CHARLES JENNER........................ 257

IV. On the Botany of Frodsham Marshes, Cheshire. By Mr JAMES F. ROBINSON. Communicated by Mr SADLER........................ 265

V. Botanical Rambles up the Weaver Valley. By Mr JAMES F. ROBINSON.. 267

Proceedings for January 1868.

I. Obituary Notices of Professor Daubeny, Oxford; Rev. Dr Hamilton, London; and Dr Schultz, Deidesheim, late Fellows of the Society. By Professor BALFOUR........................ 267

II. Notice of a New British Moss (*Amblystegium confervoides* of Bruch and Schimper) in Dovedale, Staffordshire. By Dr JOHN FRASER. Communicated by Mr JOHN SADLER. (Plate IV.)........................ 272

III. Account of a Botanical Trip to the Vosges Mountains. By Mr R. M. STARK........................ 274

IV. Letter from Mr WM. BELL, dated Kaoligir, (Dera-Doon), 2d November 1867, to Professor BALFOUR........................ 274

V. Notice of Plants collected near Kirkmichael, Strathspey. By Mr ALLAN COLDSTREAM........................ 292

VI. Observations on New Zealand Plants, No. 3. By Dr LAUDER LINDSAY.. 292

Miscellaneous Communications... 292

Proceedings for February 1868.

I. Notice of Botanical Excursions in the Highlands of Scotland during the Autumn of 1867. By Professor BALFOUR........................ 293

II. On Plants and Animals used for Food in Old Calabar. Extracted from the MS. Journals of the late Mr W. G. MILNE, by Mr JOHN SADLER.............. 300

III. Remarks on species of Elymus, Triticum, and Phleum from Vancouver's Island. By Professor BALFOUR........................ 301

IV. Report on the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'NAB........................ 303

V. Miscellaneous Notices........................ 303

Proceedings for March 1868.

I. Obituary Notice of John Baddeley, M.B., C.M., late Fellow of the Society. By Professor BALFOUR........................ 304

II. Notes on some New and Rare Mosses gathered in Ross-shire and Inverness-shire in July, by Mr Charles Jenner and Mr Charles Howie. By Mr CHARLES HOWIE, with Drawings and Descriptions by Professor SCHIMPER. Communicated by Mr SADLER. (Plate V.)........................ 31

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III. On a peculiarity in the Structure of the Stem of *Hedera Helix*. By W. R. M'Nab, M.D., Edinburgh ... 31[illegible]
IV. Recent Botanical Intelligence. By Professor Balfour ... 31[illegible]
V. Report on the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'Nab ... 32[illegible]
VI. Proposal for an Alpine Botanical Club ... 32[illegible]

Proceedings for April 1868.

I. On the *Genus Lophiostoma* of British Fungi. By Mr M. C. Cooke, (Plate VI.) ... 32[illegible]
II. On the British Species of Delphinium. By W. R. M'Nab, M.D. ... 33[illegible]
III. Report on the Open-Air Vegetation in the Royal Botanic Garden. By Mr M'Nab ... 33[illegible]
IV. Miscellaneous Notices ... 33[illegible]

Proceedings for May 1868.

I. On the Cultivation of Sumach (*Rhus Coriaria*), in the vicinity of Colli, near Palermo. By Professor Inzenga. Translated by Colonel H. Yule, C.B. Communicated by Dr Cleghorn ... 341
II. Notes of Mosses and Hepaticæ, collected by Robert Brown, Esq., on the North-West Coast of America. By George Dickie, M.D., F.L.S., Professor of Botany, University of Aberdeen ... 353
III. A Monograph of the Coniferous Genus *Thuja*, Linn., and of the North American species of the Genus *Libocedrus*, Endl. By Robert Brown, F.R.G.S. ... 35[illegible]
IV. On the Vegetable Products used by the North-West American Indians as Food and Medicine, in the Arts, and in Superstitious Rites. By Robert Brown, F.R.G.S. ... 37[illegible]
V. Report on the Open-Air Vegetation at the Royal Botanic Garden. By Mr M'Nab ... 39[illegible]
VI. Miscellaneous Communications ... 397

Proceedings for June 1868.

I. On the Reproduction and Cross Fertilisation of Passifloras. By Mr Robertson Munro. Communicated by Mr Sadler ... 399
II. On the Characters of the Akazga Plant, and the difference between the Structure of its Stem and that of *Strychnos Nux-vomica*. By Thomas R. Fraser, M.D., F.R.S.E., M.R.C.P.E., Assistant to the Professor of Materia Medica in the University of Edinburgh. (Plate VII.) ... 40[illegible]
III. Notice of Poisoning of Goats by Rhododendrons. By Mr P. S. Robertson ... 409
IV. Miscellaneous Communications ... 412

Proceedings for July 1868.

I. Biographical Notice of the late Dr Walker-Arnott, Regius Professor of Botany in the University of Glasgow. By Dr Hugh Cleghorn, F.L.S. ... 414
II. Obituary Notice of N. B. Ward, Esq. By Professor Balfour ... 426
III. Florula Discoana: Contributions to the Phyto-Geography of Greenland, within the Parallels of 68° and 70° North Latitude. By Robert Brown, F.R.G.S., &c. ... 430
IV. Notes of Algæ collected on the Coast of North-West America, by Mr R. Brown. By Professor Dickie, Aberdeen ... 465
V. On the Numerical Law of Flowers. By Joseph Bullar, M.D. ... 467
VI. Notes of a Visit to Strath Glass and its Tributary Glens. By Rev. James Farquharson, Selkirk ... 471
VII. Notes on Vegetable Morphology. By Colonel Collinson, R.E., Malta. Communicated by Dr Cleghorn ... 48[illegible]
VIII. Notice of Plants collected during recent Excursions with Pupils. By Professor Balfour ... 48[illegible]
IX. Physiological Effect of the Juice of *Scopolia lurida*, Dun. (*Anisodus luridus*, Link). By Professor Christison ... 488
X. Miscellaneous Communications ... 48[illegible]

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