TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

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VOLUME XVII.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY.

MDCCCLXXXIX.

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TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY.

VOL. XVII.—PART I.

EDINBURGH:

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MDCCCLXXXVII.

A complete copy of the Transactions, to Vol. XVI. inclusive, can be had from the Assistant Secretary. Price £7, 10s.

Dr Spruce's important work, "Hepaticæ of the Amazon and of the Andes of Peru and Ecuador," consisting of 600 pp. letterpress and 22 plates, forms Vol. XV., and may be purchased separately. Price 21s. The work is in Latin, with a few notes in English.

TRANSACTIONS

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BOTANICAL SOCIETY.

SESSION LI.

The President opened the Fifty-first Session of the Society on 11th November 1886. He returned thanks to the Fellows for again electing him to the important office, and expressed the hope that the ensuing Session would be a very prosperous one.

Reviewing the Session, it may be said that the Society has maintained its position as regards membership, and valuable contributions have been made.

There are at present 138 Resident and 312 Non-Resident Fellows, besides Foreign and Corresponding Members and Associates.

Two ladies have, under the new Rule for admitting Lady Associates, commended themselves tó the Council, and these were unanimously approved by the Society.

In view of the jubilee of Queen Victoria, the Honorary Patron of our Society, the Fellows resolved to present a congratulatory address, as emphasizing at once their loyalty and appreciation of the immense advances made in all branches of science during her auspicious reign. A gracious reply has been received from Her Majesty's Home Secretary.

We have to record with regret the loss by death of the following Fellows, who took a more or less prominent part in furthering the aims of the Society:—Sir Walter Elliot of Wolfelee, Professor Morren, Liege, Rev. W. W. Newbould, M.A., Dr Traill of Woodwick, Dr A. H. Balfour, Mr Robert Gray, Mr Thomas Moore, Mr Peterswald Pattison, and Mr James Scrymgeour, Dundee, long an Associate of the Society.

Obituary Notice of Dr James Gilchrist, Dumfries. By THOMAS A. G. BALFOUR, M.D., F.R.S.E.

It is with deep sorrow that I record the death of Dr JAMES GILCHRIST, who, from his student days till the close of his life on earth, was my sincere and attached friend. He was admitted as a Non-Resident Fellow of this Society on December 10, 1857. His early life was one of struggles, which, as in the case of so many others who have distinguished themselves in after life, contributed in no small degree to foster those qualities of earnestness, perseverance, and patient endurance which characterised his future career. He was born at the village of Collin, in the parish of Torthorwald, Dumfriesshire, on June 21, 1813, of parents in humble life. His father was a working mason, of an amiable and pious disposition, and much respected by his neighbours. He died of consumption at the early age of 30. His mother, who was the daughter of a master carpenter, and on whom the burden of his training was thus early thrown, was a woman of much energy and independence of character, and of high Christian principle; she was a strict disciplinarian, and her son again and again, in after life, looked back with thankfulness on this, as well as on her other excellent qualities, and cherished the warmest regard for her memory. He proved through life a most dutiful son, and had the inestimable satisfaction of being able to administer many comforts to which in her earlier years she had been a stranger.

He attended the parish school of Torthorwald, which was about two miles distant from Carthwood, to which the family had removed after his father's death. This school was presided over by a Mr Barton, who was a good teacher, and who, as was the case in these admirable schools, sought to imbue the minds of his scholars with religious as well as secular knowledge. An interesting circumstance in connection with his school days which he remembered, was that in winter each boy carried under his arm a long peat to supply the fire in the school-room. There was nothing special in his school life, unless it be that his holidays were spent in working at the farm of a friend, so as to recruit his mother's resources, and enable him to continue his education. Here, while herding the cattle, he acquired a taste for reading by having fallen in with an old Belfast almanack, the anecdotes in which interested him. His love for objects in nature was early developed. A brown mare that he herded was so gentle, that when feeding it would suffer him to leap on its neck, and would gently hoist him on to its back. His affection for this creature was very great, and when it was sold he wept bitter tears. Again we find him with a tame sparrow as an intimate companion. It would accompany him on his walks, flying about him, and lighting on his shoulder. A reckless boy threw a stone at it which killed it, and so deeply did he feel the loss of his pet that he has recorded the following—"That boy is now an old man, but his name is recorded in a list (happily small) of people who are not yet forgiven." He was also in very early years a shrewd observer of nature, for though he knew nothing of the names of the wild flowers, yet the place where and the time when each was to be found were familiar to him.

Through the kindness of a distant relative, who was a teacher in the Dumfries Academy, Gilchrist was enabled to obtain occasionally the benefits of that renowned institution. Here he took the second prize in writing.

While at the Academy a touching incident occurred, which showed his ardent desire for scientific knowledge. Three lectures on Geology were to be given in Dumfries, which young Gilchrist was anxious to attend, but on making inquiry he was much distressed to find that 5s. was the price charged for admission, which seemed to bar the way to his ever hearing them; his distress, however, became known to the rector, the kind-hearted Mr John M'Millan, who at once took Gilchrist along with him to the lectures, and at the close introduced the boy to the lecturer; Gilchrist asked some questions, which so pleased him that he presented his young pupil with some specimens, to the latter's great joy.

He was subsequently apprenticed to a draper in Dumfries, but for this kind of work he had no special liking; and realising at this time more fully the deficiencies of his early education, he strove in the intervals of business to supply that want. Lennie's English Grammar and the Latin Rudiments were always at his side. The hard toil and loss of sleep which this praiseworthy effort entailed laid the foundation of severe dyspepsia and its attendant evils, from which he suffered from time to time in after life.

Having seen the sad effects of intemperance in the case of many whom he had known, he determined at this time to become a total abstainer, and he remained through life a strong advocate of that cause. At the Band of Hope festival held at Dumfries after his decease, the chairman thus alluded to our excellent friend—"The Dumfries and Maxwelltown Band of Hope Union has in its infancy been deprived of the fostering care of its much-loved and highly respected honorary president. . . . His influence was ever felt for good, and his presence will be much missed."

He became also about this time a Sabbath-school teacher, and by his singularly interesting mode of conveying instruction he attracted and sustained the attention of his pupils, and was the means of leading one of them at least to devote himself to the ministry, who afterwards became an eminent pastor of an Independent Chapel in London.

Dr Gilchrist, even as a young man, had much earnestness of purpose; his motto seemed ever to be "life is real, life is earnest," and hence the frivolities of youth had no attraction for him; he, however, enjoyed innocent and healthy recreation, and was an excellent skater, though he could not tell whether his first skates were on loan or bought, but this he did remember, that on their account he was the admiration and the envy of his companions.

Having left the drapery business, he, after serious consideration, was desirous of devoting himself to the ministry in connection with the United Presbyterian Church, and by the help of some friends, and by teaching in a boarding school, he was enabled to secure a university education, and he entered the Divinity Hall of his denomination. About this time (1843), one who afterwards became Dr Gilchrist's attached friend, but was then attending the Dumfries Academy, thus speaks of his qualifications as a teacher—"Gilchrist was then supplying the place of a master who was ill. His manner was quiet, reserved, and firm, and from his bearing he soon gained control over the class."

After attending for some time at the Hall, his health gave way under continuous study, and after the delivery of a Hall discourse, he was compelled to consult Dr Alison, who ordered him to the country, and to cease from all study. He followed out these orders for some time, but idleness was irksome to his active mind, and the necessity of looking out for some means of supporting himself led him to resolve to apply himself to the study of medicine, which resolution he was enabled to carry out.

It was at the Botany class in 1846 that I first met him; no more diligent and interested student could be found. His powers of close observation and love of nature had here free scope, and over hill and dale, in wood and field, he eagerly followed the footsteps of his beloved and devoted professor, and at the end of the session his energy and proficiency were rewarded by his carrying off the first prize for monthly competitions and examinations by means of written questions and answers, without any aid from books or notes. In 1847 he was alike successful in carrying off the first prize in the senior division.

In 1848 he had rendered valuable services to my brother in connection with his class, for on a gift presented to him there is the following inscription:—"To Mr James Gilchrist, as a small mark of esteem and gratitude for services rendered. Botanic Gardens, July 22, 1848."

In all his classes he displayed the same earnest and constant attention, and when the final examinations came round he passed them all, and took his degree of M.D. in 1850. His anxieties about his means of support were soon to be ended. Dr Browne was at that time in the zenith of his renown as the medical superintendent of the Crichton Royal Institution, Dumfries, and as a vacancy had occurred in the office of assistant, he was desirous of securing the services of a thoroughly qualified graduate. He applied to his relative Professor Balfour, who strongly recommended Dr Gilchrist, and he then sought the opinion of one of Gilchrist's fellow students, who spoke of him as a man of high principle, strictly conscientious, modest and retiring in his bearing, but thoroughly competent, and one who would as faithfully as efficiently discharge the duties devolving on him. Dr Gilchrist was appointed, and fulfilled the expectations regarding him, as is evidenced by the testimony of one who was intimately associated with him for two years in the

Southern Counties Department of the Asylum:—" He was devoted to his duties, patient, attentive, kind, if anything he lacked firmness, but by his unceasing attention and thoughtfulness he gained the confidence of his patients, and I have known few men to whom they were more attached;" and after alluding to the admirable and successful treatment of the insane pursued by Dr Browne, he goes on to say—" Dr Gilchrist became one of the main agents in the carrying out of this system, and his general knowledge of science proved of great service. He gave regular courses of lectures on Botany and Geology; of which he was an enthusiastic student; and these were continued until he left the Crichton Institution to enter on his duties at Montrose. He also took the patients attending his class out for walks, and gave what may be called clinical instruction in these sciences. Fond of music, and knowing it scientifically, he held music and singing classes weekly in the Crichton Institution and Southern Counties Asylum." He remained there till 1853, when he was appointed medical superintendent of the Montrose Asylum. Here also he devoted himself assiduously and zealously to the discharge of his official duties, and profiting by the able tuition of his esteemed teacher, he carried his system of moral treatment into his new sphere of labour, and strove to introduce one improvement after another into his asylum, and it was by his efforts and advice that the noble institution at Sunnyside was projected and commenced. Here also his scientific tastes were cultivated and extended, for, meeting as he did with Mr Alexander Croall, an able and distinguished botanist and zoologist, who gave special attention to the Cryptogamic portion of the former science, we can easily understand how Dr Gilchrist was led to direct his attention to marine zoology, and to take a special interest in sea-weeds, mosses, and lichens. These are still at Linwood, Dumfries, and I am authorised by Mrs Gilchrist to state, that those who know and care for such things may have an opportunity of inspecting them by giving her notice of their desire. In this kind and generous offer she is following in her late husband's footsteps. It was while here that he sent to our Society his paper on the Geological Relation of Plants. Having in August 1853 formed one of a party who, under the auspices of my late brother, made an excursion to the botanically classic ground of Clova, he was struck with the extreme rarity of many of the plants, and by the fact that some of them were entirely limited to that district, and that these limits were of the most confined nature; and he was led to consider whether any light might be thrown on the subject by a special study of the rocks of those portions of the district where such isolated species of plant-life occurred. He confined himself to this one inquiry, for which he was peculiarly fitted by his thorough knowledge of geology. He was, however, too sensible and intelligent to suppose that the study of any one aspect of the case would be sufficient to solve the difficulty, for, as he himself frankly owns, "the problem is very difficult of solution from its extreme complexity, involving as it does not only an accurate knowledge of the plant itself, in its living and dead state, its anatomy, its physiology, its chemistry, but also its entire relation to whatever can modify its growth—to the soil on which it grows, to the air which it breathes, to the sun which gives it light, to the rain, dew, or snow which afford it moisture, to the electrical conditions which influence its chemico-vital affinities; in short, its relations to fire, air, earth, and water." His observations were necessarily limited, but included the subjacent rocks of *Oxytropis campestris, Lychnis alpina, Gentiana nivalis*, and in the following year at Braemar, *Astragalus alpinus;* and the two following conclusions were reached:— "1st, that each plant was limited in its range to a rock of the same specific character; and, 2nd, that in one case in which the examination was completed, the limits of the plant's distribution and those of the rock possessing such character were identical." He then meets some possible objections, and concludes with the judicious suggestion, that geologist, mineralogist, meteorologist, and analytical chemist should all be associated with the botanist in such an investigation.

At Montrose he made many friends, more especially among those who were fond of natural history pursuits, as he and Mr Alexander Croall were the chief supporters of the Scientific Institute of that town.

After the passing of the Lunacy Act for Scotland in 1857, Dr Browne was at once chosen as one of the commissioners, and Dr Gilchrist was appointed his successor at Dumfries. It was no ordinary trial for any man to be called to occupy the place of such a prince of psychological physicians, and no man could realise that position more than the subject of our sketch. Under a deep sense of responsibility he returned to "The Crichton," and it was no small comfort and encouragement to him to find that his return among them was welcomed with much pleasure by the patients. He threw himself heartily into his work, and, as the friend from whom I have already quoted, says, "there was scarcely a day in which something to interest the patients was not in progress to which he himself largely and unweariedly contributed during his whole tenure of office, by giving courses of lectures in Botany, Natural History, Mineralogy, and even at a time when rest would have been most needful for the preservation of his health." And as had been said by another friend, who also knew him well, "with what zeal, unwearied toil, and abundant success he conducted the affairs of that large institution for the long period of twenty-two years, its records amply testify."

During this period he spent his holidays in prosecuting his favourite sciences all over the country. But not limited to his native land, he made several tours on the Continent, and no one who had the privilege of being associated with him, as I on two occasions had, can fail to recall to mind the kindness and genuineness of his friendship, the ardour of his devotion to natural science, and his devout and reverent spirit.

Our limited time, and the consequent rapidity with which our tours were accomplished, prevented us making any collection. Our scientific work was mostly confined to inspecting the various Natural History Museums, some of which were peculiarly interesting and instructive.

The constant strain which the arduous duties of the asylum involved proved at last too much for Dr Gilchrist, and in 1879 he was compelled to resign his post as medical superintendent. The rest which this secured for him proved very beneficial, but no sooner did he feel himself improving in health, than he was impelled by his love of science, and the promptings of his generous heart, to conduct, as a labour of love, classes for the study of Botany, Geology, and

Physiology, which were a great source of pleasure to him and of profit to those who attended them.

He was emphatically a *field* botanist and geologist, and the large collections which he with his own hands gathered testify to the zeal and constancy with which he followed out his favourite sciences. He was chosen president of the Field Club of Dumfries, and exercised a decided and healthful influence by broadening, extending, and giving a fine tone to its scientific spirit.

He was quiet in his manner, but hospitable, generous, and benevolent, and was ever ready to help in every good work. For many years he offered an annual prize in the botanical class for the best essay on some specified subject. This practice he began in 1859—the prize for that year being for "the best and approved collection of fossil plants from Mid-Lothian." No competitor for it appeared, and as the prize was again offered with a like result in 1860 and 1861, he varied the subject in 1862. The prize offered was for "the best and approved essay on the Affinities of the Orders Umbelliferæ, Galiaceæ, Valerianaceæ, Dipsacaceæ, and Compositæ. This prize was gained by Mr John Thomson, Nairn. In 1863 a new subject was selected, the prize for that year being for "the best and approved essay on the so-called Parthenogenesis"; and it is very interesting to find that this prize was gained by Lauchlan Aitken, Stirlingshire, who afterwards still further distinguished himself while assistant to Sir James Y. Simpson, and still later as an able and accomplished physician at Rome, whose premature removal we have so recently been called to mourn.

In that year (1863) Dr Gilchrist seems to have offered another prize for "the best and approved series of Microscopical Preparations illustrating the Structure of the Ovary and Ovules." In 1874 he offered a prize of two guineas for "the best and approved Report on the Fossil Flora of the district within 10 miles of Edinburgh." This was nearly the same subject which he had proposed in 1859, and which in that and the two following years called forth no response from the students; and strange to say, for a similar period of three years, viz., 1874, 1875, and 1876, the offer was attended with a similar result. But Dr Gilchrist was not to be disheartened, and borrowing, no doubt, a hint from

Robert the Bruce and the spider, he renewed his offer in 1877, and this year there was in the botanical class a young, ardent, and intelligent student, whom the difficult nature of the subject only stimulated to fresh energy; he accepted the task, successfully accomplished it, and gained the well-merited prize, and I am sure that you will all feel deeply interested, and rejoice when I inform you that the distinguished student of that year is the able and accomplished botanist who so efficiently discharges the duties of assistant Secretary to our Society; I refer, of course, to Mr J. M. Macfarlane.

In 1878 a prize of two guineas was offered for the best and approved essay on the subject which, as we have seen, had specially occupied his own attention, viz., "the Relation between Plants and Soils in influencing their Geographical Distribution in Britain"; but though this prize was again offered in 1879, in neither year was there any competitor.

As might have been expected in the case of one so generous and worthy as Dr Gilchrist, there was discovered from his letters that he had made offers of help to students at college, and had given many and handsome gifts of money. The lessons of his own student days had not been lost on him, for Dido-like he could, and did, by his active benevolence, say "Haud ignora mali miseris succurrere disco."

He latterly took great delight in selecting from his immense collection specimens of the different rocks and fossils, and in presenting sets of them to schools and mechanic institutions, and even sometimes to individual children, that they might be stimulated and aided in the pursuit of natural science, from the study of which, in his own case, the resulting delight was much intensified by his tracing in the objects around him the wisdom, power, and goodness of his heavenly Father. This feature in his character, though always present, was strikingly displayed when, on one occasion, a friend who had written a book illustrating Christian truths by illustrations drawn from Mineralogy, sent him a copy. In his letter of thanks in reply, Dr Gilchrist expressed in no measured terms the delight and happiness which he had experienced in its perusal, and urged the author very earnestly to bring out another book dealing with Botany in a similar way. His latter end was peace.

I cannot conclude without recording one striking instance of his high sense of honour and noble independence. Some of his professors having, during his student days, been informed of his difficulties and hard struggles, had given him his class tickets gratuitously. This kindness he fully appreciated, and, under the circumstances, was compelled to accept, but not without the vow and determination that when he was able he would return their kind gift. No sooner had his appointment to Montrose Asylum put the means of doing so within his power, than he enclosed the money to each of the professors in repayment of what, he stated, he never ceased to regard as a debt of honour. In a like noble spirit the professors refused to receive it, but Dr Gilchrist still felt that the money was not his, and as the only way of gratifying his desire to acknowledge their kindness, he, I believe, handed over the sums to the Medical Missionary Society. What a noble example of Christian heroism does not this act afford?

Obituary Notices of C. W. Peach, R. Gray, Rev. W. W. Newbould, and Professor E. Morren. By Andw. Taylor.

Charles William Peach died on the 28th February 1886, in the eighty-sixth year of his age. Born at Wansford in Northamptonshire in 1800, where his father was a small farmer, Peach was nominated to the Coast Guard service in 1824, and continued in it till 1845, when he obtained a place in the Customs, mainly on account of his eminent services in geology, palæontology, and marine zoology. Wherever official duties called him—first at Fowey, Cornwall, and afterwards at Peterhead and Wick—Peach gained fresh laurels both as a trusted public servant and a scientific expert, till, retiring about 1862, because of the abolition of the office of comptroller throughout the service, he came to Edinburgh, where he spent the evening of his busy life.

The death of our venerable Associate is noted by public annalists among the events of the year. Doubtless his name is best known by his discoveries in stratigraphical geology and fossil ichthyology, which were landmarks of the advance of contemporary science. For these he received the Wollaston Fund in 1859, from the London Geological Society; and the Neill Prize Gold Medal and proceeds of the Fund, from the Royal Society of Edinburgh in 1875. But that unique power of observation thus trained was available also in the field of fossil botany, which mainly absorbed his closing years. He was elected an Associate at our January meeting of 1870, and in the following six years both laid before us new finds in fossil botany, and created fresh enthusiasm for its study even amongst veterans like Professor John Hutton Balfour and Sir Robert Christison. He received much kindly encouragement from the first of these worthies in making thorough searches in those new localities for fossil plants, then just laid open by industrial enterprise around Edinburgh. He had the co-operation of his son, then as now an officer of the Government Geological Survey. No one more thoroughly realised the necessity of a perfect knowledge of present-day plants for the true diagnosis of those imbedded in the rocks. Though lacking the modern discipline of the botanical laboratory, his wonderful power of seeing facts passed over by others served him well, in many localities opened up in 1870, rich in new finds in palæobotany, such as the new railway tunnel at Colinton, or the waste-shale heaps at Straiton or West Calder, at Cleugh near Falkirk, or Devonside near Tillicoultry, as well as the Grange Quarry, Burntisland. The results of these were given in a series of seven papers which run through our *Transactions* from 1871 to 1875. As brevity was considered a chief merit in a scientific communication by Peach, his brief notices give no idea of the interest excited by the large sepia drawings, as well as the neat way in which the fossils, often mounted in glass cases so as to show both sides of the stem, and having the special characteristics of each specimen carefully indicated by arrows drawn on paper which was gummed to the stone. From our limited audiences several young workers were thus incited to enter this little-trod field of science. Peach demonstrated *Cardiocarpum* to be the fruit of *Antholithes Pitcairniæ;* he showed the close relationship of *Staphylopteris* (?) with *Sphenopteris affinis,* besides giving new localities in Scotland for many English carboniferous plants. Peach's last paper, contributed in

1876, was a comparison of the Fossil Plants in the neighbourhood of Edinburgh, with those figured in Stur's *Culm Flora*, then just published. A flower-like plant he always found associated with the fossil fern *Sphenopteris affinis* at West Calder excited much of Peach's enthusiasm, and was the subject of his last and longest paper, communicated to the *Quarterly Journal of the Geological Society* in 1878. Its proposition is given in the title, which is "On the Circinate Vernation, Fructification, and Varieties of *Sphenopteris affinis*, and on *Staphylopteris* (?) *Peachii* of Etheridge and Balfour, a Genus of Plants new to British Rocks." But, as Mr Carruthers intimated during the discussion on the paper, and as Mr Kidston subsequently demonstrated, the supposed new genus is really the fruit of the fern.

Mr Peach contributed several minor notices at our meetings. Amongst these were remarks on a large cone, like that of *Pinus Benthamiana*; on *Xanthium spinosum*, growing on the banks of the Tweed, supposed to have been introduced in imported wool; and on dodder growing on French clover near Northampton. A paper was read in 1870 on the Fructification of *Griffithsia corallina*, with notes on Miss Jeffrey's observations on algæ during the dredging trip in which Peach accompanied Gwynn Jeffreys to the Shetland outskerries. This was followed up by exhibitions of a rock slab from Stromness, showing imprints of the living marine algæ *Desmarestia aculeata* and *D. viridis*, quite unimpaired after being kept in the cabinet for fourteen years; and also of striped stones from Hale, near Penzance, exhibiting appearances manifestly recently formed, which would have been designated *Calamites* if found on rocks of the carboniferous system.

Robert Gray died from an apoplectic seizure, at Bank of Scotland House, Edinburgh, on 18th February 1887, after an illness of three days, in his sixty-second year. More than one auditor besides the writer of this obituary conversed with our lamented Vice-President, apparently in good health, just a few days before his decease.

Fourteen years ago Mr Gray published *The Birds of the West of Scotland*, whilst actively engaged as a bank inspector. The book has been long out of print, and ranks amongst our most valued treatises on ornithology. When shortly afterwards Mr Gray was officially removed to Edinburgh, he was recognised as an authority in Scottish natural science. Coming just after Dr John Alexander Smith had resigned his secretaryship of the Royal Physical Society, Mr Gray filled the vacant niche so well as to have added renewed life to a Society whose meetings have all along given a fruitful nurture to so many young naturalists. Mr Gray, as Vice-President, delivered the closing address at the conclusion of the Session of the Royal Society of Edinburgh for 1875. Altogether, his distinguished career suggests a closer union of our Scottish natural science societies, now far more numerous than when, forty years ago, the Botanical and Royal Physical Societies represented the students of natural history. The autonomy of each society might be preserved, while advantages, only to be given by a strong organisation, in respect of frequency and illustration of publications, as well as mutual intercourse of members, might be gained. If such an effort were only to bring another Robert Gray to the front, it is worth attempting.

Mr Gray, though known as a west country naturalist, was born at Dunbar in 1825. Entering bank service immediately after leaving school, he died in harness as cashier to the Bank of Scotland, having passed through the several grades of accountant, inspector, and local manager under different corporations. An enthusiastic natural observer when a boy, he continued so throughout his busy official life. He husbanded time so well, either in the early morning or after eight hours' official duties, to observe and write; thus gaining his scientific reputation, while keeping to the front as a business man.

Joining our membership in 1875, when he occupied a house in Inverleith Row, overlooking the Botanic Garden, Mr Gray ever after took a warm interest in our Society; he became a Councillor, and subsequently a Vice-President. Unlike his predecessor Dr John Alexander Smith, he did not communicate papers, but his presence was an influence both in Council and Society meetings. Mrs Gray writes that her husband was familiar with every plant in the districts of the west of Scotland, explored during bye-times of bank journeyings, when pursuing his special ornithological and palæontological studies. Perhaps a too scrupulous regard for special excellencies in a scientific communication prevented his display of general botanical knowledge.

The helping of distressed literary and scientific men occupied much of Mr Gray's leisure.

WILLIAM WILLIAMSON NEWBOULD, whose lithe spare form was so long well known in the reading room, or the old Botanical department of the British Museum, died on 16th April 1886, from pneumonia incited by a cab accident in the streets of London. He was born at Sheffield in 1819. Mr Newbould was perhaps the last of the old *species* school of British botanists, with which the early work of our Society was associated. A B.A. of Cambridge in 1842, first curate, and then priest in 1845, Mr Newbould shortly after vacated holy orders, becoming for thirty years a diligent student of Botany at his London headquarters, his life there being varied with occasional country trips, and during that period he was consulted by almost every compiler of local British Floras. A pupil of Prof. Henslow's at Cambridge, he there also began his life-long friendship with C. C. Babington, then ten years his senior. It was through his influence he joined our ranks in 1841. The two botanists made many joint excursions, besides those to Scotland. During the first of these, in 1845, he was invalided under the care of the late Prof. Goodsir at Largo Manse, owing to a coach accident. H. C. Watson repeatedly acknowledges Newbould's aid in the prefaces to his topographical botanic treatises; Newbould, on the other hand, highly valued Watson's work, though he attached more influence to river basins in the topographic distribution of plants than his friend did. Dr Boswell has also acknowledged his deep obligations to Newbould, as editor of the third edition of *English Botany*. But I must refer the reader for further details to the source whence many of these have been obtained, viz., Mr Britten's admirable biography of Mr Newbould (*Jour. Botany*, No. 282, June 1886, vol. xxiv. pp. 161–177).

I cannot omit to quote the following physiognomic sketch:—"The slight bent figure, frail to attenuation with hardness of study and poverty of living; the bald head, its scanty fringe of hair, grizzled like the beard, which all but hid the nervous sensitive mouth; the wide benevolent forehead; the ragged penthouse brows, shading eyes sometimes almost uncanny in their weird brightness, sometimes beaming with simple child-like pleasure,—the pleasure perhaps of knowing that he had in his pocket some rare volume picked up at a second-hand book stall for the friend to whom he was talking; the long, lean nervous hands, pointed at the tips for handling of minute specimens, dusty with dust of rarely opened books. . . . . . The shabby clothes never concealed that impalpable something, that unconscious indestructible stamp of refinement, of gentle birth and gentle culture, which was one of the most delicately marked characteristics of the man so markedly humble."

Mr Newbould was elected Fellow of the Linnean Society in 1843. A genus of the Bignoniaceæ has been named after him.

The late EDOUARD MORREN, professor of botany, Liege, was elected one of our Foreign Corresponding Fellows in 1876; and was removed to the list of Foreign Honorary Fellows in the following year. First assistant, and subsequently successor to his father Charles Morren, as professor and curator of the Botanical Institute at Liege, he deepened the influence of his parent in furthering Belgian agriculture and horticulture; at the same time making the Institute recognised as one of the best-equipped science schools in Europe. Morren perhaps was most widely known as editor of the *Belgique Horticole* and the *Correspondence Botanique*. His talents as an administrator found scope as secretary of the Federation of Belgian Horticultural Societies. The late Antwerp Botanical International Congress of 1885 owed its great success to his indomitable assiduity.

Edouard Morren was born at Ghent in 1833. Here he also succeeded his father as botanical professor,—the offer of a prize essay on leaf structure and the colouring matters of plants first specialising his studies, which had previously alternated betwixt the law and journalism.

He had the largest and most complete collection of living Bromeliads, intending to write an extended monograph on the order.

Both father and son were valued correspondents with our

Royal Botanic Garden. Edouard Morren's visit to the late Prof. Balfour is still remembered with interest by Edinburgh botanists.

E. Morren's death happened suddenly, just as preparations were being completed for celebrating the 25th anniversary of his occupancy of the Liege botanical chair. He lectured on the 25th February 1886, and towards evening complained of excruciating pains; he expired on the 28th of the same month. Morren thus died in the maturity of his powers, and amidst a singularly unique career of public usefulness.

Obituary Notice of William Traill, M.D. By Hugh Cleghorn, M.D., LL.D.

Among the losses which our Society has recently sustained, it is our painful duty to record the death of Dr William Traill of Woodwick, Orkney, who died on 10th December in his residence at St Andrews, and was buried in the new cemetery there. He was born in his father's house, Kirkwall, and educated mainly by private tutors, including the late Principal Fairbairn, then a divinity student. When about eighteen he was sent to Edinburgh, where his medical studies were directed by his relative, Dr Thomas Stewart Traill, Professor of Medical Jurisprudence in the University. During the five years he was studying in Edinburgh he spent the recess in Orkney, where his leisure was devoted to the study of natural history, particularly zoology, on the shores of the islands of Rousay and North Ronaldshay.

We graduated in 1841, and soon afterwards we both obtained appointments in the East India Company's service at Madras, and for some months did duty together, but in the exigencies of military service we were sent in different directions. He was sent to China, and remained for one and a half years at Hong Kong, and was afterwards appointed civil surgeon at Singapore. He visited Penang and the Straits of Malacca. In these places he had abundant leisure and opportunity for studying the natural history of the Indian Archipelago. He was an excellent naturalist, standing in the first rank as a conchologist. He formed a valuable collection of shells at Singapore, and with great liberality supplied duplicate sets to Madras, Dublin, and St Andrews Universities, the museum tickets being all in his own handwriting.

After serving about ten years at Singapore, he returned to England; and on going back to India in 1856 was sent to Waltair, Vizagapatam, and Cuttack, where he became acquainted with Sir W. Elliot, then Commissioner of the Northern Circars, who encouraged him in science.

Dr Traill married, in 1847, Emma, daughter of Mr James Harvey of Bath, by whom he had two sons and five daughters. Both sons are in India, in the Public Works Department; four of the daughters are married.

In 1858 Dr Traill succeeded to the family estate of Woodwick on the death of his father, and in 1861, having served the requisite time (twenty years) to enable him to claim a retiring allowance, he returned to this country, and settled at St Andrews, being attracted by its educational advantages for his young family. He visited North Ronaldshay every year, and spent the summer months in the island, being on the most friendly terms with his tenants. His life was very quiet and happy. He was an elder of the Church of Scotland, and both Dr A. K. H. Boyd and Dr Anderson of St Andrews have made public reference to his useful services in their congregation. He was also a Justice of Peace and Deputy Lieutenant of Orkney, and was greatly respected as a magistrate. He enjoyed good health (usually playing a round of golf daily at St Andrews) till eighteen months ago, when the first symptoms of the disease appeared which ultimately proved fatal.

Dr Traill joined the Botanical Society in 1867, and contributed original notes on Submarine Forests and other remains of Indigenous Wood in Orkney (*Bot. Soc. Trans.*, vol. ix.). Again, in 1879, he read a paper on the Growth of New Zealand Flax (*Phormium tenax*) in the Orkney Islands; his observations are recorded in vols. xiv. and xvi. In the same year he directed attention to the successful introduction of various New Zealand plants,—*Myrsine Urvillei*, *Leptospermum scoparium*, *Veronica decussata*, *buxifolia*, and *Andersoniana*, into North Ronaldshay.

Let me add, in conclusion, that we all rejoice to have with us Mr G. W. Traill, brother of the subject of this brief notice, and who shows in so high a degree the diligence in study and love for scientific work which characterised his brother.

Chronological List of Papers.

1. Brief Notices of Pelagic Mollusca, collected on a Voyage from England to Madras during the months of April, May, and June 1856, with map and illustrations. *Madras Journal of Literature and Science*, March 1857.
2. On Submarine Forests and other Remains of Indigenous Wood in Orkney. May 1867. *Bot. Soc. Trans.*, ix. p. 146.
3. General Remarks on the Dwellings of Prehistoric Races in Orkney, with a special notice of the Picts House of Skerry Brae, in the Parish of Sandwick, showing the present state of the Excavations lately made there. Read April 13, 1868. *Proc. Soc. of Antiquaries*, p. 13.
4. Topographical Notes on the Island of Ascension. *St And. Lit. and Phil. Soc.*
5. On the Expedition to Mount Ophir, Malacca, in 1852. *St And. Lit. and Phil. Soc.*, December 1877.
6. On the Growth of the New Zealand Flax Plants (*Phormium tenax*) in Orkney Islands. Read 11th December 1879. *Bot. Soc. Trans.*, xiv. p. 49; *Gard. Chron.*, January 3, 1880, p. 104 ; *Bot. Soc. Trans.*, xvi. p. 165.
7. On the Occurrence of Boulder Clay in Orkney, with special reference to a considerable Deposit of this nature recently discovered in North Ronaldshay, containing Chalk, Flint, and other Minerals foreign to Orkney. *St And. Lit. and Phil. Soc.*, 27th January 1883.
8. Notes relating to North Ronaldshay in 8th and 9th Reports by Boulder Committee of the Royal Society of Edinburgh, 1882 and 1883.
9. On the Common Lupin as a Fodder Plant in Orkney. *Bot. Soc. Trans.*, xvi. p. 166.
10. Notice of Excavations at Stenabreck and Howmae, in North Ronaldshay, Orkney. Communicated to *St And. Lit. and Phil. Soc.* See *Proc. Soc. of Antiquaries*, December 8, 1884, p. 18.

Obituary Notice of John Jeffrey, Balsusney. By C. Howie, St Andrews.

John Jeffrey, Balsusney, Kirkcaldy, along with his brothers, succeeded to an extensive linen manufacturing business, carried on by their father in Kirkcaldy and the west of Scotland. The brothers, following the same honest persevering habits and strict attention to business, extended their trade over many countries. The department at Kirkcaldy was allotted to John, and of late years it has been much extended.

As a relief from the constant routine of an industrious life, he betook himself to the culture of trees and shrubs, planting his park by the side of his works with choice specimens. In consequence of Mrs Jeffrey's failing health, the family left Balsusney and rented Largo House, where Mrs Jeffrey died, and where after a protracted illness Mr Jeffrey also passed away six months ago, to the regret of all who had the pleasure of his friendship.

He was one of the old members of the Botanical Society of Edinburgh, of the Royal Caledonian Horticultural Society, the Cryptogamic Society of Scotland, and the Antiquarian Society of Scotland. His principal forte, however, was arboriculture. When the pressure of business was relaxed, so as to allow him to remain at home for a day, the recreative study of plant life in the field was his delight, nothing being more pleasing to him than the sight of some majestic tree that stood forth among its contemporaries. He resolved, in conjunction with the writer, to register the dimensions of trees in the Fife district, a dendrometer being obtained from Mr Sang of Kirkcaldy for ascertaining the height. When Mr Jeffrey resolved to publish, we restricted our pursuits only to taking note of the largest trees, and those of more recent introduction, with the description of their past history as far as we were enabled satisfactorily to ascertain it. It was beyond our province to criticise the neglected state of private woodlands, or find fault with a condition that appeared to be satisfactory to the proprietor, but no expense was spared in photographing specimens, the plates being forwarded to London to undergo the Woodbury process. There were only 100 copies printed of this labour of love;* many were given away to friends, and the rest were readily disposed of. A copy was presented to the then prime minister, with the authors' compliments. One pleasing feature, which Mr Jeffrey appreciated while passing over the estates, was the uniform courtesy he met with from the landed proprietors, foresters, and gardeners in his researches among the trees and shrubs of Fife and Kinross. He was also much interested in the excursions of the Arboricultural Society of Scotland, and he frequently joined the excursionists to note whatever was considered worthy of attention in the furtherance of arboriculture.

* *Trees and Shrubs of Fife and Kinross*, by John Jeffrey and Charles Howie. Printed for private circulation, 4to, Leith, 1879.

*Australian and New Zealand Trees in Arran.** By Rev. D. LANDSBOROUGH.

(Read 11th November 1886.)

The island of Arran is the most northern locality where Australian and New Zealand trees and shrubs have been extensively cultivated. The success which has attended the experiment has attracted much notice. Baron von Müller, in his most valuable work on the *Eucalypts of Australia*, and also in his *Select Extra-Tropical Plants*, makes constant reference to them. This has led the writer to give this year a more detailed account than has yet appeared.†

Arran, situated between $55\frac{1}{2}^\circ$ to $55\frac{3}{4}^\circ$ N. lat., 20 miles in length by 8 or 10 miles in breadth, is one of the Inner Hebrides, and lies at the mouth of the Clyde. The northern half is mountainous, ascending to the height of 2866 feet; the southern half is much more level, ascending to only half the height of the northern. The rainfall varies much, but everywhere it is great; at Lamlash it averages 66 inches. There is, however, little mist or fog along the coast, where all the trees are planted, and there are few days some part of which is not dry. The temperature in winter is much higher than on the mainland. On the lighthouse at Pladda, half a mile south of Arran, at the height of 110 feet, the lowest temperature for thirty years was in January 1881, when it sunk to 28° F. The temperature is moderated by its insular position, by the Gulf Stream, and by the fact that channels of deep water (averaging about 450 feet in depth) run lengthways near to the shore along both sides of Arran.

Many of the trees mentioned grow in the garden of Captain Brown at Lamlash. His house is in the middle of the Bay of Lamlash. The bay is 3 miles in length, and is protected by the Holy Isle, lying in the centre of the bay, at 1·38 miles from the shore and 1030 feet in height, while the mountains behind Lamlash also ascend to the height of 1003 feet. The trees are planted in a good soil, abounding

* The measurements, unless mentioned, are taken at 5 feet from the ground. When trees are not from Australia or New Zealand this is stated.

† For previous notices, see vol. xiv. app. xii., and vol. xvi. pp. 105 and 390.

in water-springs on the slope of the old coast line and about 200 yards from high-water mark. Trees are also planted at Brodick Castle high garden. This is on a slope about 100 feet above the sea, and is sheltered by wood on all sides; the soil is light, and the garden slopes to the sun. Cromla garden, Corrie, is only separated by the highway from the sea at high water; it is also sheltered by trees, while the mountains rise so abruptly behind it, and so shelter it from the wind, that, though seemingly exposed to the full fury of the east wind, it is in reality so protected that the branches of the trees all incline towards the sea, and at high water some of them actually overhang it. The soil of this garden is stiff clay, thoroughly drained.

Gum Trees.

The Alpine Gum (*Eucalyptus alpina*, Victoria).—This is one of the most remarkable of the gum trees. Its native habitat is the summit of Mount William, the highest peak (3825 feet) of the Grampians of Victoria. Though exalted in position it is of low growth, being "a mere bush 3 or 4 feet high, showing no tendency to form a main stem. Its leaves, broad and rarely above 3 inches in length, are dark green (purple when young); the flowers single, sessile, and much resembling those of the blue gum (*E. globulus*), and almost as large" (Müller). Baron Müller was so much interested in what he heard of it that he visited its lofty habitat, and took away seed, which he sowed in the Botanic Garden of Melbourne. Here it retained much of its original character, and remained so dwarfish that "in a quarter of a century it grew only to the height of 12 feet, and showed no tendency to alter its bushy habit." I am happy to report that, as became a Grampian plant, it has taken most kindly to the original land of the Grampians, and bids fair in Scotland speedily to outrival all its Australian compeers. It was planted in Arran in 1884, when its height was only 2 feet; now in 1886 it is $5\frac{1}{2}$, having last year grown 2 feet, that is four times the growth of the one in the Melbourne Botanic Garden. Instead of the leaves being only 3 inches in length, one of them, besides being so thick as to weigh three quarters of an ounce, measured 9 inches in length and 5 inches in breadth. So very vigorous is its growth, that my friend Mr

Lindsay has doubted its being the genuine *alpina*, and has given me another plant from the Botanic Garden that he can certify. Through the kindness of Mr Murray, factor to the Duke of Hamilton, this one has this year been planted in his garden in light soil, and in a sheltered spot open to the sun almost the whole day. Here I doubt not it will soon equal the one at Corrie. At present it is about a foot in height. The low habit of this Eucalypt adapts it for many places for which most of the genus would be unsuited. Its large and interesting flowers will also be the better seen.

The Blue Gum (*Eucalyptus globulus*, Victoria and Tasmania). —Unfortunately, it is not so hardy as many of the Eucalypts. "In South Europe it withstands a temperature of 19° F., but is killed by one of 17° F." At Arran several have been planted at various times, but the severe winter of 1880–81, which destroyed all the blue gums in the open air on the mainland of Scotland, killed those in Arran, with the exception of one at Captain Brown's, Lamlash. It was sown in 1874 by James Paterson, Esq., factor to the Duke of Hamilton, and is now 40 feet in height and 2 feet ½ inch in girth. It would have been about 8 feet taller had it not been polled to prevent its being blown down by the wind. The girth would also have been greater had not the winter of 1880–81 destroyed all its leaves, and so injured it that more than a year elapsed before it fully recovered its former vigour. It is near to the highway, and well seen from it; and as Lamlash is greatly frequented in summer by visitors, and the bay is often resorted to as a harbour of safety, this interesting tree attracts much attention.

The Cider Gum (*Eucalyptus Gunnii*, Victoria, Tasmania, and New South Wales).—When growing on the plains it differs a good deal from the mountain variety, and is often called the "Swamp Gum," from the nature of the ground in which it delights. "It grows to a considerable height. Bees obtain much honey from its flowers. Cattle and sheep browse on its foliage" (Müller). A special interest attaches to this tree in Britain, from the fact that at Kew it has withstood severe frost.* At Whittinghame, East Lothian, there is one, planted in 1845, which, though cut to the

* Dr M. T. Masters notes that it is injured more or less every winter, but produces new shoots from the old trunk every summer.—Ed.

ground by frost in 1860, is now more than 60 feet in height, and matures seed, which, having been sown by Mr Lindsay at the Edinburgh Botanic Garden, has germinated, so that we have now Scottish-bred trees of this species, which may be expected to be even more accommodating to a Scottish climate than their parent. Mr Stewart informs me that in New Zealand he found that, while somewhat straggling when left to its natural growth, if topped it acquires a weeping habit and becomes a beautiful tree. It grows vigorously at Captain Brown's, Lamlash. One was planted last year at the Free Church Manse, Whiting Bay, where its power to resist the sea breeze will be tested.

The Coccus-bearing Gum (*Eucalyptus coccifera*, Tasmania, at an elevation of 3000 feet).—The leaves of this plant when young are not unlike in colour, shape, bloom, and substance to box, only much larger, being about the size of a penny. It is, so far as yet known, the most hardy of all the gum trees. A plant of it grows in perfection at Captain Brown's, Lamlash; there is another at Clachaig, near Lagg, where its power of resisting the sea breeze will be ascertained. The flowers are purple. At Powderham Castle, Devonshire, there is a tree, said to be of this species, more than 60 feet in height and 9 in girth.*

The Crimson Gum (*Eucalyptus ficifolia*, South-Eastern Australia).—I have ventured to name this species popularly for this country as "the Crimson Gum," because of its crimson flowers. Two other species have crimson flowers, but this is the only one of them likely to be cultivated in Britain. I owe to the kindness of a friend a specimen of this gorgeous tree. It is now in the greenhouse of another friend, as till I have the pleasure of seeing it in bloom I will not venture it, even in Arran, in the open air. When planted it must be placed in as warm and sheltered a spot as possible.

The Giant Gum (*Eucalyptus amygdalina*, New South Wales, Victoria, Tasmania).—The peppermint tree of Tasmania, the stringy bark and Gippsland box of New South Wales, the red gum, and also the mountain ash of Victoria, where in Gippsland (south-east of Australia, the part of Australia which in climate and productions most resembles

* *Gard. Chron.*, vol. xi., 1879, p. 113, fig. xviii.

Britain) this tree is most conspicuous. This is the tallest, and in weight of timber the greatest tree in the world. Baron Müller mentions one 471 feet in height, and another 69 feet in circumference at the ground, and 15 feet in circumference at the height of 210 feet. This is the species from which the Eucalypt oil of commerce, now so much imported, is mainly obtained. The great monarchs of the Australian forest form a variety which Baron Müller proposes to call *E. amygdalina*, var. *regnans.* Those growing in Arran were from a packet of seed which produced the two varieties known. Four were planted in Arran, two of each, but both of the ordinary variety were killed by the frost of 1880–81, and one of the *regnans* variety was blown over by the wind. One only remains, but fortunately it is the giant (*regnans*) variety. I conclude that it is this variety, because when young the leaves were roundish in shape, alternate, and provided with a short stalk, while those of the other were longish, sessile, and opposite. The variety that survives also grew with more rapidity than the other. I may add that seed sent me by Baron Müller, and marked simply *E. amygdalina*, produced the common variety, the kind which had been killed in Arran. Had it been the giant species he would almost certainly have named it as such. I conclude, therefore, that Arran has the honour of growing the grand monarch of the Australian forest. It is in an admirable situation in the garden at Cromla, where it is sheltered on the north and east by a wood. It was sown in 1871, and is now 28 feet in height and $14\frac{1}{4}$ inches in girth, and adds annually 2 feet to its height and $1\frac{3}{8}$ inch to its girth. The leaves are $8\frac{1}{2}$ inches long and $\frac{3}{4}$ inch in breadth. It bloomed this year, being the first time, I believe, that it has flowered in the open air in Britain. It began to open towards the end of August. (This was a late season; in an ordinary season it would bloom at the middle of the month.) At the same time a large standard myrtle near to it also began to bloom. The genera Myrtus and Eucalyptus are very closely related, and the bloom of the two is similar in size and in appearance. The tree can be seen from the highway, and when it rises above the surrounding trees, which it will soon do, it will be well seen also from the sea.

The Manna Gum (*Eucalyptus viminalis*, South-Eastern

Australia, syn. the weeping gum, the blue gum, the white gum, the wand gum).—Two have been planted this year in Arran; a very small one at Captain Brown's, Lamlash, and a larger one at Cromla, Corrie.

The Red Box Gum (*Eucalyptus polyanthema*, syn. *Lignum-vitæ*, South-Eastern Australia).—One was planted this year at Cromla, Corrie; it is about 4 feet in height.

The Urn-bearing Gum (*Eucalyptus cordata*, var. *urnigera*, Southern Tasmania).—"The variety *urnigera* is particularly hardy, and may become of sanitary importance to colder countries in malarian regions, the foliage being much imbued with antiseptic oil; greatest height 150 feet, stem circumference 18 feet" (Müller). A plant about 3 feet in height grows at Strabane, Brodick.

The White Gum (*Eucalyptus pauciflora*, syn. *coriacea*, the weeping gum, the white peppermint tree, the flooded or swamp gum, New South Wales, Victoria, Tasmania).—It was sown in 1879, and the following year, when only about 9 inches in height, was planted at Captain Brown's, Lamlash. The severest winter followed that we have had for a quarter of a century. It was wholly unprotected, yet not a leaf was even browned. It is now 21 feet in height and 9½ inches in girth, and is growing yearly on an average 3⅓ feet in height and 2½ inches in girth. Here is encouragement to plant. Sown at one's birth, should one reach the age of seventy, it would then be a tree 230 feet high, with a trunk 14½ feet in girth. The specimen at Lamlash grows near the highway facing the sea, and is fully seen from both. It is very handsome, and has begun to assume a weeping habit. When young, it much resembles a vigorous weeping birch in general habit, though the leaves are different. The leaves are 6 inches in length and 1 inch in breadth (2½ inches shorter, but ½ inch broader, than those of the giant gum, *E. amygdalina*), and are attached by a short stalk.

Summary.—Already nine species of Eucalyptus are growing in Arran. These include the greater number of the most interesting species. In Arran they do not in general grow with the wonderful rapidity seen in Australia, though, as has been mentioned, the blue gum adds 4 feet yearly to its height, and the white gum 2½ inches to its girth; yet, in consequence of the moist, mild, and comparatively uniform temperature of this island, and also the influence which sea air is known to exert in adding to substance and size in foliage, it is believed that they are as luxuriant as (the alpine gum much more luxuriant than) those of Australia.

They are all evergreens, and many of them, especially when the plants are young, begin in mild winters to send forth young leaves as early as February, when their fresh reddish-green tints are very refreshing to the eye. They also continue to grow and look fresh till winter; and now that they have begun also to bloom, these natives of the antipodes cannot fail speedily to rank among the most conspicuous forest ornaments of this wonderful island.

Miscellaneous.—It may be mentioned that a most beautiful and perfect Araucaria (*A. imbricata*) adorns the height in front of the house alongside of Captain Brown's at Lamlash. It is most prominent, being immediately above the head of the new pier. It is of the richest green, and luxuriantly furnished with branches to the very ground.

The Blackwood Tree (*Acacia melanoxylon*, South-Eastern Australia).—This is one of the most valuable of Australian trees, the wood being very beautiful, almost equal to walnut. It grows to the height of 80 feet, with a stem several feet in diameter. I had seen and much admired this tree at Gibraltar. A friend kindly sent me seeds from Chili, and specimens were planted this summer at Captain Brown's, Lamlash. The wild olive (*Elæagnus reflexa*, syn. *japonica*) has grown for many years, as also the strange Bottle tree of Australia (*Brachychiton diversifolium*), so called from the bottle-shaped expansion above the neck of the stem.

Though Cantyre forms part of the mainland of Scotland, yet it is connected with it by so narrow a strip of land that in climate it is insular. It stretches for 30 or 40 miles parallel to Arran, and about 6 miles west of it. The fame of the Australian plants growing at Lady Campbell's, South Park, Campbeltown, led me to visit the place. The most remarkable plant is a magnificent specimen of the lofty palm-lily (*Cordyline australis*). I had imagined that those in Arran had not their equals in Britain except in the south of England, but this one at South Park is much superior. Its stem is more than 2 feet (24½ inches) in girth. At the height of more than 8 feet the stem separates into four smaller stems, and about 2 feet higher one of these parts into two, so that in all there are five stems at the top. Including leaves, it is fully 20 feet in height. Last year (1885) it bore four immense spikes of bloom, and matured abundance of seed. Some of it was sent to the Botanic Garden, Edinburgh, from which it was distributed by Mr Lindsay over Britain, in the hope that, being native, plants raised from it would prove hardy. It has not bloomed this year. It is less than twenty years since it was raised by Lady Campbell from seed.

Another remarkable plant is *Pittosporum tenuifolium.* It is 16 feet 2 inches in height, and the stem near the ground is 1 foot 10½ inches in girth. It blooms abundantly. The flowers are dusky crimson in hue and sweetly perfumed. A plant of *P. undulatum* (the lemon-scented Pittosporum) grows beside the other, but has not yet bloomed.

A high wall is covered with an Australian Convolvulus (*C. Turgurriorum*). The leaves are small, but the flowers, which are white, are of the size of those of *Calystegia sepium.* The Australian *Solanum aviculare* also grows on the same wall.

The New Zealand tea plant (*Edwardsia microphylla*) has bloomed in the greenhouse; there are also in the open air a blue and a red gum. These grow freely till they overtop the wall which protects them from the sea blast, but when exposed to it they perish.

Ballinakill, the residence of William Mackinnon, Esq., is situated on the north-east of Cantyre, and about parallel to the north of Arran. The house is surrounded by carefully cultivated woods, which give shelter to more delicate plants. Here the urn-bearing gum (*Eucalyptus urnigera*) is 3 feet 5 inches high; the little blue gum (*E. coccifera*) also 3 feet 5 inches high; and the cider gum (*E. Gunnii*) 5 feet high; all grow healthily.

Gadgirth, the residence of General Burnett, is on the banks of the Ayr, and 4½ miles from the sea. The soil is light and good, and the place is sheltered by wood and hills in all directions. Here the seed of the hardiest of all the gum trees (*Eucalyptus coccifera*) was sown in the open air in the spring of 1881. It germinated well, and now one of the plants is 12½ feet high and 3¾ inches in girth. Among the plants raised is one of a most interesting and beautiful variety, the leaves being so covered with a hoary bloom, both above and on the under side, as to be almost white. Having been transplanted, it is only about half the size of the other. I have seen none at all like to it.

Roseneath, at the mouth of Gare Loch on the Clyde, is the most northern site where the gum trees have been tried with success. It is above the 56° of north latitude. It is a most beautiful parish, and in it there is no more lovely spot than that of the Established Church manse. Here the tallest tree in the world, the giant gum (*Eucalyptus amygdalina*, var. *regnans*) was planted in 1876. It grew famously till the winter of 1880–81, when very severe frost cut it to the ground. It sprouted again in the spring, and grew so quickly that, lest it should break, it was topped. It now is, however, 15 feet 4 inches in height and $6\frac{1}{2}$ feet in girth, both height and girth being taken at $4\frac{1}{2}$ feet from the ground, as it bifurcates just above this.

Near to the giant gum grows a specimen of the urn-bearing gum (*Eucalyptus urnigera*). It was planted a few years ago, and has had to contend with a squirrel which ate its bark, and a roedeer that ate its leaves, yet it is doing well, and, being more hardy, may yet overtop its giant neighbour.

I have thus given a full and exact account of the Australian and New Zealand plants known to me as growing in Arran and in the west of Scotland. This report I will not repeat for some time. Should I, or any one else, at the end of half-a-dozen years furnish your Society with another report, it is hoped that it will tell of great growth and development.

Notes on Three Rare Carnarvonshire Plants. By A. D. Webster.

(Read 11th November 1886.)

The three plants above referred to, and which from their rarity in this country I have considered worthy of the following brief remarks, are *Lloydia serotina*, *Cotoneaster vulgaris*, and *Potamogeton Griffithii*, none of which have been found wild in any other British county, and the last named is recorded only from one station at present.

Lloydia serotina (Reichb.), or, as it is commonly called, the Mountain Lloydia, is a small and fragile plant, that to the British botanist is of particular interest, not only from its extreme rarity, but as being one of the few lingering representatives of the lily family in this country. To those who have not seen living specimens of the plant, allow me, by throwing aside botanical parlance, to say that it may readily be recalled to mind by inserting a flower of Wallace's saxifrage (*Saxifraga Wallacei*) amongst the foliage of a month-old garden onion. Rarely have I seen the Lloydia of a greater height than about 4 inches, with two or three rounded leaves and a small white flower, the interior base of the perianth segments of which are marked with yellow.

The flower stem is usually shorter than the leaves, thread-like, delicate in appearance, and surmounted by a single flower. The bulb is small, club-shaped, and covered with greyish membranous scales. This pretty plant has several stations, three at least, in Carnarvonshire, and in one or two of these it is yet fairly abundant, although much less so than in years gone by, for the enthusiasm of collectors has caused this plant-relic of the glacier period in Wales to be hunted to the almost inaccessible crags and ravines of the wild Snowdon range of hills on which it occurs. Botanists need not mourn, however, over the chances of this rare plant being for many a year yet to come, if ever, expunged from our flora, for its inaccessible position ensures its safety. Extermination by the rude hands of plant collectors has caused it to disappear from various localities, hampers full having been collected, often at the peril of the individual's life. This is the more to be regretted, as it is well known that even under the most careful management it languishes and ultimately dies out. The favourite haunts of the Lloydia are the damp, not dripping, chinks and crevices of the almost perpendicular rocks, where thoroughly decayed vegetable matter is largely commingled with fine rocky débris. On one occasion I noticed several rather dwarf specimens growing on the almost rounded top of a huge lichen-covered boulder amongst the small quantity of soil that had from time to time accumulated on its ridged and rugged surface. It seems on the whole to prefer a northern aspect. Although when brought under cultivation Lloydia survives for a few years, I have never known in a single instance flowers to be produced. I have carefully removed plants from their native haunts, with good balls of soil attached, and planted them in as natural positions as my garden afforded, but although they survived for several years (five in one instance), no flowers were ever produced, and such was likewise the case with several other experimenters of my acquaintance.

Cotoneaster vulgaris (Lindley).—Less than a dozen years ago this pretty shrub was fairly abundant on the cliffs of the Great Orme's Head, its only British station; but now, alas! its day is wellnigh past, for few specimens are to be met with even in a hard day's "working" of that beautiful headland. Growing from the crevices of the denuded limestone cliffs, and in company with *Epipactis ovalis*, this little shrub seems quite at home, and braves fearlessly both the cold sweeping blasts and scorching sunshine, to which at intervals the headland is fully exposed.

Under cultivation, Cotoneaster frequently attains a height of 5 feet, but here in its native wilds tortuous growing plants, of rarely more than half a foot high, are most commonly met with, though in some sheltered sunny nook they may attain a height of 12 inches. The fruit is reddish-tinged, small, and rarely produced in quantity.

Potamogeton Griffithii (A. Benn.), discovered by Mr J. E. Griffith, Bangor, in 1882, is an aquatic of particular interest, as, save in one locality in North Wales, it is not known to exist in a wild state. Llyn-on-Afon, or as it is better known by the name of Aber Lake, in which the plant is found, is a small tract of water in Mid-Carnarvonshire, at an elevation of some 1250 feet. It is almost entirely hemmed in between walls of rock, some of which rise so abruptly from the water's edge that, on scanning the lake from their tops, large irregular-sized patches of the Potamogeton may be distinctly seen through the clear water. The discovery of the plant is due to mere chance, for some fishermen, when following their vocation, had drawn some of the plants ashore with their lines, to which they had got entangled, and which shortly afterwards were noticed by Mr Griffith, and at once detected as a new species.

The soil at the lake's bottom, and amongst which the roots of this Potamogeton spread about freely, is composed of decayed vegetable matter, largely mixed with gritty rock, that from time to time is washed down from the hills above by the force of the rivulets which feed the lake. Occurring in such plenty as to sometimes almost impede a boat's course, this proves that the plant, although local in its distribution, is yet fairly abundant in its one known station. Annihilate it botanists never can, for no boat is kept on that lonely lake, and when taken, as it occasionally is by its owner for fishing, it must be borne by half a dozen stout men for several miles, and over the roughest ground.

A good idea of this new plant can be formed by tying a portion of the stem and leaves of the North American *P. Claytonii* on that of *P. longifolius*, the floating leaves closely resembling those of the former, and the basal or submerged leaves those of the latter.

The stem is branched, and 5 to 6 feet long; lower leaves alternate, about 1 foot long; upper or floating leaves opposite, and usually about half the length of the submerged leaves; lower leaves amplexicaul, upper leaves with foot stalk as much as 5 inches long; spike fully an inch long by $\frac{3}{16}$ inch in diameter, and remarkably close set. In the specimen accompanying these notes a good idea of the plant's general appearance may be obtained, but as it is destitute of flowers the above description must serve until opportunity allows of my procuring fresh specimens, which will be despatched to the Society's herbarium at once.

On a supposed New British Species of Sagina. By F. Buchanan White, M.D., F.L.S., F.E.S.

(Read 11th November 1886.)

Last August I received from Mr A. H. Evans, and afterwards from Mr W. B. Boyd himself, living specimens of a plant, with the information that it was supposed to be a *Sagina*, and to have been got on the Glen Callater hills, and that no one had been able to determine its name. The peculiar beauty of the plant itself, the possibility of its being a member of our own alpine flora, and the mystery attaching to it, combined to induce me to try to discover something about it, and I now lay the result of my investigations before the Society.

1. With regard to its history Mr Boyd writes as follows:—"The plant was found among a number of other plants brought by me from Braemar in the autumn of 1878. I do not remember gathering the *Sagina*, and did not remember seeing it till planting out the rest of the collections on that occasion after my return home."

2. Regarding its generic position. At the time of year that I received the plant there were, unfortunately, but few flowers, yet enough to show that it is clearly a *Sagina*, though, as will be seen presently, aberrant in structure.

3. The specific name. As the descriptions of none of the European species of *Sagina* fitted the plant, I asked my friend, Mr A. Bennett, of Croydon, to send a small specimen, which I had dried, to Dr Lange, of Copenhagen, in case he might be able to recognise it. Dr Lange, however, could not throw much light on the subject, since the few flowers in the specimen were obscure. He suggested a comparison with some Greenland forms of *Sagina procumbens*, and with *S. muscosa*, Jord. The latter is, according to Nyman, a sub-species of *S. procumbens*, and a native of hills of the south of France. Now, so far as the habit of our plant goes, it is just possible that it might be considered to be a very extreme form of *S. procumbens*, but, as the structure of the flowers is so very different, there seems to be no course open but to suppose that it is a distinct and apparently undescribed species. Under these circumstances, and to draw attention to the plant in hope that it may be rediscovered in Glen Callater, I venture to give it a name, calling it after its discoverer, so well known for his explorations of our Scottish hills.

Sagina Boydii, n. sp.—Perennial, quite glabrous, densely tufted, the internodes so shortened as to be scarcely visible; leaves crowded, regularly recurved; terminal rosette barren, lateral branches very short, crowded, producing flowers in the axils of the leaves; peduncles erect, about as long as the leaves; flowers pentamerous or tetramerous, sepals always more or less erect; petals none, styles very short, widely separated at the base; capsule globose, shorter than the sepals.

Forming dense cushions. Subterranean stem much branched, rooting. The aerial portion of the stem erect, about half an inch high, below which the stem is clothed with decaying leaves. Apex of the stem forming a barren rosette, surrounded by very short lateral branches. Leaves so closely imbricated that the internodes are invisible, about one quarter of an inch long, rather fleshy, rigid, widely and shallowly channelled above; midrib rather prominent below, tip with a short mucro, strongly and regularly recurved, dark shining green. Peduncle one-flowered, and with the flower about as long as the leaves, narrowed upwards, quite glabrous. Flower erect, or nearly so. Flowers pentamerous or tetramerous. Sepals rather unequal, widely ovate, blunt, concave on the inner side, never spreading, scarcely veined, of a paler green than the leaves, margin very narrowly paler and submembranous. Petals none. Stamens opposite the sepals, longer than and incurved over the ovary; anthers oval, the cells a little divergent at the apex. Ovary globose, flattened at the apex, which is covered by a cluster of about 11 or 12 semiglobular shining pale yellow papillæ, round which cluster is a slightly thickened rim (with 5 or 4 points and 5 or 4 angles) to the flattened apex of the ovary. Styles 5 or 4, situated within the points of the thickened rim, their bases separated by the cluster of papillæ, very short, flattened; all the upper surface stigmatic, projecting horizontally. Capsule globose, shorter and covered by the sepals; valves 5 or 4, opposite to the sepals, valves entire at the tip. When the capsule opens the flattened top falls away. Seeds few, minute, dark brown, formed like others of the genus, and covered with flattened tubercles.

The duration of the period of flowering I do not know. My plants had flowers in August and September. Even when only in leaf the plant cannot well be confounded with any other native species, though, I am assured, specimens of it have been called *Cherleria*. These must surely have been in a dried state, since living examples are extremely unlike that species. Mr Boyd tells me that the plant has not altered in the least under cultivation; but it must be mentioned that he has not raised it from seed, but increased his stock by division. So far also as he has observed, the flowers have always been similar to those described. If the structure of the ovary is invariably such as I have described—and in all the flowers I was able to examine it was the same—it is unlike that of any other of the genus, and is perhaps an example of arrested development, or of the ancestral form of the ovary and capsule in the *Saginæ*. In this connection reference may be made to a paper, "On the Origin of the Placentas in the Tribe Alsineæ," by Miss G. Lister, in the *Journal of the Linnean Society*, vol. xx. p. 423. From this paper it would seem that the ovary of *Sagina* is not in its earlier stages unilocular but 4–5-locular, and that the flattened top of the capsule which falls away represents the remains of the dissepiments. In other species of the genus these traces of primitive structure, if such it is, disappear at an earlier stage of growth. If the structure of the ovary and capsule of *Sagina Boydii* is what I suppose it to be, an investigation of its development should be highly interesting. It may be that I have not come across mature capsules, the little increase in size of the supposed capsule beyond that of the ovary being in favour of this view; on the other hand, I believe that I found what appeared to be mature seed in a capsule, and also, if I mistake not, I have seen much variation in the relative size of the ovary and capsule in other species of the genus. Be this as it may, I have seen no similar structure of the ovary and styles in any other species.

Notes on the Finding of Trichomanes radicans *in Arran in August* 1863. By W. B. Simson.*

(Read 11th November 1886.)

In August 1863 I happened to be staying in summer quarters in the neighbourhood of Brodick, and as I was then in my first enthusiasm on the subject of fern-collecting, I spent a large portion of my time in scouring the country in quest of new additions to my collection.

After a time some one informed me that the walking postman between Brodick and Corrie, Robert Douglas by name, was in the habit of collecting ferns for sale to summer visitors, and that he might be able to tell me of localities where various ferns were to be found. I accordingly made his acquaintance, but found that his knowledge of ferns was very limited, and his nomenclature not to be depended on.

One day I met him on the road when on my way to the

* See also *Gardeners' Chronicle*, No. 10, 1864 p. 220.

rocks and caves on the coast to the north of Glen Sannox in search of *Asplenium marinum.* He told me I would be sure to find it, and that he had got a nice plant of it himself a few days previously.

After some hours' hunting among the cliffs and caves on the shore I was only successful in getting one or two very small specimens of *A. marinum* within reach. A very low cave into which I could scarcely crawl was, I found, the den of a real wild cat, now very scarce. I need hardly say I saw the cat take its departure before I ventured to explore the interior.

In passing Corrie on my way home, I again met my postman friend, who asked if I had been successful. I told him I had found only one or two very small specimens, whereupon he asked me to accompany him to his cottage, and he would show me the plant he had found.

In a little garden at the back of the cottage he had lying on the ground, wrapped up in moss, a number of small parcels of ferns made up for sale. One of these he picked up, and handed to me as the plant of *A. marinum* he had been speaking about. Instead of *A. marinum,* I was much surprised to find a fern which I had never seen before, and as to which, at the first glance, I felt quite puzzled. But, on unwrapping some of the moss, and seeing the winged ribs of the fronds, it flashed on my mind that this must be the Killarney fern, a picture of which I had seen in a small handbook of Ferns I had at home. So I told Douglas that his fern was not *A. marinum,* and that I thought it was a very rare fern indeed, but that, as I had never seen it before, I could not be positive about it till I had referred to a book I had at home. I took a frond with me, and said I would be able to tell him next day what the fern was.

It so happened that on that day I had arranged to go to Campbeltown for a time on an exploring and fern-hunting expedition. To get there I walked from Brodick to Loch Ranza, where I met the steamer from Glasgow to Campbeltown. On my way to Loch Ranza I met Douglas, told him that I was right in my supposition that his fern was very rare indeed, the *T. radicans,* and that I had never heard of its having been found in Scotland before, and did not believe it had ever been found there. He promised to take me to the place where he had found it, on my return from Campbeltown, and said he had left plenty of it still growing. I urged him to say nothing about his discovery till I had returned, and, above all, to show the place where it was growing to no one.

On my return, the first thing I heard from my family was that there was quite a sensation about the finding of the fern; and that paragraphs had appeared in the Glasgow papers announcing the discovery of *T. radicans* in Arran, and in Scotland for the first time. They also told me that the postman was very angry because his name had not been mentioned as the finder of the fern—and, in fact, had not been mentioned at all in connection with it,—the credit having been taken by some gentleman, or gentlemen, from Glasgow.

When I met Douglas I found that, contrary to my advice, he had told these Glasgow gentlemen about *T. radicans*, and had even shown them the place where he had found it. He was very angry at their having taken the credit of the discovery to themselves, so I promised to write to Professor Balfour and others giving the true history of the finding of the fern.

I said I would like to see the place where it was found, and gather a specimen for myself, more especially as the frond he had given me before I went to Campbeltown had been lost in my absence.

He took me some distance to the north of Corrie, where we scrambled up some cliffs. On reaching a certain place he pulled away a large plant of *Nephrodium Filix-mas*, or other large fern, which seemed to be growing in a large crack or crevice in the rock, and told me to look in and I would see *T. radicans* growing.* I stooped and looked in, but could see nothing except a large, upright, dark crevice, with dripping wet sides.

I said to Douglas I could see no fern there, to which he replied that though the Glasgow gentlemen had taken away some plants of it, there was plenty of it left. I couldn't see a single frond, so got up off my knees,

* This large fern was the means of his discovering *T. radicans*, he told me, as it was growing in this crevice, and on his laying hold of it to pull himself up the cliff, it came away in his hand, and showed something green growing in the interior of the crevice. This was *T. radicans*.

and told Douglas to look for himself. He did so, and seeing nothing more than I did, broke out into language more forcible than elegant regarding the Glasgow gentlemen, who, he said, must have gone back after he left them, and cleaned out the hole.

In my despair I took off my coat, rolled up my shirt sleeves, and with my hand scraped the slimy mud out of the bottom of the crevice and from the sides, in the hope of finding a fragment of root, or stem rather, which might have been left behind. My "happy thought" was rewarded by my finding a fragment of a frond with an inch or two of rhizome, which I took away with me, wrapped in moss, and planted on my return to Edinburgh;—not exactly on my return either, for circumstances prevented my having it planted for about two months after the day I found it. All this time it lay wrapped up in moss in a hamper containing other fern roots I had brought from Arran.

I scarcely expected it would survive this treatment; but, notwithstanding, when planted in a flat pan under a bell glass in an attic room at our house in Eton Terrace, Edinburgh, it soon commenced to grow, and continues to grow to this day. After several fronds had developed and the plant was fairly established, I cut off the original small frond which I had found in the mud scraped out of the rocky crevice, dried it, and have it now in my herbarium.

I do not know whether this discovery of *T. radicans* has ever been noted in any Flora or Fern book, except "Babbington"; certainly I have never seen it noticed. On the contrary, I have more than once heard doubts expressed as to the *T. radicans* having ever been found by the postman at all.

What I have stated will prove that the fern was actually found at the time and in the place I have described, though I am not at all surprised that it has never been found there since.

Additional Note on the Occurrence of Trichomanes radicans *in Scotland.* By Rev. D. LANDSBOROUGH.

(Read 10th February 1887.)

So much incredulity has been expressed by some as to the occurrence of this fern in a truly wild state in Scotland, that I have thought it might be of service, for future reference, to put on record different "finds" which can be fully authenticated.

Mr R. Kidston, F.G.S., writes:—"*Trichomanes radicans* was collected by me near Dougarie, Arran, in 1876. There were three small and depauperated roots, of which I took one; it is still alive, and much increased in size since I collected it. The place of its occurrence was of such a nature as to entirely preclude the idea of its having been planted. For obvious reasons, the exact locality need not be mentioned."

Mr James Cook, proprietor of the *Paisley and Renfrewshire Gazette*, writes:—"It was found by Mr Young and myself conjointly in a cave on Lochfyneside, some two or three miles above Ardlamont Point in 1863, so far as I remember. We did not know what it was, but on bringing it home Mr Hendry identified it, and it was brought by him to the next meeting of the Philosophical Society—a very small society in these days,—and he afterwards reared it to luxuriance in a pot at his home. I have visited the cave often since, and did so in August last, but have not seen, either there or in the vicinity, any specimens of the plant. Mr MacBean, rector of the Grammar School here, told me many years ago that his sister had found it in a gorge, some miles from Loch Ranza, in the direction of the Cock of Arran."

I may add that I grew it for years in the open air at Cromla, Corrie, Arran, where it would have been still, had it not been trampled to pieces by workmen.

Recent Researches in regard to the Vegetable Cell-Wall. By G. F. SCOTT ELLIOT, M.A. Cantab.

(Read 9th December 1886.)

So long ago as 1864 Pringsheim* observed a peculiarly modified layer of protoplasm lining the cell-wall in the endosperm of Ornithogalum. He found that this layer had disppeared when the cell-wall was fully formed, and he concluded that it had been changed into cellulose. He had, therefore, apparently a very clear idea of the apposition theory. Von Mohl† and Nägeli‡ attacked Pringsheim's view, introducing instead the theory of growth by intussusception, which has since (until lately) been pretty generally accepted. Schmitz,§ in 1880, reopened the question by an excellent paper, in which he proved that the cell-wall grows by successive deposition of lamellæ, each lamella being originally a layer of protoplasm, and he also gave an explanation of the growth in *surface* of the cell-wall (Nägeli's main objection to the apposition theory), which has since been generally adopted. Each lamella, according to Schmitz, is stretched by the turgid condition of the cell, and a new lamella, being laid down over the older one, renders this distension permanent; and it is afterwards distended in turn by younger lamellæ. He also noticed that the layer of protoplasm next the cell-wall, or "*innenhaut*" (lamella in course of formation) contained many small granules, or *microsomes*, which were intensely coloured by hæmatoxylin. Schmitz considered, however, that it was possible, or even probable in certain cases, that the cell-wall continued to grow internally after its formation, though not in the way Nägeli supposed. Strasburger,‖ in 1882, brought forward a very large number of observations supporting Schmitz's views, which he also extended and developed. He considered, in particular, that the "apposition" mode of growth holds universally, growth by any kind of intussusception never taking place, but this view, from what follows, appears at least questionable.

I have brought forward the present paper in con-

* Pringsheim, *Ueber d. Bau. u. Bildung. d. Pflanzenzelle*, 1854.

† Von Mohl, *Bot. Zeitung*, 1855.

‡ Nägeli, 1858; see *Das Mikroscop.*

§ Schmitz, *Sitz. d. niederrhin. Ges. f. Natur. u. Heilkunde in Bonn*, 1880.

‖ Strasburger, *Bau. u. Wachsthum d. Zellhaute*, Jena, 1882.

sequence of an extremely interesting work by Wiesner* which has recently appeared, and which throws an entirely new light upon the question. Wiesner finds that the microsomes noticed by Strasburger and Schmitz (which he calls *dermatosomes*) are not only present in the earliest state, but can be detected in it by appropriate treatment,† always or at least so long as it continues to grow. They are organised bodies of protoplasmic nature, and take an active part in the formation of the cell-wall. Klebs‡ has recently attacked this view. He looks upon these dermatosomes as being products of disorganisation of the cell-wall, but, as Mikosch§ has already pointed out, this can hardly be maintained if we consider that the same bodies are produced by *different* reagents, some of which are not strongly destructive. The interesting part of Wiesner's theory, however, consists in his statement that not merely the microsomes, but the delicate network of protoplasm|| (*cf.* Schmitz, *loc. cit.*), by which they are held together during wall-formation, persists within the cell-wall, at least so long as it continues to grow. Each lamella consists of a layer of microsomes in this protoplasmic network; and its protoplasm is connected both with that of other lamellæ and with the protoplasm of the cell by delicate protoplasmic strings. If this is accepted, the cell-wall must be considered as a living part of the plant, a theory which would explain much at present contradictory. In support, Wiesner states that, in young cell-walls, the ordinary cellulose reaction can only be obtained after treatment with caustic potash, which he considers dissolves these protoplasm strings. He has been confirmed, so far as the fact goes, by Schaarschmidt.¶ Strasburger has also obtained the alkali-silver (solution A ? of Loew and Bokorny) reaction for living protoplasm in the cell-wall of Spirogyra.** Wiesner also found that the hyphæ of *Polyporus*

* Wiesner, *Sitz. d. k. Akad. Wiss. Wien*, Abt. i., 1886.

† He gives three methods (best material, cotton-wool fibres):—(*a*) Treat with chromic acid; or (*b*) for a week in chloral water, and then press gently on the cover-glass; or (*c*) first 20 minutes in 2 per cent. hydrochloric, then in concentrated hydrochloric, and press on the cover-glass.

‡ Klebs, *Biologische Centralblatt*, Bd. vi., 1886, p. 449.

§ Mikosch, *Botanische Centralblatt*, Bd. xxviii., 1886, p. 228.

|| Wiesner, *loc. cit.; cf.* also Fromman, *Jena Zeit.*, xviii., 1885.

¶ Schaarschmidt, see *Bot. Centralblatt*, xxii., 1885, p. 3.

** Strasburger, *loc. cit.*, p. 68; *cf.* also Loew and Bokorny, *Chemis. Kraftquelle im Leb. Prot.*, Munchen, 1882, p. 51.

fomentarius, which are thick walled, and have a very narrow lumen, contained 10 per cent. of proteid matter, most of which must have been in the walls of the hyphæ.

Besides direct evidence, there is a very large number of observations which point indirectly to the same conclusion. Various observers, *e.g.*, Berthold,* Terletzki,† Schaarschmidt,‡ and Fromman,§ have discovered protoplasm in intercellular spaces of a large variety of tissues. It is true that the two last-mentioned observers state they also found chlorophyll grains in these spaces, which would go to prove that the protoplasm had been included by the cell-walls during formation of the latter; but this observation, which seems unlikely, has been contradicted by Russow.|| Pfeffer¶ has observed protoplasm in the intercellular spaces of the mobile organs of Mimosa (also noticed by Russow**), and in the same paper he points out that the stimulus must be conveyed through the *walls* of the epidermis cells. Russow also states that in the cortex of the privet large intercellular spaces, which are undoubtedly of schizogenous origin, are lined by a delicate layer, which he considers to be protoplasmic in nature. Schenck,†† who has also examined this lining in the privet and in a large number of other cases, considers its protoplasmic nature not proved. I find that with iodine and sulphuric acid (as Schenck also observed) one gets the same appearance in the middle lamellæ, but the substance is not cutin after Schenck, and it certainly does not give the ordinary cutin reaction. Professor Bower‡‡ has pointed out that the formation of cutin, wax, &c., within the cell-wall (substances, that is to say, which differ fundamentally from cellulose, and are insoluble in water) point to the same conclusion—the presence of protoplasm within the wall. De Bary§§ states that the cutinised spines of uredospores (*e.g.*, *Phragmidium*) do not appear till the cell-wall has reached full

* Berthold, *Ber. d. deut. Bot. Ges.*, ii., 1884.

† Terletzki, *Ber. d. deut. Bot. Ges.*, ii., 1884.

‡ Schaarschmidt, *Nature*, 1885, p. 290.

§ Fromman, *Jenaische Zeit.*, xviii., 1885.

|| Russow, *Sitz. d. Dorpat. Natur. Ges.*, 1884; see *London Roy. Mic. Journal*, 1885, p. 820.

¶ Pfeffer, *Untersuch. Bot. Inst. Tübingen*, 1885, Heft 4, Bd. i.

** Russow, *Bot. Centralblatt*, xvii., 1883.

†† Schenck, *Ber. d. deut. Bot. Ges.*, iii., 1885; see *Bot. Centralblatt*, Bd. xxvi., 1886, p. 300.

‡‡ Bower, *Proc. Brit. Assoc. Adv. Sci.*, 1883, p. 535.

§§ De Bary, *Vergleich Morph. u. Biol. d. Pilze.*, 1886, p. 145.

development. Strasburger[*] admits that cutinisation and such prominences of cutin are often developed on walls already highly thickened. As an explanation, he states that cuticularisation is always connected with increase of volume.[†] This requires proof, however, and he himself states that the cuticle is formed from the union of the distended walls of the mother-cells of numerous generations,[‡] which seems to me rather against the previous statement.

With regard to lignification, Russow [§] states in a recent paper that the walls of the wood cells of Coniferæ grow by intussusception. Strasburger[||] affirms that they are formed by apposition throughout; he confesses, however, that lignification does not occur till after every trace of protoplasm has disappeared from the cell, and this seems to me hard to explain on this view. As Weisner [¶] points out, his theory would explain all such changes. This is quite true, for we cannot say what protoplasm might not do.

It appears probable that, in the majority of cases, this intramural protoplasm does not grow. One might perhaps consider that, instead of the cohesion of the molecules of a stretched lamella being overcome (*cf.* Schmitz and Strasburger) the protoplasmic strings connecting the dermatosomes are either stretched or grow (though Wiesner [¶] apparently does not hold this view).

There is certainly no doubt that in the majority of cases new lamellæ are formed from *the protoplasm of the cell*, and not that within the wall. As examples may be mentioned the cellulose thickenings on injured threads of Vaucheria (Schaarschmidt),[**] and the episporium of *Peronospora* ovum formed from the epiplasma (De Bary).[††] Strasburger, while satisfactorily explaining doubtful cases like the shell of the Brazil nut (*cf.* Millardet),[‡‡] gives an immense number of cases of this kind, *e.g.*, elater coat of Equisetum spores, pollen of *Gaura biennis* and *Scabiosa caucasica.*[§§] Moreover, it is possible actually to see the formation of the cell-wall. Dr Macfarlane informs me that at a certain stage in the development of the cell-wall of Spiro-

* Strasburger, *loc. cit.*, p. 99. † *Loc. cit.*, p. 199. ‡ *Loc. cit.*, p. 192.
§ Russow, *Newen Dörpatschen Zeitung*, 1881; see Strasburger, *loc. cit.*, p. 38.
|| *Loc. cit.* ¶ *Loc. cit.*; see also *Bot. Centralb.*, Bd. xv., 1886, p. 353.
** *Loc. cit.* †† *Loc. cit.*, p. 145.
‡‡ Millardet, *Ann. d. Sci. Nat.*, 1866, p. 304.
§§ *Loc. cit.*, pp. 100, 121, 129.

gyra one can see a ring of cell-wall projecting into the cell, and the edges connected by two parallel rows of granules embedded in a protoplasm plate (probably a network); *cf.* Schmitz * and Strasburger,† who appear to have also seen this. Moreover, the layer of protoplasm in contact with the cell-wall, and undergoing change into cellulose, is perfectly well known (*cf.* Pfurtschneller).‡ A reaction is given by Schmitz for this "innen haut." It consists in leaving the material twenty-four hours in picric acid, then washing and staining in hæmatoxylin, which colours the granules or microsomes violet. The process of conversion of this layer of protoplasm into cell-wall was traced so long ago as 1855 by Crüger § in the cells of the aerial root of an orchid. These cells possess a peculiar spiral marking, and Crüger was able to see currents of protoplasm accompanying these spiral bands before they were fully formed (confirmed by Dippel,‖ Schmitz, and Strasburger). Strasburger gives similar instances, *e.g.*, spiral vessels of Impatiens and Bryony,¶ also the spiral bands on Sphagnum leaf, &c. In certain cases he was able to contract the protoplasm away from the cell-wall, but not all of it, for some of the microsomes, coloured by hæmatoxylin, were observed sticking in the cell-wall, while most of the protoplasm was lying in the centre of the cell. A conclusive proof that the protoplasm of the cell itself can continually change part of itself into cell-wall is afforded by an experiment of Klebs.** He placed *Œdogonium* filaments in a 10 per cent. solution of glucose, and found that the protoplasm, though contracted entirely away from the cell-wall, had, after a certain time, formed a new cellulose coat, distinct and separate from the older one, round itself. Thus in most cases it appears probable that the protoplasm, assumed on Wiesner's theory to exist within the cell-wall, does not assist in the growth in thickness of the wall.

There are, however, certain cases in which a cell-wall exhibits growth of itself. For example, a certain turgidity resulting from hydrostatic pressure within the cell is necessary

* *Loc. cit.* † *Loc. cit.*, pp. 83, 173.

‡ Pfurtschneller, *Bot. Centralblatt*, xxii., 1885, p. 13.

§ Crüger, *Bot. Zeitung*, 1855, p. 606.

‖ Dippel, *Abh. d. Natur. Ges. zu Halle*, Bd. x., 1867; see Strasburger, *loc. cit.*, p. 78; Schmitz, *loc. cit.*

¶ *Cf.* also Giltay, Bd. xxii. *Bot. Centralblatt*, 1885.

** *Botanische Centralblatt*, xxviii., 1886, p. 156.

to explain growth in surface on the "apposition" theory, but Strasburger* himself admits that when the pollen grain is germinating the cell is *not* turgid, but is, in fact, largely empty. Another instance occurs in the development of the air-balloons in the pine pollen. It is found here that, *after the intine has been formed,* a swelling of the extine takes place by which the hemispherical spaces between the extine and intine are produced. Though Tschistiakoff † states that a certain amount of protoplasm is left between the two coats, this protoplasm is, according to him, dead, and can scarcely be supposed able to produce the growth of the extine. Another interesting case is found, according to Krabbe,‡ in the development of a vessel from an ordinary cambium cell. The walls of the vessel, which have very different cross sections, do not specially bulge into the walls of the neighbouring cells, hence Krabbe concludes that the peculiar growth is not produced by turgidity, but by an "active growth of the membrane," or "a specific activity of the cell membranes in contact with the protoplasm." Dr Macfarlane has observed in the first stage of conjugation of two Spirogyra cells, that the protuberances are wholly formed by the cell-wall, the protoplasm forming no projection of corresponding size. This is, therefore, a case of independent growth due to the cell-wall alone. Strasburger § has studied the development of certain prominences on the hairs of *Marsilea Ernesti ;* he finds that these are due to a bulging out of the protoplasm, and suggests that the protoplasm produces a local extensibility of the cell-wall at the place where this occurs. But he also points out that, in the case of similar prominences on the hairs of Coleus, sp., this bulging does not occur until an inner layer has been formed below the place where bulging of the outer layer afterwards occurs. Both these cases seem to me most simply explained as cases of growth of the cell-wall.||

Schenck¶ gives some instances of a similar kind, viz., the prominences on the hairs of *Deutzia scabra,* folds of the epidermis on the petals of *Narcissus Tazetta,* and in another paper

* Strasburger, *loc. cit.*, pp. 199, 200.

† Tschistiakoff, *Botan. Zeitung,* 1875, p. 97.

‡ Krabbe, *Das Gleitende Wachsthum d. Zellhaute,* Berlin, 1886; see *Bot. Centralblatt,* Bd. xxix., 1887, p. 3.

§ *Loc. cit.*, pp. 146, 181.

|| Strasburger explains the case of Coleus as "Volumenzunahme" through cuticularisation.

¶ Schenck, *Bot. Zeitung,* 1884, p. 733.

the "stabchen" found immediately under the cuticle in the spongy parenchyma cells of the Marattiaceæ.* He also points out that all cases of secretions developed immediately beneath the cuticle are not easily brought under Strasburger's theory. These and the other cases mentioned appear to point therefore towards a power of growth and change possessed in certain cases by this supposed intramural protoplasm.

But with regard to the inner mechanism of growth neither Strasburger nor Wiesner give a thoroughly satisfactory explanation. Strasburger states that it is due to a dissociation of the protoplasm. Wiesner simply states that the dermatosomes take an active part in the growth of the cell-wall,† without saying what that part may be. Now it is probable, as Strasburger says, that the mechanism of growth of the starch grain and the cell-wall is the same. The recent researches of Boehm,‡ Schimper,§ and Arthur Meyer|| appear to point to the conclusion that starch is deposited from the sugar in solution in the cell when the solution has attained a fixed state of concentration or a certain density, the protoplasm acting as a water-withdrawing substance. Does this occur in the case of the cell-wall? (Is this what Sachs seems to have thought probable?)¶

In support, it may be noticed that the formation of cell-wall sometimes coincides very nearly with the disappearance of starch (*e.g.*, endosperm of Ornithogalum,** epidermis of seeds of certain Cruciferæ).†† Wiesner also affirms that a sugary substance can be extracted from the cell-wall, as others have also found. The part played by the dermatosomes might be to deposit cellulose from the sugar solution just as a leucoplast deposits starch; but, as stated, Wiesner does not give this or any explanation, and as the explanation probably involves the vital activity of protoplasm, a thoroughly satisfactory one can scarcely be expected.

The results may be summed up as follows:—

1. Growth of the cell-wall may be effected by deposition from the protoplasm of the cell.

* Schenck, "*Ber. de deut.*," *Bot. Ges.*, iii., 1885; see *Bot. Centralblatt*, xxvi., 1886, p. 300. † Wiesner, *loc. cit.*; *c.f.* also Klebs, *loc. cit.*

‡ Boehm, *Bot. Zeitung*, 1883. || Schimper, *Bot. Zeitung*, 1885.

§ Arthur Meyer, *Bot. Zeitung*, 1885.

¶ Sach's *Textbook*, 2nd ed. (English), p. 707.

** *Loc. cit.*; *c.f.* also Klebs, *loc. cit.*

†† Abraham, *Inaug. Diss. zu Bonn*; see *Botb Centralb.*, xxviii., 1886, p. 1.

2. The cell-wall, moreover, always contains, during the life of the cell, living protoplasm, which is united to the cell protoplasm.

3. This intramural protoplasm appears in some cases capable of growth on its own account.

4. Possibly the cell-wall is formed in the same way as the starch grain (according to A. Meyer's and Boehm's explanation).

I have to thank Professor Dickson and Dr Macfarlane for the great trouble they have taken in obtaining for me the necessary literature, and also for the use of the reagents, &c., in the Winter Botanical Laboratory.

Notes on the British Species of Epilobium. By Arthur Bennett, F.L.S.

(Read 14th April 1887.)

In 1884 Professor C. Haussknecht published an exhaustive monograph of Epilobium, illustrated with twenty-three fine plates. So far as I am aware, there is no reference to this work in our Floras that have appeared since; and as Professor Haussknecht visited this country to study our herbaria, I thought a few notes on the result of that study might interest our botanists, as well as urge them to observe the genus further, which evidently will repay careful examination in Britain.

Hybrids are largely noticed in the monograph, and the following references to them in our works may be useful:—

Briggs' *Flora of Plymouth*, p. 154 (1880).
Review of same, in *Journal of Botany*, p. 284 (1880).
Briggs, in *Journal of Botany*, p. 308 (1881).
Rev. M. Rogers, *loc. cit.*, p. 104 (1886).

I have gone through the monograph, and jotted down what seemed of most interest, in the sequence that he arranges the species.

1. *Epilobium angustifolium*, L.

Under this he accepts our plants as—

Var. n. *brachycarpa*. *E. brachycarpum*, Leighton, *Ann. Nat. Hist.*, viii. p. 401.

Var. o. *macrocarpa*. *E. macrocarpum* Stephans, *loc. cit.* p. 170.

He does not accept *E. rosmarinifolium*, Haenke (or as he names it, *E. Dodonaei*, Vill.), as a Scotch plant.

2. *E. hirsutum*, L.

Under this he has a large number of varieties and forms, but none named as from Britain. He quotes *E. ramosum* (Hudson, *F. Angl.*, i. p. 162, 1762), for this plant.

Since then Mr Towndrow, of Malvern, has gathered the var. γ *villosum*, Koch, in Worcestershire.

3. *E. parviflorum*, L.

Under this he has *E. parviflorum* × *roseum* = *E. persicinum*, Rchb. Derbyshire (Herb. Hooker).

4. *E. montanum*, L.

Form f. *latifolium*. England.

„ i. *verticillatum*. Derbyshire (Babington).

(*E. collinum*, Gmel. In insul. Brit. ut videtur o.)

This, from its distribution in Europe, ought to occur in Britain. Resembles *montanum*, but is a smaller plant, with petioled leaves.

5. *E. lanceolatum*, Seb. et Maur.

(*E. lanceolatum* × *montanum*, *E. neogradiense*, Borbas. Recorded from Germany. An hybrid like this occurred in my garden, where *lanceolatum*—originally from Surrey locality—comes up by hundreds every year, and *montanum* sparingly).

E. lanceolatum × *obscurum* = *E. Lamotteanum*, Haussk. Rumple Quarry, Plymouth. A. Briggs (*Herb. Mus. Brit.*).

E. lanceolatum × *parviflorum* = *E. Aschersonianum*, Haussk. Plymouth. A. Briggs, 1867 (*Herb. Mus. Brit*).

6. *E. tetragonum*, L. (*E. adnatum*, Griseb. of Haussknecht). Form c. *stenophylla*, Sussex (Trimen); London (Dyer).

I have not seen Scotch specimens of true *tetragonum*, but it is reported from Edinburgh and Perth; and Professor Babington gives it from Scotland in the eighth edition of his Manual.

In 1880 I gathered a curious form of this, on which Professor Haussknecht remarks, in a letter to my friend Mr G. Nicholson of Kew:—

"A very interesting form, which I had not before seen; it is very near *tetragonum* = *adnatum*, but with larger flowers and subpetiolate leaves I beg you to dry a series of this form, and collect it in ripe fruit, in order to decide whether it is a new species or a form of *adnatum*."

Unfortunately, when I went in 1881 to gather a series the ground was occupied by the builders, and I have not since observed it.

7. *E. Lamyii*, F. Schultz.

Haussknecht gives several counties for this from Watson's *Cybele;* but Watson distinctly says, "Apparently poor examples of *Ep. obscurum* thus named."

He has seen examples from "Brickfield, Middlesex, *Herb. Mus. Brit.;*" "County Cork, Ireland, J. Allen, as *obscurum*, *Herb. Mus. Brit.;*" and "Hampton Court."

I have only seen this from Worcestershire, where it was gathered by Mr Towndrow, and confirmed by Professor Haussknecht. I have sent a specimen of this for the Herbarium.

8. *E. obscurum*, Schreb.

"*E. obscurum* × *palustre* = *E. Schmidtianum*, Rostkov.

Liverpool—Harbord Lewis, as *obscurum.*

Teesdale—Babington, as *virgatum.*

Thrisk—Baker (*E. ligulatum*, Baker).

Hale Moss, Cheshire.

Near Filby, Norfolk—Ar. Bennett."

At Filby this plant is plentiful, growing in a wet fen, with *Senecio palustris*, *Cladium*, *Cicuta*, *Sium latifolium*, &c. Professor Babington thought it a form of *obscurum;* Haussknecht named it as above. A specimen sent.

E. obscurum × *parviflorum* = *E. Dacicum*, Borbas.

Devonshire—Briggs, in *Herb. Kew.*

Surrey—(G. Nicholson).

Cheshire—Bailey.

9. *E. roseum*, L.

Hybrids occur with ten other species, but he gives no particulars.

10. *E. palustre*, L.

Mr Beeby found last year, in the Shetlands, Haussknecht's var. *fontanum*, which also occurs in the Faroes.

E. palustre × *parviflorum* = *E. rivulare*, Wahl.

Cork, Ireland—(Allen).
Teesdale—(Babington).
I have seen in Surrey what I believe to be this form.

11. *E. anagallidifolium*, Lam.

Haussknecht quotes Syme, *Eng. Bot.*, 3rd ed., t. 506–7, for this, restricting *E. alpinum*, L. sp., Pl. 348, No. 7 p.p. *C. Hornemanni*, Dict., to a rare plant which he names *E. lactiflorum*, and locates in Scandinavia, Iceland, Greenland, Labrador, &c.

Nyman, *Consp. Fl. Europææ*, p. 248, gives *E. Hornemanni*, Rchb. Beurl., *Bot. Not.*, 1853, as Scotch, but Haussknecht and he do not agree at all in their synonymy, hence we are left in doubt as to whether Nyman means what we have called *alpinum* or the *lactiflorum* of Haussknecht.

12. *E. alsinifolium*, Vill.

He quotes a station for this which must be an error, *i.c.*, "Stapelton, pr. Bristol, *Herb. Kew.*"

E. cordifolium, Don, in herb. Smith (1822), is an earlier but unpublished name.

E. alsinifolium × *anagallidifolium* = *E. Boissieri*, Haussk., Forfar, Clova (Gardiner), Glen Dole, Forfar inter parentes (*Herb. Kew*). A rare form occurring in the Sudet, and the Sierra Nevada, at 7000 to 9000 feet.

E. alsinifolium × *palustre* = *E. Haynaldianum*, Haussk., Weltrope, in Durham, leg. Baker.

In conclusion, I trust these notes may stimulate to the study of the genus. I will do my best to help in any way.

On the Monthly Increase in Girth of Trees at the Royal Botanic Garden, and at Craigiehall, near Edinburgh. By David Christison, M.D.

(Read 14th April 1887.)

In a paper read to the Royal Society of Edinburgh in March 1883 I gave the results of monthly girth-measurements of eleven trees, taken by Sir Robert Christison in the three previous years, and of the same trees, with thirty-five others, taken by myself in 1882. As stated at the time, these observations were too limited to allow of perfectly reliable deductions being made from them; but as they have since been continued for five* additional years, considerable confidence may now be placed in the accuracy of the results. In considering them, however, I shall only make use of the last four years' observations in the case of deciduous trees, and of the last five years' observations in the case of evergreens, as it was only in these years that the growth for the month of April was ascertained.

The principal subjects which I shall endeavour to elucidate from my observations are,—the beginning and the end of the growing season, and the proportional growth of different species in each month of the growing season.

I. *Commencement of the Growing Season in Deciduous Trees.*

Sir Robert Christison concluded, from three years' experiments on five deciduous trees, that substantial increase in girth in that class of trees began in June, but evidently full confidence could not be placed in general deductions derived from observations on so small a number of trees. Accordingly, to test the question further, I experimented in 1882 upon twenty-eight trees, and found that not less than 16 per cent. of their annual increment took place before the month of June. Five years' subsequent observations have fully confirmed this result.

Having ascertained, by the observations of 1882, that a

* For four years only, when this paper was read; but the observations for 1887 having since been concluded, I have been able to take advantage of this additional year, thereby increasing the number of years from which the averages are struck.

substantial increase in girth did take place in deciduous trees, as a whole, previous to the month of June, I resolved to carry the investigation still further back, and to ascertain whether an appreciable increase might not be traced even in April. Four years' observations have proved that such an increase does take place. The amount indeed is very small, and to establish the fact it is essential to measure a considerable number of trees, because, even in a favourable season, some do not increase in April at all, while in others a slight decrease has been observed to occur, the aggregate decrease, however, being always exceeded by the aggregate increase. Thus, in April 1884 the aggregate increase of twenty-eight deciduous trees, due to nineteen of their number, and after deducting the apparent slight decrease in a few of the others, was 1·30 inch, or not much less than the May growth (1·85 inch); similarly, in April 1885, the increase, due to fifteen of the twenty-eight trees, was 1·35, actually greater than that for May (1·05); on the other hand, in April 1886, when the spring was unusually late, the increase, due to only seven of the twenty-eight trees, was but 0·40 inch, while that of May sprung up to 2·30 inches; lastly, in 1887, when the spring again was very backward, the April increase, due to twelve trees, was 0·65 inch, that of May being 2·90. It thus appears that in an advanced spring the increase of girth of deciduous trees in April may be equal, or even superior, to that in May, while in a backward spring the April increase may be very inferior to that of May. The greatest April growth in any one tree was a quarter of an inch, in a Hungary oak in 1885.

The question now arose whether any increase could be detected earlier than the month of April. I had already ascertained by experiment on forty-eight deciduous and evergreen trees that there was no appreciable difference between measurements of their girth taken in October 1882 and again in March 1883. This proved pretty conclusively that no *permanent* increase in girth takes place earlier than April, but bearing in mind the activity shown by many trees even as early as February, as indicated by swelling of their buds and expansion of their flowers, it seemed not improbable that temporary increments might occur thus early in the season. With the view of testing this point, therefore, I this year measured at intervals in February and March several trees, known to be early and quick growers. The result in five deciduous trees is shown in the following Table:—

Species.	Girth.	Increase or Decrease in 100ths of an inch.		
	Feb. 8.	Mar. 4.	Mar. 19.	Mar. 31.
	Inches.			
Fagus sylvatica, . . .	69·30	+·05	+·05	−·05
Fagus sylvatica, . . .	80·75	−·05	−·05	+·05
Quercus conferta, . .	28·00	+·05	+·05	·00
Castanea vesca, . . .	79·50	+·05	−·05	−·05
Cratægus Oxyacantha, .	42·90	−·05	·00	·00
Increase, . . .	...	+·15	+·10	+·05
Decrease, . . .	...	−·10	−·10	−·10
General result, . .	...	+·05	·00	−·05

The movements indicated here are very trifling, not greater than may be ascribed to errors of observation, unavoidable in measuring large and irregular surfaces. It will also be observed that the differences in excess or defect almost counterbalance each other. So far as these experiments go, therefore, they lend no support to the theory of early spring movement, but possibly they are too limited, as the following statement in Sachs' *Text-Book of Botany* (Eng. ed., p. 728) appears to point to the occurrence of a very considerable movement early in the season:—"The experience of every year shows that the fissures in the bark, especially of thick trunks, at the end of winter in February and March, become deeper and wider, evidently in consequence of the great swelling of the wood, which at this time contains the greatest quantity of water; while the bark had time to dry up and contract during the dry weather of winter." I must say, however, that the changes in the bark here described have not been observed by me.

II. *Commencement of the Growing Season in Evergreen Trees.*

Sir Robert Christison, from experiments on six trees, concluded that evergreens as a class show a substantial increase in girth earlier than deciduous trees. My subsequent measurements of twenty trees confirm this, as on an average of five years their growth before June amounted to 28 per cent. of their annual increment, or nearly double the proportion of the deciduous group. It was remarkable, however, that the greater energy in spring of the evergreens was confined chiefly to the month of May, as the proportion for the two groups in April was almost the same. So that it would appear as if the evergreens did not start earlier than the deciduous trees, although they quickly surpassed them in activity of growth.

Going into details, it appears that of the twenty trees under observation, seven in 1883, six in 1884, two in 1885, ten in 1886, and fourteen in 1887, did not increase at all in April; that the aggregate growth in these years respectively was 1·30, 1·50, 2·05, 0·43, and 0·45 inches, the falling off in the last two years, owing to backward springs, being very marked; and that the most remarkable tree for early growth was a *Pinus austriaca* at Craigiehall, which increased fully a third of an inch in April three years in succession. So marked a result in this tree is sufficient in itself to prove decisively that an increase in the girth of trees may take place in April.

Signs of activity in early spring might be expected to be more marked in evergreen than in deciduous trees, but my observations show even less indications of early movement among the former than among the latter. As will be seen from the Table below, of seven trees in the Botanic Garden,

Measurements in early Spring of Evergreen Trees.

In the Botanic Garden.				
Species.	Girth.	Increase or Decrease in 100ths of an inch.		
	Feb. 8.	Mar. 4.	Mar. 19.	Mar. 31.
Sequoia gigantea,	31·60	·00	·00	+ ·05
Sequoia gigantea,	35·70	·00	·00	− ·10
Cedrus Deodara,	23·60	·00	·00	·00
Cedrus Deodara,	25·20	− ·05	·00	− ·05
Abies Lowiana,	25·05	·00	·00	·00
Cedrus atlantica,	41·20	− ·05	·00	·00
Araucaria imbricata, . .	26·60	·00	+ ·05	·00
Increase, .	...	+ ·00	+ ·05	+ ·05
Decrease, .	...	− ·10	− ·00	− ·15
General result,	...	+ ·10	+ ·05	− ·10

At Craigiehall.			
Species.	Girth.	Increase or Decrease in 100ths of an inch.	
	Nov. 8.	Mar. 3.	Mar. 29.
Pinus austriaca,.	29·70	+ ·05	·00
Cupressus Lawsoniana, .	21·30	− ·05	·00
Araucaria imbricata, . .	23·60	− ·05	·00
Increase, .	...	+ ·05	+ ·00
Decrease, .	...	− ·10	− ·00
General result,	...	− ·05	·00

selected as the most remarkable for activity in April, two showed no movement whatever in February and March, and in none of the others did the apparent movement, one way or other, much exceed the twentieth of an inch. Similar results were obtained at Craigiehall from three evergreen trees, which, however, were not measured so early in spring as the trees in the Botanic Garden.

III. *The End of the Growing Season in Deciduous and Evergreen Trees.*

The limit of the growing season was more evident in autumn than in spring. Deciduous trees grew but little after August, although their increase in girth during that month was very substantial. The aggregate increase of twenty-eight trees in September 1884, 1885, and 1887, the only years tested, was seven-tenths of an inch, one inch, and four-tenths of an inch respectively. In 1884 eighteen, in 1885 fourteen, and in 1887 twenty-two of the twenty-eight trees did not increase in September at all. With evergreens it appears to be much the same. The September growth of twenty evergreen trees amounted in 1884 to half an inch, in 1885 to one inch, and in 1887 to sixty-five hundredths of an inch. At first sight it seems as if this result was somewhat in favour of the evergreens, because their aggregate increase in September equals that of the deciduous group, while the number of them measured was smaller. But it must be remembered that the proportional annual growth of the evergreens was considerably greater than that of the deciduous trees. In 1884 thirteen, in 1885 ten, and in 1887 thirteen of the twenty trees did not increase at all.

On the whole the following conclusions may be come to on this branch of the subject:—

1. There may have been a slight fluctuation in the girth of some trees, particularly of the deciduous class, but there was no progressive increase in February or March.

2. Progressive increase began in some trees in April, but the amount, except in rare instances, was trifling.

3. Substantial growth ceased by the end of August, but a certain number, both of deciduous and evergreen trees, continued to grow a little in September.

Finally, it must be remembered that these conclusions cannot be held to establish general rules, unless for trees of similar age to those tested, and growing in similar soil and climate.

IV. *The Months in which the greatest Increase of Girth occurs in Deciduous as distinguished from Evergreen Trees.*

In my former paper it was stated that the limited observations then available indicated July as occupying the first place in the deciduous class, and June in evergreens. Subsequent experience with the same trees confirms this; but as only a limited number of species have been tested, and as some of them proved to be exceptions to the rule of their class, it would be rash to found a general principle on such a basis. Moreover, from observations begun in the present year, I have reason to believe that a good deal may depend upon the age of the trees experimented upon, and it is my intention to test the whole subject more thoroughly by additional observations on new species and younger subjects.

V. *Proportional Monthly Increase in Girth of Different Species of Trees.*

The two following Tables give the percentage of annual growth due to each month in different species of deciduous and evergreen trees. The figures I believe show accurately enough the facts, so far as the trees actually under observation are concerned; but certain reservations must be used in accepting the results as establishing general laws of growth for the several species concerned.

In the first place, they are only applicable to the neighbourhood of Edinburgh. Obviously very different results may be expected from observations made under different conditions of soil and climate, even within the limits of our own island.

Secondly, they are only applicable to trees of a certain age. The great majority of the trees under observation were between thirty and eighty years of age or upwards; but experiments on young trees from 4 to 12 inches in girth, initiated this year, lead me to believe that they, as a rule, grow more vigorously in the earlier months of the season than the older trees.

Thirdly, even as regards the species experimented upon, the results are much more reliable in some than in others, partly because of the varying number of trees measured in the different species; partly because, from roughness or liability to scale in the bark, some species were not so eligible for measurement as others; and partly because individual trees proved, for various reasons, to be indifferent growers, and therefore were probably in an abnormal condition. The degree of confidence that may be placed in the results obtained in the various species will be indicated in the sequel.

Monthly Percentage of Increase in Girth in different Species of Deciduous Trees, based on four years' measurements (only three for September).

Species.	No. of trees observed.	April.	May.	June.	July.	Aug.	Sept.
Liriodendron tulipifera,	one	2	4	4	34	43	13
Betula alba, . .	one	...	...	24	58	18	...
Tilia europæa, . .	one	...	...	24	56	20	...
Quercus Cerris, . .	two	4	18	9	37	32	...
Castanea vesca, . .	one	8	14	11	37	26	4
Quercus Robur, . .	one	7	24	7	41	21	...
Fagus sylvatica, .	nine	4	9	25	36	21	5
Quercus conferta, .	three	9	10	20	34	23	4
Quercus palustris, .	one	10	18	16	41	15	...
Carpinus Betulus, .	one	17	17	17	37	12	...
Acer Pseudo-Platanus,	two	10	8	37	32	13	...
Monthly averages of the whole class, .	...	6	11	18	41	22	2

Remarks.—The species are arranged in this Table in the order of their vigour in the *latter* part of the growing season. In the following remarks the girth of the trees is given as on October 1887.

Beeches.—Girths, 64, 66, 70, 78, 80, 81, 100, 121, 138 inches. The most reliable of all the species observed. Nine specimens were tested, all healthy to the end, and the smoothness of the bark in this species ensures a degree of accuracy unattainable with most other trees of similar age.

Hungary Oaks.—Girths, 26, 30, 40 inches. Also very reliable. The objectionable roughness in the bark is compensated by the large increments, greater than in any other deciduous species.

Turkish Oaks.—Girths, 47, 80 inches. Both fine healthy specimens; the first especially accurately measurable from the smooth regularity of its finely reticulated bark: its growth, however, was slow, averaging not much above half an inch yearly, while that of the older and rough-barked specimen at Craigiehall averaged nearly an inch. Results reliable.

American Oak.—Girth, 35 inches. A somewhat damaged young tree, growing less than half an inch a year; not very reliable.

English Oak.—Girth, 73 inches. The native oak, although it attains a considerable size in the Edinburgh district, rarely looks much at home in it, tending to defective ramification and scanty foliage. The single specimen observed, growing at Craigiehall, increased at the rate of only one-third of an inch yearly, and the results cannot be regarded as characteristic of healthy vigorous oaks in more suitable districts.

Hornbeam.—Girth, 48 inches. Accurately measurable, but growing at the rate of less than half an inch yearly.

Birch.—Girth, 60 inches. Trunk rough and irregular. Increases at the rate of less than half an inch a year. Results not altogether reliable.

Lime.—Girth, 46 inches. To all appearance a fine healthy tree, but growing only at the rate of quarter an inch yearly.

Spanish Chestnut.—Girth, 80 inches. Still vigorous, increasing at the rate of nearly an inch in the year. Results therefore probably reliable.

Liriodendron.—Girth, 81 inches. Healthy; annual increase about three quarters an inch. Bark rough, but the results each year are so uniform that they may be accepted as tolerably accurate.

Sycamores.—Girths, 62, 130 inches. The older tree very rough and scaly in the bark, and apparently ceasing to grow; the younger, although to all appearance vigorous, increasing at the rate of only one-third of an inch yearly. Results not reliable.

Monthly Percentage of Increase in Girth in different Species of Evergreen Trees, based on five years' measurements (three only for September).

Species.	No. of trees observed.	April.	May.	June.	July.	Aug.	Sept.
Araucaria imbricata, .	three	16	25	32	17	10	...
Sequoia gigantea, .	four	3	24	39	21	11	2
Pinus austriaca, . .	one	18	25	21	18	13	5
Cupressus Lawsoniana,	one	8	24	31	30	7	...
Abies Lowiana, . .	one	9	28	19	22	22	...
Cedrus atlantica, .	one	4	20	24	26	26	...
Taxus baccata, . .	four	8	16	21	26	24	5
Cedrus Deodara, . .	four	3	10	21	28	30	8
Monthly averages of the whole class, .	...	8	22	26	23	18	2

Remarks.—The species are arranged in this Table in the order of their vigour in the *early* part of the growing season. The evergreens under observation were much younger than the deciduous species examined; but, on the other hand, the generality of their tribe in the Botanic Garden tend to get prematurely old, and cease to be reliable at a comparatively early age.

Araucarias.—Girths, 22, 24, 27 inches. All three, although healthy at first, degenerated afterwards, but the monthly results have been so uniform as to inspire me with considerable confidence in them.

Sequoias.—Girths, 32, 32, 36, 38 inches. Two of these have become thin and straggling in the branching, and sinuous at the top, but have followed the same laws of growth as the other two, which preserve their youthful looks. Results therefore reliable.

Austrian Pine.—Girths, 31 inches. This Craigiehall tree, although it lost two years' growth of its top shoot in 1882, and never acquired another, looks quite healthy, and has grown at the rate of $1\frac{1}{2}$ inch a year, so that the results seem reliable enough.

Cypress.—Girth, 22 inches. Healthy and vigorous, though the annual increase has fallen off progressively in the last three years.

Abies Lowiana.—Girth, 26 inches. Top shoot lost in 1880, and never replaced. The branches and foliage have got thinner every year, and although the tree grows at the rate of above an inch yearly, its characteristics can hardly be taken as typical of the species.

African Cedar.—Girth, 42 inches. Vigorous, healthy, and reliable.

Yews.—Girths, 27, 34, 41, 72 inches. This is the only species in which scaling of the bark seems to be a formidable obstacle to accuracy of measurement, yet the uniformity of results during five years does not appear to have been seriously disturbed from this cause, and the averages taken for so long a period in four specimens may be accepted as sufficiently reliable.

Deodars.—Girths, 24, 26, 34, 70 inches. The two older trees are not easily measured, but the results do not differ materially from those obtained in the two younger trees, and the average of the whole is satisfactory.

The following general conclusions may be drawn from the Tables:—

1. July was decidedly the best growing month in the deciduous class, its proportion being double that of any other month. It was also the best in nine of the eleven species. But in the evergreens no month predominated decidedly over the others, June being but a trifle above July, while May and August lagged not far behind. This arises partly from growth in each species being more evenly distributed over the months among evergreen than deciduous trees, partly from the maximum occurring in a greater variety of months among the former. Thus, May was the maximum month in *Abies Lowiana* and *Pinus austriaca*, June in *Araucaria imbricata* and *Sequoia gigantea*, July in *Taxus baccata*, August in *Cedrus Deodara*, while in *Cupressus Lawsoniana* the maximum was distributed nearly equally over June and July, and in *Cedrus atlantica* over July and August.

2. In several species the rate of increase, month by month, to the maximum was not progressive. This occurred chiefly in the deciduous group, and was most marked in the group of oaks. Thus, in the Hungary oak the rates for April and May were almost the same; while in the Turkish, American, and English oaks the rate for June was actually less than for May, in some of them most remarkably so. It would be rash, however, to hold that these results are generally applic-

able to the family of oaks, as nearly all the specimens under observation grew very slowly. This curious halting in their course, therefore, may be abnormal, although it is fair to state that it occurred also in the healthy and vigorous Spanish chestnut. On the other hand, the progress of the evergreens was more regular. *Abies Lowiana* was the only species which lagged in its course, having dropped from 28 per cent. in May to 19 per cent. in June, rising again to 22 per cent. in July. The Deodar was remarkable for its steady progress to a maximum so late in the year as August.

3. The spread of the increase over the months varied very much in the different species. In two of the deciduous group,—the lime and birch,—more than one-half of the annual increase took place in the single month of July, and in neither of them was there any increment in April or May in any of the four years; but the very slow rate of increase in these trees renders it doubtful whether so strange a result is normal. On the other hand, the substantial growth of the beech and Hungary oak was spread over June, July, and August. On the whole, the increment of the evergreens was more equally diffused over the months than that of the deciduous group. No evergreen species grew more than 39 per cent. of its annual increase in a single month, and there was no instance among them of an absolute deficiency of increment in May in any year, or in April for every year of the four under observation.

4. I expected to find that increase in girth would go on *pari passu* with development of the leaf, but such was not by any means invariably the case. This is shown in a rough way in the Table, page 57. If we take, for example, the growth of the Hungary oaks for April, which may be regarded as the month of budding, and for May, which may be regarded as the month of expansion, we find that the amount was nearly equal, and similarly in the case of the sycamores that the amount was actually greater in April than in May. The results in the sycamores, indeed, are inconclusive, as their very slow growth indicates a great lack of vigour; but as to the Hungary oaks there can scarcely be a mistake, as they are the earliest and quickest growers on my list. But the proof is strengthened if we consider the actual state of the foliage,—which was carefully noted by me,—in connection with the

growth. Thus on the 30th April 1885, when the leaves of the three Hungary oaks were only beginning to expand, the stems had already added an aggregate of half an inch to their girth; and on the same date on each of the two following years, when the leaf buds were only beginning to burst, the same trees had increased about half an inch in aggregate girth. On the other hand, one sycamore, with leaves half expanded, and another with leaves fully out, had made no increase in girth on 30th April 1885; and even on 31st May, when both trees had long been in full luxuriance of foliage, there was still no increase in girth. Thus, on the one hand, we have trees in full foliage for several weeks without any increase in girth; and on the other, trees merely in bud showing a decided growth. These facts point to the conclusion that, in some trees at all events, the initial spring growth may be independent of leaf expansion.

VI. *Proportional Increase in Girth in the First and Second Half of the Growing Season.*

My former observations showed that the majority of the deciduous trees measured grew mainly in the second half of the season, and the majority of the evergreens mainly in the first half of the season. This has continued to be the case since, but it would not be safe to found a general rule on these results, even in regard to trees of their age, as the number of species tested is insufficient. As to younger trees, it seems probable, from experiments commenced this year, that the majority of them will be found to complete their substantial growth earlier than trees of middle or advanced age.

The following Table shows that in nine deciduous species the increase in the second half of the season exceeded, and generally greatly exceeded, the increase in the first half of the season; the smallest difference being in the American oak (44 and 56 per cent.) and the greatest in the tulip tree (10 and 90 per cent.). In two species the result was the opposite. In the hornbeam the difference was slightly in favour of the first half of the season (51 and 49 per cent.), and in the sycamore the difference in the same direction was greater (55 and 45 per cent.), but in neither was the excess remarkably great, and as the trees measured turned out poor growers, the result is perhaps not quite reliable:—

Proportional Increase in Girth in Deciduous Trees in the First and Second Half of the Growing Season.

Species.	April to June.	July to Sept.
Fagus sylvatica (average of 9 trees), .	38	62
Quercus conferta (average of 3 trees),	39	61
Quercus Cerris (average of 2 trees), .	31	69
Quercus palustris (1 tree), . .	44	56
Quercus Robur (1 tree), . . .	38	62
Carpinus Betulus (1 tree), . .	51	49
Castanea vesca (1 tree), . . .	31	69
Betula alba (1 tree), . . .	24	76
Liriodendron tulipifera (1 tree), .	10	90
Tilia europæa (1 tree), . . .	24	76
Acer Pseudo-Platanus (aver. of 2 trees),	55	45
Average of the whole, . .	35	65

Proportional Increase in Girth in Evergreen Trees in the First and Second Half of the Growing Season.

Species.	April to June.	July to Sept.
Sequoia gigantea (average of 4 trees),	66	34
Araucaria imbricata (aver. of 3 trees),	73	27
Abies Lowiana (1 tree), . . .	56	44
Pinus austriaca (1 tree), . . .	64	36
Cupressus Lawsoniana (1 tree), .	63	37
Cedrus atlantica (1 tree), . .	48	52
Taxus baccata (average of 4 trees), .	45	55
Cedrus Deodara (average of 4 trees),	34	66
Average of the whole, . .	56	44

In the evergreens the results are on the whole the reverse of those in the deciduous group, the greatest increase having been in the first half of the season, but the difference between the half-seasons is not so marked as in the deciduous trees, and there is greater variety in the behaviour of the species.

In five, viz., *Araucaria, Sequoia, Pinus austriaca, Cupressus,* and *Abies Lowiana,* the predominance of the first half-season is well marked.

In one species, *Cedrus atlantica,* the two half-seasonal growths were almost equal.

In two, *Taxus baccata* and *Cedrus Deodara,* the increment of the second half was considerably greater than that of the first.

The extreme differences were between the Araucaria (73 and 27 per cent.) and the Deodar (34 and 66 per cent.).

The result in the case of the Deodar is the more remarkable, because it was the earliest of the measured species to show activity in spring. In the years 1885 and 1886 I measured the length of the new shoots in all my marked evergreens on the 30th April and 31st May, and those of the Deodars were decidedly the longest; nevertheless, these trees were speedily distanced in girth-increase by the other species, and two-thirds of their increment was delayed till the second half of the season.

Interesting questions arise from the facts brought forward in this paper. For example,—Why should growth be distributed over the months so variously in different species, some effecting the largest part of their increase in a single month, while in others it is pretty equally distributed over two, three, or even four months? Why should the maximum growth in different species occur at such various periods as June, July, and August? Why is it that some species complete by far the greater part of their growth by the end of June, before the real heat of summer has begun? The explanation cannot be found in atmospheric influences or in the nature of the soil, as all the species are similarly circumstanced in these respects. Possibly a difference in the depth of roots below the surface may have some influence, the roots of some species being reached earlier than others by the gradually descending heat of spring and summer. Structural differences may also have something to do with it; and it is perhaps not an extravagant supposition that introduced trees may still bear the impress of the laws of growth which regulated their ancestors in climates different from our own.

Excursion of the Scottish Alpine Botanical Club to Glen Spean and Pitlochrie in 1886. By WILLIAM CRAIG, M.D., F.R.S.E., F.R.C.S.E., &c.

The Annual Excursion of the Scottish Alpine Club in 1886 was to Glen Spean and Pitlochrie.

The following members were present:—Mr W. B. Boyd, Rev. G. Alison, Captain Norman, Rev. D. Paul, Dr Stuart, Mr Neill Fraser, Mr Evans, Mr Lindsay, and myself. The Rev. W. W. Peyton of Broughty-Ferry was with the Club as a visitor.

The members left Edinburgh at six o'clock A.M. on the morning of Thursday, 29th July 1886, and went by train to Oban, thence by steamer to Fort William, where conveyances were waiting to drive us on to Roy Bridge Hotel, which we reached about six o'clock the same evening.

Roy Bridge is about 15 miles from Fort William, and 37 from Kingussie, and is near the junction of the Roy with the Spean. It is a convenient centre for botanising the mountains in Glen Spean. The Spean river flows out of Loch Laggan, and falls into Loch Lochy. The valley of the Spean, especially the lower end of it, is wild and grand in the extreme. The mountains on either side are high, rocky, and precipitous, and the ravines of the higher mountains were filled with snow.

The highest mountains on the south side of the valley are Aonach Beag, 4060 feet; Aonach Mòr, 3999 feet; Stob Choire Claurigh, 3858 feet; Stob Choire an Easain Mhoir, 3658 feet; and Stob Coire an Easain, 3545 feet. On the north side of the Spean the highest mountain in this district is Creag Meaghaidh, 3700 feet. The Club spent four days botanising the mountains in this district, and were on the summits of all the above-named mountains except Stob Choire an Easain Mhoir. The weather was fine, except the first day, which was very misty. The south side of the Spean is chiefly deer forest, belonging to Lord Abinger. Lord Abinger, through our President, Professor Dickson, kindly granted the Club full permission to examine the mountains in his deer forest, and also sent his head stalker, Mr Donald Cameron, to accompany us as our guide.

Mr Cameron was of great service to us, especially the first day amongst the mist. He showed us much kindness, and rendered us every service in his power.

The Club had no previous record of the plants of Glen Spean. The whole district was to them a *terra incognita*, and as the district was wide we could only very partially explore it. We were successful in finding many very rare alpines, and, although we discovered no new species, we found several new stations for rare alpines, and succeeded in gathering one plant which had not been gathered in Scotland since 1832.

The chief plants collected in Glen Spean were—

Silene acaulis, *L.;* Caryophylleæ.
Cerastium alpinum, *L.;* ,,
,, trigynum, *Villars;* ,,
Vicia sylvatica, *L.;* Leguminosæ.
Dryas octopetala, *L.;* Rosaceæ.
Potentilla Sibbaldi, *Hall. f.;* ,,
Rosa involuta, *Sm.;* ,,
Saxifraga oppositifolia, *L.;* Saxifrageæ.
,, nivalis, *L.;* ,,
,, stellaris, *L.;* ,,
,, aizoides, *L.;* ,,
,, rivularis, *L.;* ,,
,, hypnoides, *L.;* ,,
,, cæspitosa, *L.;* ,,
Drosera anglica, *Huds.;* Droseraceæ.
Cornus suecica, *L.;* Cornaceæ.
Saussurea alpina, *DC.;* Compositæ.
Hieracium alpinum, *L.;* ,,
,, nigrescens, *Willd.;* ,,
Vaccinium uliginosum, *L.;* Ericaceæ.
,, Vitis-Idæa, *L.;* ,,
Arctostaphylos alpina, *Spreng.;* ,,
Loiseleuria procumbens, *Desv.;* ,,
Pyrola media, *Sw.;* ,,
Armeria vulgaris, *Willd.;* Plumbagineæ.
Veronica alpina, *L.;* Scrophularineæ.
,, humifusa, *Dicks.;* ,,
Melampyrum sylvaticum, *L.;* ,,
Salix Lapponum, *L.;* Salicineæ.
,, herbacea, *L.;* ,,
Habenaria viridis, *Br.;* Orchideæ.
,, chlorantha, *Bab.;* ,,

Luzula arcuata, *Swartz.;* Junceæ.
Carex pauciflora, *Light. f.;* Cyperaceæ.
,, pallescens, *L.;* ,,
,, vaginata, *Tausch ;* ,,
,, pulla, *Good.;* ,,
,, saxatilis, *L.;* ,,
Deschampsia cæspitosa, *Beauv.;* Gramineæ.
Pteris aquilina, *L. var.:* Filices.
Cryptogramme crispa, *Br.;* ,,
Lomaria spicant, *Desv.;* anomalum, ,,
Asplenium viride, *Huds.;* ,,
,, Filix-fœmina, *Bernh.; var.* rhœticum, Filices.
Cystopteris fragilis, *Bernh.; var. forked,* ,,
Aspidium Lonchitis, *Sw.;* ,,
Nephrodium spinulosum, *Desv.;* ,,
,, Oreopteris, *Desv.; var.* truncata. ,,
Polypodium alpestre, *Hoppe;* ,,
,, flexile, *Moore;* ,,
Splachnum sphæricum, Musci.

From the above list it will be seen that some common alpine plants were not observed in our excursion. On the other hand, several very rare and interesting alpine plants were gathered by the Club. I would specially notice the following:—

1. *Vicia sylvatica.*—This is not a very common plant, and was gathered in the woods on the banks of the Roy, above the hotel.

2. *Cerastium trigynum.*—This plant was seen in great profusion on all the hills visited. We gathered on several mountains a variety of Cerastium which differs from the recorded British species, and which may turn out to be *C. arcticum.* The plant is being cultivated with a view of determining the species. We also gathered several forms of *C. alpinum.*

3. *Rosa involuta* was common on the banks of the Spean and the Roy. Both the red and white varieties were seen.

4. *Salix herbacea.*—A variety with very small leaves, and very procumbent habit, was met with on the top of Creag Meaghaidh.

5. Of Ferns we did not find any species very rare except *Polypodium flexile,* but we found several good varieties, including a beautiful forked variety of *Cystopteris fragilis.*

6. On the banks of the Cour we saw large quantities of *Pedicularis palustris*, L., with white flowers.

7. *Mimulus luteus*, L.—We observed a meadow literally yellow with this beautiful plant. It was, however, near a house.

8. *Arctostaphylos alpina.*—This plant had not been gathered by the Club on any previous excursion. It is common on Ben Wyvis, on many of the mountains in Glen Affric, in Ross-shire, and Sutherlandshire. It is also found on Ben Nevis, from which station there is a specimen in the University Herbarium. There is also a specimen in the same herbarium, labelled "Hill on Loch Leven side, opposite Ballachulish, 1837." We only found it on one of the mountains visited, and in the usual situation for the plant—"on the tops of the low shoulders of the mountains." This is a new station for the species, but not a new locality, as it was previously recorded from Ben Nevis and Loch Leven side; but the plant is not common, and is very rare so far south.

9. *Luzula arcuata.*—This plant is common on several of the Sutherlandshire hills, is found on Lochnagar, on the Cairngorm range of hills, and is well known as the "Gerse that grew on Ben M'Dhu, that ne'er a coo would care to pit her mouth till." I am not aware of this plant having been found south of the Spean on any previous occasion. In the last edition of Watson's *Topographical Botany*, East Perth is marked with a ?, but in a Supplement by Bennet, East Perth is mentioned as a locality; but the special hill or hills are not mentioned. Specimens of the plants collected are in cultivation in the Royal Botanic Garden, and are undoubtedly the true *arcuata*. The plant was found in considerable quantity on Aonach Beag, and more sparingly on Aonach Mòr.

10. *Saxifraga rivularis.*—This plant has been found sparingly on various mountains of the Cairngorm range; more abundantly on Lochnagar. It is also recorded from Ben Lawers and Ben Nevis. It was gathered by the Club on Ben Nevis in 1876. We found this plant on two separate mountains. It occurred in considerable abundance on a mountain on the south of the Spean, and still more abundantly on Creag Meaghaidh, a high mountain on the north side of the Spean. Some of the specimens gathered on this latter mountain had very large fleshy leaves, and were much

more luxuriant than I had ever observed it before. I am not aware of any record of *S. rivularis* having been found on either of these hills previously. The late Professor Balfour in 1867 visited Corry Arder, the great corry on Creag Meaghaidh, but did not find this rare Saxifrage. An account of his excursion is given in vol. ix. of the *Transactions* of this Society.

11. *Saxifraga cæspitosa.*—This rare species was found sparingly on one of the mountains in Glen Spean, but in much greater quantity than it had ever been found in Scotland on any previous occasion. This undoubtedly was the "find" of our excursion, and forms an important contribution to the botany of Scotland. The plant was first picked by our Vice-President, Mr Boyd, and afterwards by the other members present. This is one of the very rarest of our alpine plants, and it has seldom been gathered in Scotland. Mr Baker writes me to say that there is in the Bower Herbarium at Kew a "specimen mentioned as collected on Ben Nevis by Mr Joseph Woods." I suppose this is the authority for Ben Nevis being mentioned as a station for this rare Saxifrage. "There is no date to it," adds Mr Baker. I can find no record of this discovery by Mr Woods in any of the authorities I have consulted.

There appears to be considerable confusion in our floras about this plant. Hooker regards it as a sub-species of *S. hypnoides.* Babington mentions it, and makes several varieties of it, and records as stations Caernarvonshire, Aberdeenshire, and Kerry; I suspect, however, that they confound several varieties of *hypnoides* with the true *cæspitosa.* Bentham, on the other hand, who cannot be accused of any tendency to subdivide species, not only makes it a distinct species, but gives a very excellent drawing of the true plant. He says it is "a high northern and Arctic plant. In Britain, only on some of the higher Scotch mountains, such as Ben Avers and Ben Nevis"; and adds, "High alpine forms of *hypnoides* have frequently been mistaken for this plant." He says it is very near to the *hypnoides,* "but never emitting the weak procumbent barren shoots of that species; the leaves broader, more obtuse, and more frequently lobed, and the calyx divisions also obtuse. The short leafy stems are crowded into dense tufts; the flowering stems, from 2 to 3 inches high, generally covered with a short grandular down, and bearing one or two white flowers." This is an excellent description of the true *cæspitosa.* The petals never spread so much as in *hypnoides,* and any one who is acquainted with the true plant can scarcely mistake it for *hypnoides. Ben Avers* is evidently a misprint for Ben Avon. With the exception of the single specimen in the Bower Herbarium at Kew, said to have been found on Ben Nevis, all the other specimens at Kew are from Ben Avon. In the University Herbarium here the only wild specimens are from Ben Avon and Beinn A'Bhùird.

The plant was collected on Beinn A'Bhùird by the late Mr William M'Nab in August 1830. I believe only a single tuft was collected on Beinn A'Bhùird, and it has never been found on that mountain since. The following year (1831) Professor Graham, Mr William M'Nab, Dr Martin Barry, and others made a special search on Beinn A'Bhùird, but failed to find it. After the return of the party to Edinburgh, Mr William M'Nab and Dr Martin Barry returned to Braemar, and again searched the mountain, but without success. Mr M'Nab having to return to Edinburgh, Dr Martin Barry remained behind at Braemar with the view of making a further search for this rare Saxifrage. Dr Barry, accompanied by Mr John Mackenzie, gardener, Invercauld, as his guide, examined the rocks on Ben Avon facing Beinn A'Bhùird, and they were successful in finding a new station for this, undoubtedly one of the rarest of British alpines. The first specimen was picked by John Mackenzie, so that he, and not Dr Barry, was the real discoverer of the Ben Avon station. In the following year this station was again visited by Dr Barry, but the plant was picked by him only *sparingly.* There is a specimen in the Brand collection of the University Herbarium, dated 1832, collected on Ben Avon. In the Watson Herbarium at Kew a specimen is marked "Ben Avon, 1831—W. Stables." There is no record of this plant being gathered on Ben Avon since 1832, and I am not aware of any person who knows the station on Ben Avon in the present day.

In the eighth volume of the *Journal of Botany* for 1870, at page 281, Mr J. G. Baker of Kew, in his remarks on *Saxifraga cæspitosa,* regards the plant as occurring in Ireland ;

at page 354 Mr J. Carroll, in reply to Mr Baker, uses these words—"The Scottish specimens may belong to true *cæspitosa*, which is abundant in Ireland; but Irish *S. cæspitosa* and *S. hirta* are evidently only luxuriant forms of *hypnoides*." To this Mr Baker replies in these words:—"I am informed by Mr Watson that this plant was gathered by Dr Martin Barry, in 1832, on Ben Avon. As I never heard that Dr Barry collected it more than once, it is probable that the station on the Clova mountains, which I gave at p. 281, on the authority of the note copied on the sheet with the specimens in the Kew Herbarium, is incorrect, and I would consider that this Ben Avon station for the plant is the only one in Scotland yet ascertained that rests upon a safe foundation." There is abundant evidence that Beinn A'Bhùird is a station for this Saxifrage, for that collected by Mr M'Nab was undoubtedly the true plant; and this mountain in Glen Spean is a third station "that rests upon a safe foundation." In a letter from Mr Baker he says—"I was at Edinburgh last September, and Mr Lindsay showed me your Glen Spean plant alive. It is clearly the true thing." The plant we found is undoubtedly the true *S. cæspitosa*, L.; and although common in many Arctic regions, such as Iceland and the Faroe Isles, it is exceedingly rare in the British Isles, being only found in a few stations in Scotland, and in no case abundantly. Although by no means common in the Glen Spean station, yet from the published records it evidently is more luxuriant and more abundant there than on any of the other recorded stations.

I have endeavoured to find out the dates of the discovery of this plant in Scotland, but in this I have not been very successful. Professor Babington, in a letter to me, says—"Hooker, in 1821, seems to have had specimens gathered by G. Don (*Scot. Fl.*, pt. i. 32). In 1830 Mr M'Nab gathered it on Beinn A'Bhùird. In 1831 Mr M'Kenzie found it on Ben Avon."

In the herbarium of Rev. Dr Gordon, of Birnie, there is a specimen labelled "Ben Avon, August 1831." The plant was collected by Mr W. Stables, and the label is in Mr Stables' handwriting. Mr Stables is still alive, but is too old to remember anything concerning this find. It is possible that he was the original discoverer of the plant on Ben Avon, for, from Professor Graham's account of the discovery of this plant on Ben Avon by Mr Mackenzie and Dr Barry in 1831, it appears to have been after August that they found it.

Before 1838 it was found by Joseph Woods on Ben Nevis, but the exact date of Mr Woods' find I cannot ascertain. There is no record of the plant having been found in Britain after these dates till 1886, when it was found by the Scottish Alpine Botanical Club in Glen Spean.

On Wednesday, 4th August, the members of the Club left Roy Bridge by the mail coach for Kingussie. The day was very fine, and the drive was most delightful. On passing along the side of Loch Laggan the sun was shining brightly, there was not a ripple on the surface of the water, and the reflection of the clouds and high mountains from the surface of the loch was much admired by all.

After reaching Kingussie we took train for Pitlochrie, and were comfortably entertained in Fisher's Hotel. Before dinner we ascended Ben Vrackie, a mountain close to and north of Pitlochrie, and 2757 feet high. We found several good alpine plants, including *Oxytropis Uralensis,* DC., and *Astragalus alpinus,* L., both in flower. This mountain was visited by Professor Balfour in 1867, and a record of plants collected is given in vol. ix. page 293 of the *Transactions* of the Society. But his list does not include either of these plants, although both were found by us in great abundance, especially *Astragalus alpinus.* This plant was first discovered on Ben Vrackie in September 1884 by Mr Neill Fraser, a member of our Club. Previously it was only known to grow on two mountains in Britain,—one in Clova, and the other in Braemar. It was first discovered in Scotland, on 30th July 1831, on a steep cliff in Glen Dole, Clova, by the late Mr Brand. In August 1842 the late Professor Balfour found it on Little Craigendal in Braemar, and in September 1884 it was discovered by Mr Neill Fraser on Ben Vrackie.

In many parts of Ben Vrackie the turf is full of this pretty leguminous plant, and it is a mystery how it remained so long undiscovered, and had even escaped the vigilant eye of the late Professor Balfour, who had carefully examined the botany of the mountain.

On Thursday, 5th August, the members of the Club returned to their several homes, and thus the excursion of 1886 came to a close, an excursion which will long be remembered as one of the most delightful and certainly one of the most productive in the history of the Club.

On the Dimorphism of the Flowers of Wachendorfia paniculata. By JOHN WILSON, B.Sc., University of St Andrews. (Plate I.)

(Read 9th December 1886.)

The inflorescence of this Wachendorfia (as exemplified by the plants experimented with) is a raceme of from seven to eleven scorpioid cymes, each cyme bearing usually four or five flowers. Each flower lasts one day only, its duration depending on the amount of sunshine. On many days they may not be fully open more than six hours. They open rapidly, and become degenerated as rapidly, those studied during the beginning of June being closed and crumpled at 6 P.M. They are faintly scented. The perianth segments are much alike in size and shape. What, for convenience, may be called the uppermost outer segment (Pl. I. fig. 2, *us*), is of a general dull orange. All the other segments are very pale yellow, with a touch of orange at the apex, and a central line of the same colour. There is a crescentic band of orange in the centre of the flower, passing over the three upper segments. As to the disposition of the perianth segments seen in front view, the uppermost outer segment is vertical in position, and the other two horizontal. The upper inner segments stand at an angle of about 45°, and the lower one (Pl. I. fig. 2, *ls*) is vertical. In profile the latter is seen to be capable of affording a lighting place for insects. There are two honey-glands, situated in the angles between the bases of the upper outer segment and the adjacent inner segments. They open at the back of the flower by lenticular apertures formed by the eversion of a small portion of the margin of the segments bounding the glands (Pl. I. fig. 4, *gl*). The secreting portion is at the outer extremity of the glands. While quite exposed from behind, they are approachable from the front of the flower by two small orifices (Pl. I. fig. 2, *o*). Secretion, curiously enough, takes place the afternoon before the flower opens, and the glands remain conspicuously moist the day after flowering. The three stamens are inserted opposite the inner segments. The basal portion of their filaments are half sunk in grooves in the walls of the ovary (Pl. I. fig. 5, *st*), the exterior of the latter being bluish-green and papillose. The two upper stamens diverge and curve outwards in a symmetrical manner, their bases being in the glandular region (Pl. I. fig. 6, *bs*), and their anthers both rising to the same height, about the level of the centre of the flower. The third stamen (Pl. I, figs. 2, 3, 6, *s*) starts from the base of the lowest segment, passes under one of the other stamens, and curves upwards till its anther is a little higher than the other anthers. The style (Pl. I. figs. 2, 3, 5, *sty*) passes beneath the other (opposite) stamen of the pair, and in position, length, thickness, and curvature corresponds with the odd stamen. There is thus bilateral symmetry in the flower, faulty only in the absence of an anther where the simple stigma is.

All the flowers of a particular inflorescence have the style bent to the same side. In the four plants which flowered, two had all the styles bent in one direction, and two all the styles bent in the opposite direction—the odd stamens, of course, changing sides. This arrangement constitutes the dimorphism of the species.

The lowest flower (Pl. I. fig. 1, *lf*) is the first to open. There is much diversity as to time in the sequence of opening of the flowers in any particular cyme. The most common interval between the period of expansion of one flower and that of the next above it is three, four, or five days. An interval of one, two, six, or seven days is relatively very seldom found, such occurring usually between the last and the second last flower of the individual cymes. Seldom so many as five or even four flowers on one thyrsus (as figured) expand in one day. It is common enough to have either two or three, but in the greatest number of cases, especially towards the close of flowering, there is only one flower open at a time,—a fact perhaps worth noting. The subjoined table will serve to illustrate these remarks. The observations set down in it have reference to two distinct inflorescences, which may be regarded as typical. The cymes are numbered from below upward. The Arabic numerals indicate the days on which the flowers open. Thus, in the lowest cyme (I.) of A, the first flower being held as opening on the 1st day, the second opening on the 4th, the third on the 10th, and so on. The figures 1, 4, 7, 9, 11, 15, 17, 19 in A, and 6, 9, 13, 14, 15 in B, indicate instances in which one flower alone was expanded; and the absence of 12 in the latter indicates that on the 12th day no flower opened.

A.		B.	
Cymes.	Flowers.	Cymes.	Flowers.
XI. . .	9, 14	VII. . .	4, 7, 10, 15
X. . .	7, 12, 16	VI. . .	3, 7, 10, 14
IX. . .	5, 10, 14	V. . .	3, 6, 9, 13
VIII. . .	5, 8, 13, 18	IV. . .	2, 5, 8, 11
VII. . .	3, 8, 12, 17	III. . .	2, 5, 8, 11
VI. . .	3, 6, 11, 15	II. . .	1, 4, 8, 10
V. . .	3, 6, 12, 16	I. . .	1, 4, 8, 11
IV. . .	2, 5, 10, 14, 19		
III. . .	2, 5, 10, 14, 18		
II. . .	2, 5, 10, 13, 18		
I. . .	1, 4, 10, 14		

Eighty flowers were experimented on during the summer of 1885, the object being to discover whether the dimorphism is of service in the economy of the plant, viz., a means of securing a better yield of seed by cross-fertilisation.

Results of Experiments with Wachendorfia paniculata.

	Left alone.	Own Pollen.	Like (Crossed).			Unlike (Crossed).
			Same Plant.	Different Plant.	Total.	
No seed, . .	8	5	7	5	12	1
One seed, . .	(2)	5	4	2	6	7
Two seeds, . .	0	4	1	0	1	8
Three seeds, . .	0	4	0	0	0	17

Of the eighty flowers experimented with, ten were left alone, and two of these bore one small seed each, pollination of an inferior character having been effected by some accidental agency. The eighteen flowers impregnated with their own pollen yielded twenty-five seeds, that is an average of 1·33 for each flower—no inconsiderable success. Twelve flowers crossed with pollen from others on the same plant bore six seeds—average ·5 for each flower. Seven flowers crossed with pollen from similarly constructed flowers on distinct plants bore two seeds—average ·28. Thirty-three crosses were made between dissimilar flowers, and in twenty-eight of them the pollen was taken from the anther of the one flower which corresponded exactly in position with the stigma of the other. Seventy-four seeds in all were borne by the thirty-three flowers, that is, an average of 2·24 for each flower. Three seeds is the full complement of the capsule. The results in sections "Crossed" point directly to the fact that what may be termed the *intended* cross is best. In comparing the last two columns in the table, the relative number of failures and successes is remarkable. In the "Likes" (same type) the numbers fall from 12 unfertilised, through 6 bearing one seed, 1 bearing two seeds, to none bearing three seeds; whereas the "Unlikes" rise from 1 bearing no seed, through 7·8 and 17 bearing one, two, and three seeds respectively. The nineteen flowers in the former series bore only eight seeds in all; whereas the thirty-three flowers in the latter series bore seventy-four, the ratio being as 100 to 532. These figures fulfil one's anticipations. The presumption is that if an insect of sufficient spread of wings, after having visited a flower of one type, alights on a flower of the other, it must cross-fertilise the latter, inasmuch as the stigma will come exactly in contact with the part of the insect's wing bearing pollen from the former plant. And while one cross is being effected, new pollen is being acquired for pollination of the opposite type. The success, however, indicated by the figures in the second column of the table may well give rise to speculation.

The seeds were all kept in separate packets for further study; but, during winter, they unfortunately became mouldy, and hence probably deteriorated, a circumstance which led to their being sown promiscuously. Twenty-eight germinated, and are growing vigorously, a fact which leads one to infer that a large percentage of the seeds saved must have been good, and that, but for the partial damage they sustained, some confirmation of the results of fertilisation might have been drawn from their germination.

The plants used in the experiments were gathered and sent direct from Cape Colony by the writer's brother, Mr Alexander Wilson.

[*P.S.*—Since the above was read, additional experiments have been made with the flowers of a single vigorous inflorescence. Of the forty-three flowers borne by it (all as usual of one type), six were untouched, twenty fecundated with their own pollen, and seventeen with pollen from a different flower. Although done in the most favourable circumstances, and the pollen applied in many ways,—for instance, from nearer or more remote flowers, from the one or the other of all three stamens,—no seed at all was borne. Such a result goes to emphasise the significance of the figures in the last two columns of the second table, strengthening the assumption that the dimorphism of the flowers is of decided benefit to the species.]

Explanation of Plate I.

Wachendorfia paniculata.

Fig. 1. *Wachendorfia paniculata* (reduced). *lf*, lowest flower.

Fig. 2. Front view of a single flower (nat. size). *us*, upper outer segment of the perianth ; *ls*, lower inner segment ; *sty*, style ; *s*, stamen corresponding to the style ; *o*, aperture of passage to honey-gland.

Fig. 3. Front view of the opposite type of the flower depicted in fig. 2 (nat. size).

Fig. 4. Side view of a flower (nat. size). *gl*, honey-gland bearing a drop of nectar.

Fig. 5. Front view of the ovary (nat. size). *sty*, base of style ; *st*, base of stamen ; *gl*, honey-gland.

Fig. 6. Side view of reproductive organs (nat. size). *bs*, base of upper stamen.

On the Fructification of Sphacelaria radicans, *Harvey, and* Sphacelaria olivacea, *J. Ag.* By G. W. Traill, Joppa. (Plate II.)

(Read 10th February 1887.)

These plants differ greatly, both in general appearance when growing, and also in their fructification ; yet, owing to their similarity of structure when viewed under the microscope, they have generally been considered by authors as belonging to one species. Both occur on sandstone rocks at many places along the shores of the Firth of Forth, but at very different levels.

The one, *Sphacelaria radicans* of Harvey's *Phycologia*

Britannica, occurs at low water in continuous loose tufts, seldom exceeding half an inch in height on this coast; of a dark olive-green colour when mature—lighter when young.

It generally frequents exposed places where there is some surf, and is often found lining the sides of small channels among rocks into which the sea rushes with violence. More rarely the tufts occur in a matted state in a tenacious deposition of sand.

Sporangia, which are well known, occur in winter. They are produced along the sides of the upper branches; are sessile, very numerous, and clustered together, as shown in the accompanying plate.

The other plant—*Sphacelaria olivacea*, J. Ag. *partim*, *Conferva olivacea*, Dillwyn—occurs, on the contrary, a little below the high-water mark of neap-tides, and generally in the shade. It grows in dense velvety patches of an olive-brown colour, which, however, become olive-green when dry. It adheres closely to the rock, and has the habit of *Callithamnion Rothii*, which it often accompanies.

It is a very much smaller plant than the former, the fronds being generally only about the 1-16th of an inch in length.

Seeing that Harvey made no mention of the fruit applicable to this form, and also that there did not appear to be any record of its ever having been observed, I watched the plant at Joppa at frequent and regular intervals during the last eighteen months, and succeeded in finding simple oval zoösporangia in a young state on the 19th of December. These are almost invariably on short-jointed pedicels or branchlets; and not sessile or clustered, as in Harvey's *Sphacelaria radicans*.

The fruit had reached maturity by the 15th of January, at which date many of the zoösporangia had burst at the apex, and had allowed their contents to escape. The accompanying plate shows the fructification in its mature state.

Remarks on Sphacelaria radicans, *Harv., and* Sphacelaria olivacea, *J. Ag.* By E. M. Holmes, F.L.S.

The plant alluded to by Mr G. W. Traill, in the above paper, under the name of *Sphacelaria olivacea*, J. Ag., does not appear to have been well understood by any of the preceding algologists who have described it, except Dillwyn.

Agardh, in his *Species, Genera, et Ordines Algarum*, p. 31, mentions *S. olivacea*, and a variety *radicans*, distinguished by its rather firmer filaments rooting from the upper portion, but does not remark that it has a different habit of growth. This rooting character, however, is figured by Kützing, under *S. olivacea !*

In *English Botany*, two figures are given, one of which, tab. 2430, represents *S. olivacea*, as having a more flaccid character than *S. radicans*, tab. 2429. In the description of the species there given, the author remarks that *S. olivacea* approaches so nearly to *S. radicans*, that the creeping habit of the latter seems to constitute the only real difference. *S. radicans* is described as growing on sand-covered rocks, and *S. olivacea* on rocks and larger algæ.

It would thus seem that both the plants of *English Botany* grow under water, one being rather more rigid than the other.

Harvey, in the *Phycologia Britannica*, combines these two under the name of *Sphacelaria radicans*. He remarks that *S. olivacea* of British authors is less disposed to throw out radicles than the other, but that the *S. olivacea* of Lyngbye may be a different plant. I cannot find, however, that Lyngbye describes a species under this name. He doubtfully identifies his *S. cæspitula* with Dillwyn's *S. olivacea* (*Dillw. Int.*, p. 57, suppl. tab. c.).

More recent authors* follow Harvey in uniting the above two forms under the name of *S. radicans*. The difference in habit of the *S. olivacea* of Dillwyn from that of *S. radicans*, Harv., is very marked. As I have seen *S. olivacea*, Dillwyn, growing in caves at Berwick, it forms a dense coat on the walls of the cave like velvet plush, of a fine brown colour,

* Farlow, *Marine Algæ of New England*, p. 76; Hauck, *Meeresalgen der Deutschland*, p. 343.

extending for many feet, alternating or mixed with *Callithamnion Rothii.* With a knife it can be cut off like turf. This I have never seen to be the case with Harvey's *S. radicans,* of which it would be impossible to obtain a felted piece an inch square. This difference appears to arise from the fact that in the former plant the radicles and ramuli are densely felted together, which is not the case in the latter. I have never met with this plant in the south of England.

With respect to the fructification, the specimens of the felted plant (*S. olivacea,* Dillwyn) sent me by Mr Traill have the sporangia distinctly stalked; while those received from him of the low-water plant exactly correspond with Harvey's figure of *S. radicans,* Harv., in having sessile bodies resembling unilocular sporangia. I have, however, found specimens of the latter plant at Falmouth with the fructification sessile above, and stalked lower down on the filaments; and in *English Botany* the fruits of *S. radicans* are described as "sessile or stalked." Moreover, Agardh describes them as oval, long-stalked, situated on the upper ramuli singly, or a few together ("subsingulis").

So far as I have observed in Mr Traill's *S. olivacea,* Dillw., the unilocular sporangia are invariably stalked, and more distinctly so, *i.e.,* on longer pedicels, than in my Falmouth specimens of *S. radicans,* Harv.

Unfortunately, the length of the joints in *S. olivacea* and *S. cirrhosa,* and Mr Traill's felted plant, are so nearly alike, that the habit of growth and the angle at which the branches arise, and the distinct localities at which they grow, are almost the only characters by which to distinguish these plants. (The same is the case with *S. racemosa,* which Mr Batters was so fortunate as to find last month at Berwick-on-Tweed in good fructification. This species has, I believe, been only once or twice previously found—first, by Sir John Richardson, near Granton, in 1821; and next, by the late Mr Hennedy, in the Clyde, according to Harvey, many years subsequently.* In this species the joints are about as long as broad, resembling in this respect the above-mentioned species. The plant is, however, taller, and grows

* I have seen Hennedy's specimens, but could find no fruit on them, and doubt if they belong to *Sphacelaria racemosa.* I should refer them to *Sphacelaria radicans,* Harv.

in scattered tufts. In *Sphacelaria tribuloides*, however, which I met with at Dunbar, the joints are twice as long as broad.) The felted mode of growth of *S. olivacea*, Dillw., and the diameter of the filaments, which is only about half of that of *S. radicans*, Dillw., and the growth in small isolated tufts of *S. racemosa*, and the racemose fruits, are the best modes of distinguishing the species from *S. radicans*, Dillw.

Pringsheim (*Morphol. Differenzirung in der Sphacelarieen-Reihe*, Berlin, 1873, p. 165) has given the best description yet published of the fructification of *S. olivacea.** He figures the following reproductive organs:—

1. Unilocular sporangia, of an elliptical or oval form, terminal on pedicels, consisting of about three joints.

2. Globular sporangia, on longer stalks, consisting of about nine joints. (These appear to be plurilocular sporangia.)

3. Propagula, or deciduous special branches, like those found in *S. cirrhosa*.

4. Gemmæ (Brutzellen), formed out of lateral segments of the joints, which may either develop into ordinary or into fruit-bearing ramuli, or subdivide and form a conglomeration of cells on the branch.

The sessile bodies, figured in the *Phycologia Britannica* as the fructification of *S. radicans*, are considered by Pringsheim to be probably a parasite, similar in character to, but different from, *Chytridium*.

With respect to the time of fructification, he remarks that the germination of the zoöspores often takes place very slowly, since he has found sporangia in July and August, with spores but little advanced in development (I have found them in August). The plurilocular sporangia were also met with in July and August.

The deciduous special ramuli, or propagula, he found of rare occurrence, except in a solitary tuft, which was remarkable for the abundance of hairs it bore.

On the cæspitose form of the plant the propagula appeared to be extremely rare, and they were developed out of the gemmæ above alluded to.

Pringsheim's statement concerning the sessile fructification

* Pringsheim recognises four varieties of *S. olivacea*, Dillw., viz., *cæspitosa*, *radicans*, *solitaria*, and *clatia*.

of *S. radicans,* Harv., figured in the *Phycologia Britannica*, seems to require further confirmation; and as, at this time of the year, as Mr Traill has shown, the fructification is in its best condition, I hope that the subject will not be allowed to rest until the doubtful points are cleared up by careful microscopical investigation. The fact that both kinds of sporangia may occur on the same plant, or even on the same branch, in this family of Algæ (*e.g.*, *Ectocarpus hyemalis*), should be borne in mind. It seems probable that the plurilocular sporangia may afford characters in their position or shape by which to distinguish the closely allied *S. cirrhosa*, *S. radicans,* and *S. racemosa*, the joints of which are almost equal in length. A comparison of the sections of the stems might also reveal some differences.

Dillwyn describes *S. olivacea* as having joints equal in length and breadth, and *S. radicans* as having them about half as long as broad.

I cannot close these remarks without paying a willing tribute to the perseverance and careful observations of Mr Traill. I know of no other algologist who has kept such a careful record of the times of fructification and duration of growth of various species as this gentleman, and only wish that he could be induced to publish in detail his algological diary.

In conclusion, I may add that, as Dillwyn does not describe the fructification of *S. olivacea*, Mr Traill's discovery of it adds one more fact to our knowledge of this group of plants.

The Indigenous Flora of Madeira, in special relation to its Peculiar Plants. By FRANCIS M. NORMAN, Commander R.N.*

(Read 12th May 1887.)

From time to time, before the year 1857, fragmentary and intermittent notices of the flora of the island of Madeira, and lists of some of its plants, were published both in England and Germany, but no serious attempt to produce a

* Herbarium specimens of most of the plants mentioned, and many not noticed in this paper, were exhibited by the author.

complete and systematic flora was made till that year, when the first number of *A Flora of Madeira and the Adjacent Islands of Porto Santo and the Desertas*, by the Rev. Richard Thomas Lowe, M.A., was brought out by Van Voorst of London.

But before proceeding more directly to the subject matter of my paper, I beg leave briefly to interpolate a notice of the late Mr Lowe, and the circumstances which led to my acquaintance with him.

Mr Lowe was born in 1802, graduated at Christ's College, Cambridge, in 1825, as senior optime, became a deacon in the Church of England in the same year, and priest in 1830. From 1832 to 1852 he held the appointment of English chaplain in Madeira, after which he became rector of Lea, Lincolnshire, in the gift of the late Sir Charles Anderson, and where, for a few months, the present Bishop Wilberforce of Newcastle was his curate. Though Mr Lowe's English preferment took him away from the island, and severed his official connection with it, it did not sever his botanical, for he continued to visit it nearly every spring, partly to escape the east winds of Lincolnshire, and partly to work out on the spot the materials for his Flora, for which a continuous residence of twenty-six years,* together with numerous subsequent visits, had amply furnished him; in the compilation of which, too, he carefully availed himself of previous or contemporary labours of others in the same field.

Madeira, then, was the one spot to which he always returned when he could get away from his parish; and in April 1874, accompanied by his wife, he left Liverpool in the s.s. "Liberia," hoping in a few days to be once again in the favoured clime where his chief scientific interests were. From the day that the "Liberia" left port until the present time, nor ship, nor soul on board her, has ever been heard of again!

It is satisfactory to know that his collection of dried plants was secured for Kew.

My own friendship with Mr Lowe thus came about:—

In 1863 I was recruiting in Madeira, and unable to take up a fresh appointment in my profession.

Soon getting comparatively well, I wanted employment,

* Mr Lowe lived in the island before he became chaplain.

and being sensible of a taste for natural history, I began to teach myself botany, and with such success that, in a year afterwards, when I met Mr Lowe for the first time, on the occasion of one of his annual visits, I was able to show him, dried and named by myself by aid of "Hooker and Arnott," a large proportion out of the 260 British species which, approximately speaking, are found in Madeira, as well as most of those which were described in his Flora as far as it had gone.

Thenceforward, until I left, we were in constant communication. I must also express my grateful thanks to Senhor J. M. Moniz, the one Portuguese resident who was a botanist, for all the great assistance which he subsequently gave me. Mr Moniz's name is constantly met with in Mr Lowe's book, and many interesting plants are named after him, such as *Monizia edulis*, Lowe, a splendid Umbellifer to be seen at Kew; *Helichrysum Monizii*, Lowe, &c.

I remained in Madeira for three years after I began to study plants, during which period I carefully botanised the whole island. It is greatly to be regretted that Mr Lowe's Flora was never finished. It appeared only up to the end of *Solanaceæ*.

It is now nearly thirty years since the issue of Mr Lowe's first number, and there is still no complete Flora of Madeira to be had. But I am very glad to know that at last Mr James Yates Johnson, a naturalist who has long resided in the island, but whose health has interfered very much with his researches, has finished one which is expected shortly to be published by Dulau, of Soho Square, London.

The basaltic island of Madeira, 30 miles long, with an average breadth of 10 miles, presenting a central mountain ridge of great elevation (upwards of 6000 feet on the summit of Pico Ruivo, the highest point), is in lat. 32° 43″ N. and long. 17° W., 1300 miles from Southampton, the nearest land being a point on the African coast, 320 miles distant. The chief features in its climate are great general steadiness of weather and marked equability of temperature, with a definite and considerable atmospheric humidity, which is occasionally, for three or four days at a time, violently interrupted by a hot extremely dry east wind, called "Leste," from the African continent, and this charges the atmosphere with dust from the deserts to such a degree that everything inside as well as outside the house is coated with an impalpably fine yellow powder. The sun's heat is often great; but it is so tempered by land and sea breezes, and by the prevalence of cloud screens, that by proper management comparatively little inconvenience need be felt. In summer for three months consecutively the thermometer stands at 76° at 2 P.M. in your shaded room with windows open; while during the winter months it will be from 60° to 63° in the same situation. Moreover, by having houses at different elevations, it is possible to keep that latter temperature indoors during the whole of the year.

The picturesque scenery of Madeira is adorned by an interesting and instructive *native flora;* but, probably, to the majority of visitors, not a very attractive one.

To appreciate it, one must spend the whole year on the island, and explore the mountains and the ravines of the interior, as well as the shores, sea-cliffs, and slopes on both sides, and get away from time to time from the horticultural influences of Funchal and its neighbourhood, by which the indigenous flora is very much eclipsed.

The cultivated flora is strikingly and impressively beautiful and luxuriant; rare, showy, and interesting growths from all parts of the world flourishing in its gardens with but little care; while many or most of our ordinary hothouse or greenhouse favourites grow in the open air, and attain a vigour and luxuriance which must be seen on the spot to be appreciated.

I may notice, in passing, that the wooded appearance of the island, or of large portions of it, induced its Portuguese discoverers, in the fifteenth century, to call it Madeira, the word signifying "timber"; while the name of the capital, and only town, Funchal, means "Fennel" in Portuguese, and was given because large quantities of that umbelliferous plant were observed (as it may be to this day) growing on and around the site of the future city.

In Madeira there are certain fairly well marked regions or zones of vegetation. The lowest, or semitropical, from sea-shore to about 700 feet; the hill, or temperate, from 700 feet to 2500 feet; the mountain, from 2500 to 5000 feet; and the highest peaks, from 5500 to 6000 feet.

In taking a collective view of the flora of these regions, we cannot help being struck with the very large number of peculiar plants which, in proportion to the limited area of the island, they produce.

Speaking approximately, and subject to the few corrections which subsequent researches may have necessitated, there are in Madeira 710 flowering species, of which 602 are presumably indigenous, and 108 known to be naturalised.

Of these 602, no less than 120 are supposed to be PECULIAR, and about 260 BRITISH. The proportion of South European plants is very large, and is thought to favour the idea that there was in ancient times a land communication between the south of Europe, north of Africa, and Madeira.

It is probable that when the African flora has been more fully investigated this large total of Madeira "peculiars" will have to be reduced. Mr Lowe, too, it must be confessed, had rather a weakness for species-making.

Of ferns and fern allies we have 46 species, of which 21 are British and 3 peculiar, as well as one Lycopodium. There are no alpines, even on the highest mountain tops.

The daisy is not indigenous, nor will the British botanist ever be reminded of his native country by such plants as the primrose, cowslip, anemone, bitter sweet, or harebell. The common groundsel is not very abundant; while ragwort is conspicuous by its absence.

Remarks on some of the Plants PECULIAR *to the Island.*

Ranunculus grandifolius is pre-eminent in the genus by its enormous size, being sometimes 6 to 7 feet high, and by its profusion of great golden flowers.

Saxifraga maderensis is one of the most beautiful wild Saxifrages to be met with. It occurs in tolerable profusion on craggy rocks in the hill and mountain regions, and usually forms spreading tufts, on large thick beds, rarely solitary. It is reddish, stiff, glutinous, and shining, as if varnished; large and luxuriant in growth, with panicles of conspicuous pure white flowers. I have never seen this plant in Britain.

The Umbelliferous order has some interesting representatives. The rare *Bunium brevifolium*, Lowe, inhabits the highest mountain slopes, between 5000 and 6000 feet, and springs from an edible tuber, which is much sought for by shepherd boys, like pignuts in our own country.

Bupleurum salicifolium, Lowe, is a shrubby perennial, 2 to 4 feet high.

Melanoselinum decipiens, Schrad. and Wendl., is one of the noblest of its tribe, with tall, simple, palm-like, slender stem, and terminal umbrella-like tufted head. It is sometimes 10 to 12 feet high, and represents a group of arborescent Umbelliferæ. Some time ago it was introduced into European gardens, but for long its true native country remained unascertained. It is now known to be strictly indigenous to Madeira.

Among the *Compositæ*, our attention is at once drawn to *Sonchus squarrosus*, or *fruticosus* of L. fil., a magnificent representative of its genus, subarborescent and gigantic in all its parts. It adorns wet perpendicular rocks in the ravines of the interior, and is from 4 to 12 feet high, with a trunk as thick as the arm, the flowers being like those of the common dandelion. The plant is perennial, and flourishes in English gardens if taken under glass for the winter.

The other two species of *Sonchus*, viz., *pinnatus* and *ustulatus*, are also worthy of attention.

Cynara horrida is well named, as it is a most formidable plant, and is very difficult to press.

There are three beautiful species of *Helichrysum*, one of which, *H. Monizii*, is worthy of special note. The plant is snowy-tomentose, with a profusion of golden heads, and inhabits sea-cliffs and the rocky sides of ravines near the sea. A gigantic black basaltic headland, nearly 2000 feet high, called Cape Giram, has its steep sides adorned with great masses of this plant, which, when agitated or waving in the wind, add greatly to the impressiveness of the scenery.

The *Campanulaceæ* contain two splendid plants—*Musschia aurea* and *Musschia Wollastoni*.

Among the *Ericaceæ* we find *Vaccinium maderensis*, the Madeira bilberry, which forms close thickets of vast extent in all the upper parts of the island between 2000 and 5000 feet, and whose foliage turns into most brilliant crimson tints of every shade, imparting to the hillsides quite a gorgeous appearance: but chiefly we shall mark the *Clethra arborea*, found in woods everywhere in the uplands of the interior, first introduced into England in 1784, and growing, I believe, at the present time in the Botanical Gardens. The native name for *Clethra* is "Folhado," and its wood being light and strong, is in great request for hammock poles and such uses.

The *Boraginaceæ* furnish two remarkably fine and strong species of *Echium*, both of which adorn the sea cliffs in spring—viz., *candicans* or *fastuosum*, "The Pride of Madeira," and *nervosum*, less showy.

In the *Solanaceæ* I take particular interest, as to it belongs the genus which Mr Lowe did me the honour to name after myself. But I was never fortunate enough to find *Normania triphylla*, and the specimen I have came from the Lowe Herbarium, which, as I have mentioned, is at Kew.

Among the *Scrophulariaceæ* I would ask your particular attention to *Isoplexis sceptrum*, one of the handsomest but one of the rarest of mountain treasures. To find it one must penetrate the recesses of the most remote and sometimes difficult and dangerous ravines. It is a shrub with large Gloxinia-like corollas of an orange colour, striped with brown.

There is a common and pretty *Sibthorpia peregrina*, in shape and habit resembling *S. europæa*, but much larger.

Among the *Labiatæ*, *Thymus micans* glitters profusely with odoriferous glands, but is abundant only in three or four hill localities—not universally diffused, like our Scottish wild thyme.

Sideritis Massoniana is a hoary, velvety Labiate, common enough in ravines. I cannot find a notice of it in any of my botanical dictionaries as being known here. Before leaving the *Labiatæ*, which supplies no less than ten to our list of peculiar plants, let me mention that there are three handsome species of *Teucrium*.

Plumbaginaceæ shows *Armeria maderensis*, Madeira thrift, which is found only about the highest peaks, among the rocks of which it is a great ornament.

Polygonaceæ.—*Rumex maderensis*, the Madeira sorrel, is very common in the hill region; it is generally glaucous, and has showy fruit panicles.

Urticaceæ.—*Parietaria gracilis*, Lowe, is a delicate and uncommon representative of its genus.

As in Britain, so in Madeira, *Dioscoreaceæ* has only one plant, *Tamus edulis*, Lowe, which is very rare and very graceful.

Of the *Smilacineæ*, *Smilax pendulina* is a common plant, climbing by its stipular tendrils.

Goodyera macrophylla is one of the very few native representatives of the *Orchidaceæ*, which I was never fortunate enough to come across. *Orchis foliosa* is common enough.

Among *Liliaceæ* there is *Asparagus scaber*, while the *Juncaceæ* supply two forms of *Luzula*—one of them, *elegans*, being remarkably pretty and graceful.

The order *Cyperaceæ* has three or four uninteresting and doubtfully peculiar sedges.

Gramineæ.—There are three or four peculiar grasses.

Phragmites congesta, or Madeira sea-reed, and *Deschampsia argentea*, or silken hair grass, are the most noticeable. Of three handsome species of *Festuca*, two are found on the highest peaks.

Filices.—As already mentioned, there are three peculiar ferns, viz., *Polypodium drepanum*, *Aspidium or Polystichum falcinellum*, and *Polystichum frondosum*.

One species of *Lycopodium* (*suberectum*, Lowe) formerly ranked as peculiar.

On the Movement of Water in Plants. By G. F. SCOTT ELLIOT, M.A., B.Sc.

(Read 14th July 1887.)

There has been more discussion on the subject of the ascent of crude sap in the living plant than on almost any other botanical problem, and the literature is correspondingly large. I have intentionally confined myself to the more recent observations, and I have to thank Professor Dickson, Dr Macfarlane, and Mr John Rattray for the very kind assistance they have given me in this respect.

The question naturally falls under two heads. First, the path by which the sap ascends; and, secondly, the moving causes. The first of these questions is regarded by most German and French botanists as practically decided, but as Mr Vines (1), in his recent work on the physiology of plants, has dismissed their view in small type of a short paragraph, it may be of service to bring some of the evidence together.

The older view of Sachs (2) and Unger that the water travels *in the walls* of the lignified vessels, and not in their cavities, rests mainly on the supposed fact that these vessels contain air and not water. It was for exactly the same reason that arteries were long supposed to conduct air and not blood; and there seems to be as little foundation in both cases. Von Höhnel (3) showed long ago that the cavities of the vessels were *not* in communication with the intercellular spaces or stomata. Moreover, the same observer, as well as Scheit (4), Boehm (5), and Russow * (6), have shown that cell-walls, when wet, are practically impervious to air. Scheit (4), for instance, was unable, even with a pressure of 120 cm. of mercury, to expel air from a piece of the stem of *Abies balsamea*.† There is no evidence to show that the air can enter by the roots. There is therefore some difficulty in understanding how the air can enter the vessels except accidentally.

Sachs lays stress on the fact that freshly-cut wood floats

* See also Weisner, *Sitz. d. k. Akad. d. Wiss.*, Abt. i., 1879; Schwendener, *Schutzscheiden*, Berlin, 1882.

† Klebahn's (7) experiments can only be held to prove the existence of air in intercellular spaces.

on the surface of the water, only sinking when the contained air was driven out by water. He does not, however, take into consideration the possible entrance of atmospheric air at the section surface. I tried the experiment with the addition of cutting in every case two pieces of wood;—one of these was cut under water to exclude atmospheric air, the other cut in the usual way and then dropped into water. I found in many cases that both twigs sank. In two cases, however, I found that the twig cut under water never rose to the surface, while the one cut in the air floated. The difference in these cases was therefore clearly due to the entrance of atmospheric air. This experiment, however, is far too rough to be worth working out, for, as Sanio (8) points out, air in the intercellular spaces would account for the floating. Sachs' experiments cannot therefore be regarded as conclusive.

Direct experiments by cutting sections of wood under oil or glycerine,—Hartig (9), Elfving (10)—particularly if conducted with specially constructed apparatus,—Volkens (11), Schwendener (12),—certainly appear to show that there are bubbles of air in the vessels and tracheids. Scheit (4) maintains that these bubbles are not air-bubbles, but simply empty spaces, because in glycerine these cavities quickly disappeared. This last view requires confirmation, but the presence of air does not show that there is no water. Hartig (9) gives the proportion of air and water as varying from one volume air to three volumes of water to from nine volumes to ten volumes water; Schwendener (12) gives air 0·33 mm., water 0·19 mm. in the vessels.

Most observers—Hartig (9), Von Höhnel (3), Boehm (5), Volkens (11)—seem to think that the vessels and tracheids are full of water at night, and that it is only during the day, at the time of most active transpiration, that air enters (according to Scheit (4) the vessels are emptied). The air is also at an extremely low tension. Boehm (5) found that if a twig of *Robinia* is cut under mercury, the mercury rises in the vessels to a height of 116 cmm.; *cf.* also Von Höhnel (3). Vesque (13) found in one or two cases that the contained air was at a pressure equal to that of the atmosphere; but in his experiments it is not easy to see how the air in the intercellular spaces can be distinguished from that in the vessels. No one supposes that water is ever entirely absent from the vessels.

There are also some anatomical objections to the view of Sachs. Sachs acknowledged that in some Monocotyledons and Dicotyledons, there is not enough lignified tissue in the bundles to conduct the water, and suggested that as sclerenchyma resembles true wood, it probably conducts the water to some extent in its walls. This, however, is not the case. Elfving (10) tested this view with the stem of *Chamædorea*. He covered the section of the stem with paraffin, and then removed this paraffin first *from the peripheral sclerenchyma*, in which case no water passed through (even with a pressure of 120 cm. Hg.), then *from the vessels*, and found that water passed through abundantly.

Moreover, Russow (6) pointed out that in that part of the haulm of grasses which is protected by the leaf there is practically no lignified or sclerenchymatous tissue at all, and the water certainly travels through it.

There are also other objections. First, on Sachs' view there is no known reason why the water travelling in the wood walls should not pass with equal ease in every direction. Elfving (10) and Boehm (5), however, found that it is quite easy to force water through pieces of coniferous wood cut tangentially, and impossible to force it through pieces cut in the radial direction. As the disc thickenings are on the radial walls only, this is what one would expect if the water travels by the lumina.

The method of causing the roots or cut surfaces of plants to suck up coloured solutions has been very largely used (*e.g.*, La Baisse, in 1733; Reichel, in 1758; and Herbert Spencer (14), in 1866). The substances used are very different. Professor MacNab (15) (see *Transactions* of this Society), used lithium salts. Van Tieghem (16) used either fuchsin or a double treatment—first with potassium cyanide, then with ferrous sulphate. The best substance, however, appears to be eosin,—Darwin and Phillips (17).

Sachs himself used this method, but considers it unsatisfactory, as the salt may not travel as rapidly as the water. He uses, however, an identical method—viz., non-passage of cinnabar particles, to show that coniferous cells are not in open communication for water. Van Tieghem ignores Sachs' view, on the ground that if you cut a plant close to the root you can see, on rapidly applying blotting-paper to the section, water oozing out of the section. All who have used this method are against Sachs' view. Elfving (10) gives what is tantamount to a direct proof of its incorrectness. Eosin stains some substance in the cell-walls of coniferous wood, as can easily be seen in a transverse section; but if a branch of *Taxus* is made to suck up coloured solutions, *the walls are not coloured*, according to Elfving, while the cavities are full of eosin.

There are also some indirect ways of getting at the truth. Sachs and Dufour (18), and latterly Darwin and Phillips (17), tried the effect of making incisions in the stems. The latter observers made two incisions, each as far as the pith on opposite sides, and some distance apart. They found that in Helianthus (where such treatment would cut almost all the vessels) the transpiration was greatly diminished; while in Taxus, where continuity by the tracheids would not be affected, there was practically no difference.

The same observers (17) and also Kohl (18) and Vesque (13), have found that when a stem is strongly squeezed together in such a way that the cavities of the vessels may be considered obliterated, no water can pass through; though, on Sachs' view, it is quite possible.

Another method, on which Sachs appears to rely, has been adopted (at Würzburg) by Dufour (18). If a twig is bent at a very sharp angle, Dufour found that transpiration is not stopped. He considered that in this twig the vessel cavities must be closed, as he could not inject twigs bent in this way when separated from the tree. This conclusion is quite fallacious, however. Russow (6) clearly shows that the cavity of the vessels in this case is not closed, and Scheit (4) has shown that if Dufour had cut the bent twigs under water they could have been injected; see also Vesque (13).

A very ingenious proof is given by Weber (20), who found that vessels whose walls were apparently changed by heat into a gummy substance still continued to conduct water.

Some remarkably conclusive experiments of Elfving (10) appear to me to prove the point. His method consisted in closing or rather filling up the cavities of the vessels by melted coco-butter injected by the cut surface. The lumina being filled and the fat hardened, he cut a thin section from the cut surface, to take away the ends of the cell-walls which might be affected by the fat, and he then attempted to force water through. This was in every case impossible. On Sachs' view there is no reason why the water should not travel by the walls. His experiments have been repeated, always confirmed, and made absolutely free from all objection by Scheit (4), Vesque (13), and specially by Errera (21), who used a mixture of 40 per cent. gelatine instead of coco-butter. It seems to me one must conclude from this evidence that the crude sap travels in the cavities of the vessels.

Now, with regard to the forces employed, Sachs, followed by Pfeffer (22), considers that it is the force of *imbibition*, a force quite different from capillarity, which causes the water to mount in the cell-walls. We have scarcely the right to assume that imbibition is different from capillarity; *cf.* Haberlandt (23). Moreover, I fail to see how the water can easily move upwards through imbibition, and at the same time be strongly held in the walls through the same force. Also, the water does not travel in the walls. The theories held by other observers are almost as numerous as the observers.

It is best to classify them according to the forces supposed to be effective. The first force, which certainly has great influence, is *osmosis*. There are two different ways in which this acts. Namely, the *osmosis* of the cells of the root, or *root pressure*, and the *osmosis* of all the cells of the stem and leaf which a vessel supplies. First, as to root-pressure. Von Höhnel and Scheit (4) consider that it is the only force in action. This is, however, probably doubtful, as most observers do not consider that the root-pressure could lift the water to a greater height than six metres. There is, however, so much variation in the measurements given for the root-pressure that one must take all such figures with great reserve. Leclerc du Sablon (25), for instance, found a difference of 180 mm. in manometers only 8 or 10 cm. apart on the same tree. There is no doubt, however, that it has some influence.

The importance of the osmosis of the cells of the leaf and stem was first pointed out by Westermaier (24). The following experiment is worth giving to show the effect:—A circular disc of 6 mm. radius was cut out of a leaf of Peperomia. This was placed in a salt-solution, and weights were placed on the upper surface. He was able to place a considerable weight on the upper surface without producing subsidence of the epidermis cells. From this he calculated that a whole leaf could lift 180 kg. a short distance. This is the only attempt at exact measurement of this force that I know, but if we consider the number of living cells that a vessel encounters on its course from the root to the leaf, we must consider it as probably the most important agent in the ascent of water.

Capillarity would be, according to Scheit (4), able to raise the water to a height of 1·25 to 1·69 m. Vesque (13) gives, on the other hand, ten metres. But there are three distinct theories as to the contents of the vessels and tracheids, which would modify the action of capillarity. First, Scheit holds that the vessels are full of water-vapour during the day, and at night contain water. Secondly, Vesque (13) and Elfving (10) hold that the vessels contain air-bubbles, which are suspended in water (not touching the sides of the vessels). Thirdly, Boehm holds that the air-bubbles are in contact with the sides of the vessels. Taking Scheit's view first, it must be remembered that the main loss of water occurs during the day. Van Tieghem (26) gives the loss of water by the evaporation due to the action of chlorophyll "chlorovaporisation" as 168 g. to every 2 g. produced by the ordinary evaporation, which takes place both day and night. If we imagine a vessel filled during the night with water, and suppose that as the water evaporates, the empty space is filled with water-vapour, there is no difficulty in seeing that the process of emptying can go on, the continuity from the leaf to the root being kept up by the water-vapour; but the difficulty consists in seeing how the vessel is filled up with water at night, and here Scheit gives no assistance, and we are obliged to take capillarity and root-pressure alone, and these two forces appear to be insufficient.

Secondly, if the air-bubbles are supposed to be floating freely in a vessel full of water, and if we suppose that capillarity can raise a column of water to a height of 10 metres, and that the amount of air is equal to the amount of water, then in this vessel capillarity can raise the water to a height of 20 metres, because the water is exactly half as heavy on account of its contained air-bubbles. And if we take Hartig's figures, nine volumes of air to ten of water, there is no difficulty in seeing why water should not rise to as great heights as are found in nature. If, on the other hand, the air-bubbles are in contact with the walls of the vessel, their presence is simply an obstruction, and the water will have to get round them by the neighbouring cells. Boehm's view that the relative tensions of such air-bubbles assists in the elevation of water has been disproved by Zimmermann (27). The surface tension of every bubble must be a resistance in addition, and the resistance must therefore depend on the number of air-bubbles of Zimmermann (27).

The difficulty of the question is that the premises, namely, the contents of the vessel, at all times of the day, are quite unknown. If we assume that the second view of Vesque and Elfving is correct, we can say that the water rises through the following forces:—first, osmosis (*absorbent activity of Vines*), both of the cells of the leaf and root; and, secondly, capillarity; possibly the pressure of the atmosphere may be set down as a third force (Vesque), but we have no data to show what the several influences of these forces may be, and must keep the conclusions open till the premises are satisfactorily settled.

Literature.

(1) Vines, *Physiology of Plants*, Cambridge, 1887.
(2) Sachs, *Physiology*, Eng. ed., 1887.
(3) Von Höhnel, *Botan. Zeit.*, 1879.
(4) Scheit, *Jena. Zeit.*, Bd. xviii. and Bd. xix.; also *Botan. Zeit.*, 1884, p. 175.
(5) Boehm, *Botan. Zeit.*, 1879; also 1881 and 1886.
(6) Russow, *Bot. Centralblatt*, Bd. xiii. p. 29.
(7) Klebahn, *Ber. d. deut. Bot. Ges.*, 1883, p. 113.
(8) Sanio, *Botan. Central.*, Bd. xxii. p. 75.
(9) R. Hartig, *Botan. Zeit.*, 1883.
(10) Elfving, *Botan. Zeit.*, 1882, p. 707; also *Bot. Centralblatt*, xxi. p. 263.
(11) Volkens, *Inaug. Dissn.*, Berlin, 1882.
(12) Schwendener, *Sitz. d. Kon. Preuss. Akad.*, Bd. xxxiv., 1886; see *Bot. Centralblatt*, Bd. xxx. p. 232.
(13) Vesque, *Ann. d. Sci. Nat.*, 1884, p. 159.
(14) Herbert Spencer, *Trans. Linn. Soc.*, 1866, p. 104.
(15) M'Nab, *Trans. Bot. Soc. Edin.*, 1871.

(16) Van Tieghem, *Ann. d. Sci. Nat.*, 1871, p. 298; also Text-book, p. 804.
(17) Darwin and Phillips, *Proc. Cam. Philos. Soc.*, vol. v. pt. v.
(18) Kohl, *Die. Trans. d. Pflanz.*, Brunswick, 1886.
(19) Dufour, *Arb. d. Bot. Inst. Wurzburg*, 1883.
(20) Weber, *Ber. d. deut. Bot. Ges.*, Bd. iii., 1885.
(21) Errera, *Bull. Soc. Roy. d. Belg.*, 1886.
(22) Pfeffer, *Physiolog. Pflanzen*, Bd. i. p. 127.
(23) Haberlandt, *Physiolog. Pflanzen Anat.*, Leipzig, 1884.
(24) Westermaier, *Ber. d. deut. Bot. Ges.*, 1883, p. 371.
(25) Leclerc du Sablon, *Bull. Soc. Bot. d. la France*, viii., 1886, p. 208.
(26) Van Tieghem, *Bull. Bot. d. la France*, viii., 1886, p. 132.
(27) Zimmermann, *Ber. d. deut. Bot. Ges.*, 1883.

Facts regarding the Morphology and Affinities of certain Genera of the Order Scrophulariaceæ. By P. Sewell.

(Read 14th July 1887.)

Systematists have noticed with considerable detail the different modifications in the flowers of Scrophulariads, and made use of such for the purpose of distinguishing one genus from another. They have, indeed, rather attempted to detect differences than to see resemblances.

In this way they have somewhat overlooked the *natural series* of such modifications which afford the most important evidence of relationship and common ancestry.

The following notes instance a few of these series which have come under my notice in an attempt to determine the relationships of certain genera of Scrophulariaceæ.

In regard to the *gynœcium*, we may notice that fewer ovules occur in *Veronica* than in the less specialised genera of the order. This reduction, entirely in keeping with the condition of the calyx and corolla, serves as one of many examples that might be brought forward to show that reduction is an almost constant concomitant of specialisation.

A feature of very considerable interest has been observed and shown by Mr W. E. Fothergill in regard to the placentation. In young ovaries of *Digitalis*, he noticed that instead of an axile placentation towards the apex, it was very often parietal—suggesting the similar series of modifications in Saxifrageæ. In *Datura*, also, the four cells are at times not apparent near the apex of the ovary, where, owing to the cessation of growth in two of the septa, the ovary appears two-celled. These cases suggest the origin of axile from parietal placentæ, and though requiring further support from other similar orders, they seem to emphasise more clearly the affinities of Scrophulariaceæ with such orders as Gesneraceæ, where the two parietal placentæ yet remain constant.

In regard to the *stamens*, we may remark that their didynamous condition is directly the outcome of the bilabiate form of the corolla, both of which modifications secure the better fertilisation of the flower.

We may select genera, however, which retain the fifth posterior stamen found in the allied order Solanaceæ, as *Verbascum;* others which show, as *Scrophularia,* its presence at times as a fertile stamen, at times as a staminode, or it may be entirely absent.

Other genera show in addition the partial suppression of the anterior stamens—*Gratiola*, perhaps, in as interesting a manner as any—inasmuch as it serves as a link to the condition in *Veronica*, where all trace of other than the lateral ones has disappeared.

Müller * has pointed out that where the stamens are collected to the upper part of the flower, the missing stamen is rudimentary, or altogether absent, apparently making room for the style, which protrudes above the anthers. Where the stamens are not so collected in the upper lip, as in Scrophularia, an evident staminode, or even perfect stamen, may be found; in such a case Müller shows it will not be in the way. He therefore considers that the disappearance of the posterior stamen is to be accounted for by the natural selection of those forms which are fertilised the most readily, as above shown.

It would at first sight appear that the abortion of one stamen rather than another might be accounted for, not by natural selection, but by reason of the unequal growth in the development of the parts of the flower. The results of this inequality of growth during development are very clearly seen in *Pinguicula*, where, as Professor Dickson has pointed out, the growth is from the anterior to the posterior, and where the missing posterior stamen is thus the last to be developed; whilst, if developed at all, the two lateral appear only as staminodes.

* *Fertilisation of Flowers*, p. 434.

But that this inequality of growth throughout the parts of the flower does not account for the disappearance of the stamens in the majority of cases is evident when we notice that the posterior stamen in most Scrophulariaceæ (as in Labiatæ) is on that side of the flower which develops first; the growth in most genera, as Payer has pointed out,* being from the posterior to the anterior.

Payer, in his *Organogénie* has noticed it as a remarkable thing, that whereas the growth in most flowers of the order is thus from the posterior to the anterior, the lateral stamens should be smaller than the anterior, and he further expresses surprise that the lower petal in *Veronica*, the first to develop, should be smaller than the upper, which is the last. It is therefore evident that this unequal growth in the developing flowers is not the chief cause, but that certain of the stamens, especially in asymmetrical or bilabiate flowers, are of more advantage than others, and therefore are developed with the greatest certainty in the struggle for development, which struggle is present, though on so small a scale, as surely among the parts of the flower as elsewhere.

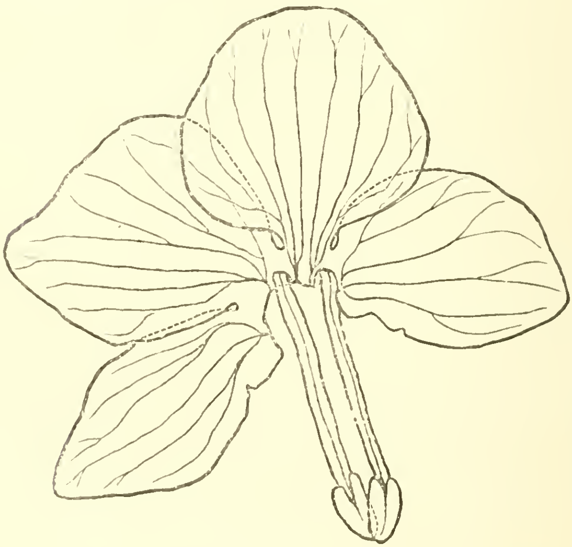
The *corolla* affords much material for careful comparative study, but it is to be doubted whether its modifications of form can be regarded as indicating very definitely lines of relationship among the genera. Being the attractive part of the flower, it is most likely to be specialised, and this is seen remarkably in *Schizanthus* and *Collinsia*, where modifications exist to aid in fertilisation, which remind one of those which occur in *Cytisus*. Minor points may be made out, however, as, for instance, where a small pouching in *Antirrhinum*, which aids in fertilisation, may be connected with the more or less conspicuous spurs in the different species of *Linaria*. Again, in *Verbascum*, which is now recognised as the link between this order and Solanaceæ, there is to be observed a tendency to irregularity where the two upper petals are generally smaller than the three lower. This irregularity in tube or limb becomes more and more pronounced in *Digitalis* and *Mimulus*, until finally it reaches a climax in the firmly shut lips of the personate limb of *Antirrhinum* and some species of *Linaria*.

* *Traité d'organogénie comparée de la fleur.*

Perhaps the most noticeable divergence from the normal bilabiate condition common throughout the order is the four-parted condition in *Veronica*.

This has been held by most of the older botanists as an ordinary case of tetramerous construction.

Indeed, most recent systematists mention the occurrence of 4 or 5 lobes in the corolla for the purpose of cataloguing the genera. Payer, Henfrey, and others have shown how this condition is brought about, namely, by the union of the two upper petals into one, and by the suppression of a sepal; by this is shown the true relationship of *Veronica* to the rest of the order.



Corolla of *Veronica Buxbaumii*, showing two bundles in upper petal. (The stamens are bent forward.)

Payer* made, in connection with the variably pentamerous or tetramerous condition in *Limosella*, the generalisation that apparently tetramerous flowers have evidently resulted from pentamerous types where they occur with sepals arranged *diagonally* to the axis, not orthogonally, as in Cruciferæ and Onagraceæ.

After finding this conclusion of Payer's, I made some examination of a limited number of species of *Veronica*, that

* "Scrophulariaceæ," *Familles Naturelles.*

I might obtain evidence in support of the conception otherwise hinted at that it is virtually a pentamerous flower, which has become specialised into its present condition.

I found that in many species two bundles, or nerves, passed into the upper petal, whilst each of the other petals had the normal single bundle entering from the axis.

Even an isolated instance of this would be very suggestive as to the union of two petals into one; but, although not by any means always present, the two bundles are so constantly in the upper petal in different species as not to allow of any other explanation.

Of the species I have examined they are both present in—

V. Buxbaumii.	*V. gentianoides.*	*V. pinguifolia.*
V. rupestris.	*V. spicata.*	*V. Bendusoni.*

They, however, do not occur in the specimens of *V. Lyalli*, *V. maritima*, *V. longifolia*, which I examined, but it is very probable that complete union of the two bundles has taken place, this having been observed as by no means an uncommon occurrence in other cases.

Monstrous flowers of *Veronica* often occur in which there are five petals. This I have noticed in *V. glauco-cœrulea*, *Veronica spicata*, and in a few other species. Also, Payer mentions that it is normal for *Veronica Teucrium* to have five sepals.

Since making the above examination in regard to *Veronica*, my attention has been called to a paper by A. Braun,* in which he mentions *Veronica*, among many other plants, as an example of an apparently tetramerous condition resulting from a pentamerous.

Comparison of the condition of calyx and corolla in *Veronica*, thus established as falsely tetramerous, with the condition of the outer floral whorls in less closely allied genera reveals the interesting fact that *Buddleia* (placed by some botanists in Loganiaceæ), *Lathræa*, and *Plantago* exhibit with their apparent tetramery the diagonal arrangement of the sepals.

Other points of resemblance among these genera are emphasised by this fact, and *Plantago* may be referred to as illustrating the fact that this relationship should be taken account of in systematic works. Prantl† has asserted, on the

* "Uber Pseudotetramere Blüthen," *Bot. Zeit.*, 1875.

† Prantl and Vine's *Textbook*, p. 266.

resemblance to *Veronica,* that the upper petal in *Plantago* must be regarded as the result of the union of two; but the nervation in this case does not come to our aid, as the veins are almost entirely wanting in the membranous petals.

If, then, we regard Plantaginaceæ as thus related to Scrophulariaceæ, they should be grouped together, as indeed is the case in the rough classification by Goebel.

On the contrary, Sir Joseph Hooker, in his appendix to "Le Maout and Decaisne," has placed the order Plantaginaceæ apart as an anomalous order of Series II.

This might perhaps be allowed in an artificial classification, but it is not warranted, in view of those affinities, in a professedly *natural* arrangement, and this is only one example out of many which might be given showing that the accepted principles of evolution must enter more largely as a factor into the work of systematic arrangement.

The tendency to union of the parts of the corolla is seen throughout the order. For instance, *Digitalis* has the two petals of the upper lobe barely distinguished, whilst at the same time its fifth and upper sepal is always smaller than the other four, suggesting its probable elimination in the future. *Gratiola* similarly has but a very slight notch in its upper lip to show the two petals of which it is composed.

The genus *Calceolaria,* however, offers an exception to the general rule which is laid down by Payer in regard to diagonally arranged sepals occurring in pseudotetramerous flowers, in that it has its sepals placed orthogonally. For it is not likely that the genus, agreeing in other particulars so closely with the mass of the order, is much less nearly related than is *Veronica;* how then has modification been brought about from an assumed pentamerous form?

In the corolla of some of the cultivated species, I found very clearly five bundles passing out from the axis—two in the upper lip, three in the lower, much as in *Utricularia.*

At times a sport occurs in the lower lobe of the corolla, which seems to indicate a fifth petal, inasmuch as a spur projects from the median nerve in the normal pouching of the lower lip.

In several South American species, however, I do not find more than four bundles, and in some cases so considerable is the union among the branchings of these bundles that it is nearly impossible to distinguish at what point they enter the axis. In extreme cases the united bundles form a complete fibrous ring at the base of the corolla. I believe that usually, if not always, the bundles passing into the corolla are the same as the commissural bundles observable in the calyx. Hence, if the calyx is normally 4-lobed, the bundles supplying the corolla will be four, alternating with the median bundles in the sepals.

Yet in certain abnormal cases five sepals occur in the calyx—quite as often there are indications of six—inasmuch as when one sepal tends to become bifid, the one opposite to it shows also a bifid character, suggesting unmistakably the modification of an extra pair of the decussate leaves of the stem. I have also found a calyx with seven lobes.

Two explanations as to the usual orthogonal arrangement may be brought forward. One is, that instead of the suppression of a posterior sepal, union of two *anterior* ones has occurred. There is no confirmation of this offered by the nervation in the lower sepals—insertion of another bundle or bifurcation occurring quite as often in a lateral sepal as in the anterior one.

Moreover, suppression of a sepal is the usual form in which reduction takes place in the calyx, and this suggests another explanation, which is borne out by the apparent tetramery in *Pentstemon digitalis,* instanced by Braun in the paper already referred to.

In this case the orthogonal condition may result from the suppression of one of the *anterior* sepals—not the posterior one. This appears likely when it is observed that the staminode, opposite the posterior sepal, remains in the orthogonal condition just as in the pentamerous form ; whilst one of the fertile anterior stamens, and by inference the superposed sepal, has disappeared.

Perhaps the fact that at times a posterior stamen is present in certain species of *Calceolaria* * may be considered as strengthening this latter suggestion.

In any case it is difficult to account for the decision of Braun in reference to the genus, "that *Calceolaria* must be looked upon as a normally tetramerous flower of the order Scrophulariaceæ." How can a plant be normally tetramerous,

* *Vide* Bentham and Hooker's *Genera Plantarum.*

and yet related to a normally pentamerous? There must be some explanation of the transition from one form to the other, and I think that this unusual case of *Pentstemon* instanced by Braun himself serves reasonably to connect the two conditions.

On the Mechanism for Fertilisation in the Flowers of Bolbophyllum Lobbii. By GUSTAV MANN. (Plate III.)

(Read 14th July 1887.)

Bolbophyllum Lobbii was discovered in Java by Mr Thomas Lobb, and was named after him. This orchid is described in the *Botanical Magazine*, No. 4532. The flowers are said to be 4 inches across, yellow, shaded with cinnamon, spotted with light brown, and speckled outside with brown purple; but the flowers of the specimen I saw were not very conspicuous, the diameter being between 2 to 3 inches, while the colour was a dirty yellowish brown, with reddish-brown spots at the back of the perianth and on the internal surface of the upper part of the column, the latter being yellow near the stigmatic surface, while dirty white towards the prolongation carrying the labellum. The labellum was dirty yellow, but this colour was nearly obscured by a great number of small reddish-brown spots. The superior sepal had a few faint guiding lines of a brownish colour, all directed towards the pollinia. The guiding lines of the lateral petals were a little more distinct, while the two inferior sepals were attached halfway down the column, and exhibited each nine dark-brown guiding lines, which were also directed towards the pollinia and stigmatic surface. The spreading solitary flowers have a pleasant though not very strong smell.

The column (figs. 4 and 7) is prolonged downwards, forming a hook-like structure, at the apex of which is the labellum, and this column consists of the following parts :—

(1) The anther case and pollinia.

(2) Two lateral collar-like expansions, which surround the stigmatic surface.

(3) The stigmatic surface proper.

(4) The hook-shaped prolongation already mentioned.

The anther case is a lid-like structure containing the two pollinia, which in this case have no caudicle or viscid disc, and each of which consists of two parts joined together like the two cotyledons in a bean.

The two lateral collar-like expansions are the two stamens of the inner whorl. This can be easily proved by making a transverse section of the column about the region of the stigma, when one finds, first of all, one bundle trace which belongs to the fertile stamen and two lateral traces belonging to the staminodes. The spiral vessels of the lateral traces are in the same position as the missing stamens of the inner whorl.

The stigmatic surface (fig. 7, *s*) in the newly expanded flower consists of a deep depression, at the basal margin of which is the viscid matter in the shape of two protruding drops, lying close side by side. In the upper half of the depression, two yet deeper depressions are to be seen, and these form the stigma proper. The two depressions are either for the two pollinia—but this, however, I don't consider likely, because the pollinia are removed singly—or for the two halves of one pollinium, which seems to be the right explanation, as will be shown afterwards.

The viscid matter is of great toughness, so that it is possible in rather old flowers to draw out threads 6 to 7 inches long. After the flower has been open for two or three days the viscid matter loses its drop-like appearance, and fills up the whole depression between the two collar-like expansions.

The hook-shaped prolongation of the column consists of the petiole of the inferior petal, and the filaments of the two remaining stamens of the outer whorl.

The heart-shaped labellum is fixed to the column by a thin neck (figs. 8 and 9), much compressed in the antero-posterior direction, and freely movable, only, however, from the horizontal position into a more or less vertical one. The thicker but short bilobed basal portion is directed towards the centre of the flower, while the apex hangs out as a tongue-like projection. The labellum is curved, more or less, like a half moon; the superior surface being hollowed out from side to side, and so distinctly concave. On the superior surface of the labellum near the base are three yellow spots; one larger than the others is situated in the middle line above and a little anterior to the junction of the labellum and the column, and the other two at the inner side of the posterior lobes.

With regard to the anatomical structure of the column and labellum, the hook-like process of the column consists of ordinary rounded parenchymatous cells, some of them containing acicular crystals, and embedded in them are three tracts of spiral vessels. The cells become smaller and smaller towards the point of junction with the labellum, while the epidermal cells also become smaller; but they soon broaden out again in the labellum, and some of them have protuberances which further on get elongated, and the cells become stellate as in the Rush (fig. 3). It is also possible, as Mr Scott Elliot pointed out to me, to distinguish that the main axis of these cells are arranged parallel to the long.axis of the labellum, that is to say, that if we would draw lines through the main axis of these cells, we would get lines radiating from a common point near the attachment of the column to the labellum. From the main axis of these cells there are from three to five projecting arms joining one cell with another.

The epidermis of the labellum also exhibits a very remarkable structure. The epidermal cells which are next the column have a corrugated appearance, the highest point of the cells being in the middle; but as one travels towards the apex, one finds the highest points of the cells becoming shifted more and more forward, until in the region of the larger yellow spot they come to form distinct bulgings pointing towards the apex of the labellum.

In general appearance these cells (fig. 2) strongly resemble those on the under surface of the lid of *Cephalotus*, the cuticle showing a striped appearance, the cells of one transverse row alternating with those of the next row. About the middle of the labellum, however, these downward-directed bulgings become less marked and less striped, while at the same time peculiar pit-like depressions make their appearance; these pits are directed upwards, and are formed in the following way:—

The epidermal cells alternate as already stated; now we have, say, between two cells of the upper row a cell of the lower row. The end of this cell, which is next the centre of the flower, is depressed or concave, while the other end projects slightly outwards, and is convex, forming the bulging, but in a less marked degree. The two halves of the upper cell roof over the concave depressed part of the lower cell, and thus a pit is formed, with its cavity directed towards the centre of the flower. Sometimes, however, three upper cells correspond to one large cell below, and in this way we get a pit formed with two points directed upwards. The nearer we come to the apex of the labellum, the deeper are these pits, and in a preparation made by maceration of the epidermis with subsequent staining in anilin purple, these pits took up the colour, and had very much the appearance of upward-directed hairs, and it was only by making a vertical section through the labellum that I was able to make out the real structure.

At the yellow spots, already referred to, the cells contain a bright yellow colouring matter in the form of numerous granules. It is worth noting that the other cells of the labellum also contain this substance, but comparatively only few granules are to be found. Between the three yellow spots there is a tract of small oblong, delicately walled, slightly corrugated cells (fig. 1). The function of these I will afterwards return to. The cells on the under surface of the labellum also protrude, but only slightly, and not so much as those on the upper surface.

Now, I may state the function which those different parts perform in the fertilisation of the flower. Darwin mentions in his work on the Fertilisation of Orchids *Bolbophyllum cupreum*, *B. cocoinum*, *B. rhizophoræ*, and *B. barbigerum;* and he states that in *B. rhizophoræ* two pollen masses are fully exposed, and are attached by viscid matter, and that both are removed at the same time, and that in the same plant the stigmatic chamber, which is very deep, is fitted exactly by one of the two pollen masses. He states also that the sides of the oval orifice of the stigmatic chamber slope in after fertilisation, and so close the orifice completely, a fact which he did not observe in any other Orchid, and which he presumes is related to the exposed condition of the whole flower. Darwin does not specially mention the labellum, and only conjectures that the extreme flexibility of the labellum in *B. rhizophoræ* serves to attract the notice of insects.

When I first saw the flower of *B. Lobbii,* I came to the conclusion that the labellum had to perform the important function of tilting over and throwing the head or thorax of the insect first against the viscid matter, and then the insect would bring by its withdrawal the head in contact with the pollinia, and so remove at least one of them. To make sure, however, I tried the following experiment:—I caught several humble bees, hive-bees, and different kinds of fly, including some blue-bottles, and put them along with the Orchid under a bell-jar, and watched them. For the first two hours the insects were rather excited, but after that they became quiet, and a hive-bee entered the flower first. It alighted on the labellum, and then moved towards the base of the labellum until its thorax came to the region of the first yellow spot, when suddenly the labellum tilted up, and the bee was thrown with the back part of the head and the thorax against the viscid matter, and by crawling backwards its head moved the anther case. I did not see the pollen masses removed, however, for I had used them for fertilising another flower in which the pollinia had been defective. The blue-bottle came next, alighted in the same way, and when it put out its proboscis to try whether the yellow spot contained something sweet, the labellum lost its balance, and came into a vertical position; this seemed to frighten the blue-bottle, and it quickly crawled backwards.

The stellate hairs of the labellum give it a certain strength, combined with lightness. The yellow colour of the three spots serves to draw the attention of insects to this particular place, and why we shall see shortly. While the epidermal bulgings at the same time prevent the insect from slipping, when the labellum is in a vertical position, in order to give the insect a sure foothold, the pit-like depressions are developed towards the apex of the labellum. It must be remembered that the claws of the two posterior pairs of an insect's legs are directed backwards, and being curved, will naturally go into the pits and help the insect to crawl back till the heavier parts of its body are outside the yellow spot in the middle line of the labellum, when, of course, the labellum will fall back into its horizontal position, and the pits being now directed upwards, the insect will have no difficulty in withdrawing its claws, and may fly to the next flower, where the same thing will happen over again, only with the difference that now one pollinium—or may be both pollinia—is pressed into the viscid matter of the stigma, and so fertilises the flower, while at the same time new viscid matter and the pollinia of the second flower will be attached to the insect's head.

There is no nectary in this flower, and it is my opinion that, just as in the common English Orchids the cells of the spur contain a viscid matter which is sought after by insects, so in *B. Lobbii* the thin-walled cells, already alluded to (fig. 1), between the three yellow spots, contain a viscid substance which serves to attract insects; and this is still more probable from the fact that in another species whose name I have not been able to make out, certain cells are to be found at the same spot containing dense matter resembling somewhat the crystalloids in the leaf of *Ficus indica*, along with a red colouring matter; a portion of a section containing these bodies became yellowish brown when I tested by boiling in Fehling's solution.

In one flower which I had fertilised by bringing both pollinia on the stigmatic surface the following changes had after twenty-four hours occurred. The two lateral collar-like portions of the column, which I have already shown to be the filaments of the stamens of the inner whorl, together with the filaments of the fertile stamen, had become much swollen, the filaments of the fertile stamen curve forward to such an extent, that the anther case is carried downward, and the swollen filament shuts in the stigmatic chamber above, and forms the highest part of the column. The two lateral staminodes close in the stigmatic chamber from both sides. It is worth noting that I introduced both pollinia, but during this process of swelling, one of these was pressed out along with much viscid matter; therefore if an insect had introduced both pollinia as I did, the second one would in all probability be pressed out, and would easily be withdrawn should another insect enter the flower. Besides the changes in the column, changes in the perianth also occur: the superior sepal bends forward, and forms a sort of roof over the column, while at the same time the two lateral petals and the inferior sepals approach one another in front in such a way that the labellum becomes fixed in its usual position. The flower becoming in this way tubular, this latter process also takes place independent of fertilisation, when the flower is five or six days old and begins to wither. Even then fertilisation is possible by the insect penetrating deeply into the flower, and on crawling backwards removing viscid matter and the pollinia.

This closed-up condition also obviously protects the flower in a very beautiful way from any kind of injury.

Description of Plate III.

Fig. 1. *a*, thin-walled cells, acting instead of a nectary; *b*, hairs of middle yellow spot.

Fig. 2. Epidermis of labellum near apex, showing the pits. The dotted lines show position of down-directed hairs.

Fig. 3. Stellate tissue of labellum.

Fig. 4. Upper part of column in newly-expanded flower.

Fig. 5. Flower after fertilisation: p^1, outer, p^2, inner, whorl of perianth; *l*, labellum.

Fig. 6. Upper part of column, showing changes after fertilisation: *a*, anther case; *st.f*, fertile stamen; *st*, the staminodes; *v*, viscid matter; *p*, second pollen mass; *c*, column.

Fig. 7. Section of flower, lettering as in fig. 5: *a*, anther case; *v*, viscid matter; *s*, stigmatic surface; *st*, staminode; *c*, column.

Fig. 8. Labellum, from behind: *y.sp*, yellow spots.

Fig. 9. Labellum, viewed sideways.

List of New and Rare Plants presented to the Herbarium of the Royal Botanic Garden. By Arthur Bennett, F.L.S., Croydon, and Symington Grieve, Edinburgh. Communicated by S. Grieve.

(Read 10th March 1887.)

The following plants have all been examined and named by Mr Arthur Bennett, and as they are of considerable interest, are worthy of preservation in the Herbarium at the Royal Botanic Garden:—

Potamogeton prælongus, Wulf., from the island of Rum, has only been previously recorded from Kirkcudbright, in the south-west, and not hitherto in any of the western counties of Scotland. It is common on the east coast.

Carex flava, var. *gaudia* of Gay, from the island of Rum. If this plant is correctly named, this is the first record of it in Scotland. It has only previously been once recorded in Britain, having been collected on Snowdon many years ago. The specimen now exhibited has been compared with the Snowdon specimens preserved in Kew, and while Mr Bennett has little doubt as to its being the same plant, he cannot be perfectly certain, as the fruit is immature. In any case it is a remarkable form of *Carex flava*. Gathered by S. Grieve July 1884.

Cerastium arcticum, Lange, var. *Edmonstonii*, Beeby, grows on Serpentine Hills, Unst, Shetland.

Alsine hirta, var. *foliosa*, Hartm., from Serpentine Hills, Unst.

Luzula maxima, DC., var. *gracilis*, Rostrup, gathered by Mr W. H. Beeby on Saxa Vord Hill, Unst, on 28th July 1886. Appears to be new to Britain.

Psamma baltica, R. & S. The specimen now before you is from Caistor in East Norfolk, which is the second recorded locality for this plant in Britain, and a new station.

Festuca sciuroides, var. *intermedia*, Hächel med., from Mitcham Common, Surrey. Mr Bennett remarks, "a new variety, which appears to be a connecting form between *Festuca sciuroides* and *F. myurus*, L."

List of Hepatics and Mosses collected in the Island of Rum, Hebrides, during July 1884. By Symington Grieve. (Named according to the London Catalogue.)

(Read 13th January 1887.)

The Hepatics and Mosses of which the following is a list were collected at the island of Rum during a short stay I made there early in July 1884. The special object of my visit was to note the phanerogamic flora, but after I had to some extent accomplished the more important part of that work, I was able to pay some attention to the Cryptogams.

As you are all aware, to collect mosses in the month of July made it certain that I would get comparatively poor specimens quite unfit for preservation. However, I felt that if I could get enough of each moss to have it identified, I would be always doing a little towards recording the flora of Rum. Most of the specimens are really so poor, that they are exceedingly difficult to determine. I identified as many as possible myself, but fully half of those now named wanted identification when, a few months since, Mr E. M. Holmes, of the Museum of the Pharmaceutical Society of London, very kindly offered me his aid, and through his efforts the list has now reached its present dimensions. In addition to a number of the mosses, Mr Holmes has named all the Hepatics. Several uncertain mosses were submitted to Dr

Braithwaite, who named all but two, which he returned to Mr Holmes with the remark that they were "*Rum*" mosses when he could not name them.

A few of the mosses are rather interesting, but I will only call your attention to *Campylopus atrovirens,* and to its variety *epilosus,* Braithwaite, which latter does not appear in the London Catalogue of British Mosses for 1881.

With more time at my disposal, I feel sure I could add greatly to this list, as the cryptogamic flora of Rum is rich, and will repay further investigation.

MUSCI.

SPHAGNUM, *Dill.*
- acutifolium, *Ehrh.*
- intermedium, *Hoffm.*
- rigidum, *Schpr.* b. compactum, *Brid.*
- tenellum, *Ehrh.* (*molluscum,* Bruch.)
- cymbifolium, *Ehrh.*

ANDREÆA, *Ehrh.*
- petrophila, *Ehrh.* (*rupestris,* Hedw.) b. acuminata, *Schpr.*
- alpina, *Turn.*
- Rothii, *W. & M.* (*rupestris,* 'L.' Schpr.)

GYMNOSTOMUM, *Hedw.*
- curvirostrum, *Ehrh.*

ANŒCTANGIUM, *Schwg.*
- compactum, *Schl.*

DICRANELLA, *Schpr.*
- squarrosa, *Schrad.*

DICRANUM, *Hedw.*
- scoparium, *L.*
- majus, *Turn.*

CAMPYLOPUS, *Brid.*
- atrovirens, *De Not.* (*longipilus,* p.p.)
- atrovirens, var. *epilosus,* Braithwaite.
- Schwarzii, *Schpr.*
- fragilis, *B. & S.*
- pyriformis, *Brid.* (*turfaceus,* B. & S.)

LEUCOBRYUM, *Hampe.*
- glaucum, *L.*

DIDYMODON, *Hedw.*
- rubellus, *B. & S.*
- cylindricus, *Bruch.*

BARBULA, *Hedw.* (*Tortula.*)
- tortuosa, *L.*

ENCALYPTA, *Schreb.*
- ciliata, *Hedw.*

GRIMMIA, *Ehrh.*
- apocarpa, *L.*
- trichophylla, *Grev.*

RHACOMITRIUM, *Brid.*
- ellipticum, *Turn.*
- aciculare, *L.*
- protensum, *A. Braun.*
- sudeticum, *Funck.* (*microcarpum,* Hedw. p.p.)
- heterostichum, *Hedw.*
  - b. alopecurum, *Bry. Eur.*
  - c. gracilescens, *Bry. Eur.*
- fasciculare, *Schrad.*
- lanuginosum, *Hedw.*
- canescens, *var.* prolixum, vide *Wils., Bry. Brit.*

PTYCHOMITRIUM, *B. & S.*
- polyphyllum, *Dicks.*

AMPHORIDIUM, *Schpr.* (*Zygodon.*)
- Mougeotii, *B. & S.*

ULOTA, *Mohr.* (*Orthotrichum.*) (*Weissia,* Ehrh.)
- phyllantha, *Brid.*

ORTHOTRICHUM, *Hedw.*
- affine, *Schrad.*

SPLACHNUM, *L.*
- sphæricum, *L. fil.*

ENTOSTHODON, *Schwg.*
Templetoni, *Hook.*
PHILONOTIS, *Brid.* (*Bartramia.*)
fontana, *L.*
BREUTELIA, *Schpr.* (*Bartramia.*)
arcuata, *Dicks.*
WEBERA, *Hedw.* (*Bryum*, Dill.)
nutans, *Schreb.*
BRYUM, *Dill.*
inclinatum, *Swartz.*
bimum, *Schreb.*
alpinum, *L.*
pseudo-triquetrum, *Hedw.*
MNIUM, *L.*
undulatum, *Hedw.*
hornum, *L.*
punctatum, *Hedw.*
AULACOMNIUM, *Schwg.*
palustre, *L.*
OLIGOTRICHUM, *DC.*
hercynicum, *Ehrh.* (*incurvum*, Huds.)
POGONATUM, *P. Beauv.*
nanum, *Neck.* (*subrotundum*, Huds.)
urnigerum, *L.*
POLYTRICHUM, *L.*
piliferum, *Schreb.*
commune, *L.*
FISSIDENS, *Hedw.*
adiantoides, *Hedw.*
FONTINALIS, *Dill.*
squamosa, *L.*
HEDWIGIA, *Ehrh.*
ciliata, *Dicks.*
ANTITRICHIA, *Brid.*
curtipendula, *L.*
NECKERA, *Hedw.*
crispa, *L.*
PTERYGOPHYLLUM, *Brid.* (*Hookeria*, Wils.)
lucens, *Sm.*
THUIDIUM, *Schpr.*
tamariscinum, *Hedw.*
THAMNIUM, *Schpr.*
alopecurum, *L.*
ISOTHECIUM, *Brid.*
myurum, *Poll.* (*H. curvatum*, Turn.)
HOMALOTHECIUM, *Schpr.*
sericeum, *L.*
CAMPTOTHECIUM, *Schpr.*
lutescens, *Huds.*
BRACHYTHECIUM, *Schpr.*
albicans, *Neck.*
rutabulum, *L.*
populeum, *Hedw.*
EURHYNCHIUM, *Schpr.*
myosuroides, *L.*
Swartzii, *Turn.* (*prælongum*, Bry. Eur.)
prælongum, *Dill.* (*Stokesii*, Bry. Eur.)
HYOCOMIUM, *Schpr.*
flagellare, *Dicks.* (*H. umbratum*, Sm. E. B.)
RHYNCHOSTEGIUM, *Schpr.*
ruscifolium, *Neck.*
PLAGIOTHECIUM, *Schpr.*
pulchellum, *Hedw.*
denticulatum, *L.* a. aptychus, *Spruce.*
undulatum, *L.*
AMBLYSTEGIUM, *Schpr.*
serpens, *L.*
riparium, *L.*
HYPNUM, *Dill.*
filicinum, *L.*
hamulosum, *B. & S.*
cupressiforme, *L.*
d. ericetorum, *Bry. Eur.* (*compressum*, Wils.)
molluscum, *Hedw.*
palustre, *L.*
cuspidatum, *L.*
Schreberi, *Ehrh.*
purum, *L.*
scorpioides, *L.*
HYLOCOMIUM, *Schpr.*
splendens, *Dill.*
brevirostre, *Ehrh.*
squarrosum, *L.*
b. calvescens, *Wils.*
loreum, *L.*

MARCHANTIACEÆ.

PREISSIA, *Corda* (1829). (*Chomiocarpon*, Scop. 1760.)
commutata, *Ness.* (*C. quadratus*, Scop.)

JUNGERMANNIACEÆ.

FRULLANIA, *Raddi* (1818).
Tamarisci, (*Mich.*) *Dum.*
PLEUROZIA, *Dumortier* (1835). (*Physiotium*, Nees, 1838.)
cochleariformis, *Weiss.* (*J. purpurea*, Lightf. 1777.)
BAZZANIA, *Gray* (1821). (*Mastigobryum*, Nees, 1845.)
tricrenata, (*Wahl.*) *Lindbg.* (*deflexa*, Mart.)
HERBERTA, *Gray* (1821). (*Schisma*, Dum. 1823.)
adunca, *Dicks.*
ANTHELIA, *Dumort.* (1835). (*Chandonanthus*, *Mitt.* p.p.)
julacea, (*L.*) *Lightf.*
JUNGERMANNIA, *Linn.* (1745).
quinquedentata, *Web.* (*J. Lyoni*, Tayl.
GYMNOMITRIUM, *Corda* (1829). (*Cesia*, Gray, 1821.)
concinatum, *Corda.*
crenulatum, *Gottsche.*
PELLIA, *Raddi.* (1818). (*Marsilia*, Mich. 1741.)
calycina, *Tayl.* (v. *furcigera*, Hook.)

Experimental Planting in Central Africa. By J. W. MOIR, Manager of the African Lakes Company.

(Read 13th January 1887.)

The operations referred to in this paper were conducted at Mandala, close to the Blantyre Mission Station, nearly 16 degrees south of the equator, over 3400 feet above sea-level, and over 200 miles from the nearest part of the ocean. We have there a high, continental district, with a mean temperature of 67°, ranging from 33° in the cold season to 95° in the hot, and a rainfall of about 50 or 55 inches. Hardly a month passes without a very little rain, but the rainy season lasts five months, from middle or end of November to middle or end of April.

I shall then commence by speaking of the introduction of coffee into Central Africa. To quote from the *Times* of Friday last, "little short of romantic are some of the incidents connected with the company's progress. Making very bad weather of it for many years, two little stunted coffee plants led a miserable existence in the Edinburgh Botanical Garden. It was a happy and kindly thought all ways when the Curator asked Mr John Moir to take them away with him to the Shiré Highlands. In due time they arrived; the fittest survived. Too much happiness perhaps killed the other. The survivor took a new lease of life, struck deep roots into the warm red soil of the hills, and burst out with berries and cuttings in the glorious air of the Highlands."

But to this old patriarch of the Edinburgh Garden is every berry traceable. It is computed that 100,000 trees claim direct descent from him, and Scotland may claim to have put some of her own energy and pluck into his fibre.

This plant shot up two fine stems, both of which were allowed to grow. In 1882 we might have about 300 plants from the seed of this tree from the Mission, which my brother planted, as in Ceylon, 6 feet apart every way, and in little holes the size of a hat. These had to be pretty much left to themselves from the exigencies of our other work, and were worked at diligently by the insects; when I arrived, I found most of the seedlings with from three to seven stems. Being a town-bred boy myself, I knew little or nothing of gardening, but was most fortunate in having at hand a good friend, the late James Stewart, who sent me a volume of Spon's most valuable Encyclopædia, containing a splendid article on coffee, which I carefully read and thoroughly digested.

I dug a goodly trench round each tree, and manured them rather liberally, pruned them carefully, and irrigated them. These trees shot up marvellously, and bore heavy crops. But I rather overdid it. For as the cold dry season of 1885 came on, finding the foliage falling off a bit, owing doubtless to the enormous crops such young trees had just borne, I thoughtlessly kept flooding one patch with water, when it should have been left alone, and soon found that the roots were rotting off.

In 1883 we got about 2000 plants from the Mission, which I planted out in terraces, two rows of trees in a terrace, with a small canal for irrigation between the rows. Those trees throve splendidly.

Some thousands of plants got in 1884 were planted more nearly according to the Ceylon plan, in rows only 12 inches apart. Between each row a stream of water could be run as often as desired. These were planted out in the rainy season of 1885, fine healthy plants averaging about 18 inches high, and we lost almost none in the planting out.

It was evident that the making of terraces involved more work and expense than necessary, so I thought out a better plan. The ground was carefully lined out at such an angle to the lie of the ground as to give the rows an average fall of one in twenty. One gang of workers then dug the holes 30 inches in diameter, but throwing out only rich surface soil, and always *up-hill* from the hole. Another gang followed, throwing out the subsoil till 18 inches depth was reached, and throwing it *down-hill* from the hole. Much later, when filling in, the soil was taken from the up-hill side of the hole only—first what had been weathering, and then the rich surface soil from the same region. The red subsoil on the lower side of the hole was levelled down. The result we found to be very satisfactory.

Our next experiments were with Cinchona, as we were sure that a supply of good fresh bark in the country where so much malarial fever is prevalent would be very valuable. We got seeds sent over from Ceylon, India, and home, but in every case but one it had lost its germinating power. The delight we felt when the seed of that particular lot sent up its tiny leaves I leave to your imagination. The most successful were in boxes, well drained, but kept moist by flower-pots with water sunk into the mould, while all was covered with panes of glass. One part sand to two parts vegetable mould, and equal parts of each, were used. They all damped off, till but one was left. This one was cared for like an infant; but from other misfortunes we likewise lost it.

Indigo.—We imported seeds from Calcutta, but sufficient time has not elapsed to enable me to say whether it will equal the coffee.

I have sent out eight Wardian cases during last year, two of the cases from Edinburgh Botanical Garden, with over 300 plants of 70 different sorts, and seeds of about 60 kinds of economic plants, from some of which we hope a good deal, and the results I anticipate some day to lay before the Society.

Report on a Visit to Applecross by the Members of the Summer Camp, 1886. By JOHN ALLAN.

(Read 9th June 1887.)

The Applecross district of Ross-shire having been selected for the Summer Camp Excursion in 1886, and the sanction of Lord Middleton, the owner of the district, having been obtained, through the kind intervention of Professor Dickson, two parties were formed, who visited the district in succession. The first party consisted of Dr Wm. Watson and Mr Symington Grieve, and the second of Dr Macfarlane and Mr John Allan, who were accompanied by Mr James M'Bride, a botanical student.

The party was accommodated in the schoolhouse, through the kindness of Mr John Macdonald, the schoolmaster at Arrinachrinach.

Arrinachrinach is a small crofter and fishing village, situated on the southern shore of Loch Torridon, about 3 miles from its junction with the sea. The village consists of ten or a dozen houses, situated on the western bank of a small stream which takes its rise in Loch-na-Creige, one of a number of freshwater lochs about half a mile distant, and falls into Loch Torridon in a small sheltered bay just below the village. Beyond the village, to the west, there is a long stretch of desolate moor and moss, interspersed with numerous low hills and freshwater lochs; while in front of the village rises a high, rocky ridge, clothed with wood, chiefly birch and laurel. There is a magnificent view across Loch Torridon to Ben Aligin on the opposite shore, and the high and picturesque range of hills which border Upper Loch Torridon. Ben Aligin rises to a height of about 3100 feet, and is considered to be the highest mountain in the district.

The first party left Edinburgh on the morning of 19th July, taking the early morning train to Inverness, and thence by the Dingwall and Skye section of the Highland Railway to Strathcarron Station. The next stage of their route was by gig to Shieldaig, and thence by boat to Arrinachrinach, where they arrived the same evening. The second party left Edinburgh on the morning of Tuesday, 27th July, met the first party at Shieldaig the same evening, and afterwards continued their journey to Arrinachrinach.

The first party during their stay visited the following places:—The moorland south-west of Arrinachrinach and the numerous lochans in the district as far as the Amhainn Chuaig and Loch Gaineamhach. Mr Grieve also explored the western side of Croic-bheinn, and climbed to its summit. He then botanised along the eastern side of Beinn Bhan, working his way along the face of some very grand corries, and then ascended through a gully to near the summit of the mountain, which was then visited, the altitude being 2936 feet. A number of rare plants were observed, but there were only isolated specimens, and nowhere was there the luxuriant growth of alpine vegetation to be seen in some parts of the Breadalbane mountains and in other well-known localities. Mr Grieve was accompanied during this excursion by Mr Alexander Macrae, one of Lord Middleton's gamekeepers, who was most obliging. The return from the top of the mountain was made along the northern ridge.

After leaving Arrinachrinach, Dr Watson and Mr Grieve spent two nights at Shieldaig, and made an excursion by the south side of Loch Torridon, along the carriage road as far as Balgy, and thence by the bridle path past the new shooting lodge at Camus Roil to the head of the loch. They botanised over the stretch of links between the road and the sea, and then walked up the road towards Kinlochewe for about 1½ miles, being passed on their way by a party of members of the Geological Society in two wagonettes, who were on their way to Torridon House. The return journey to Shieldaig was made by the same route.

Among the first visits paid by the second party was one to Ardheslaig. There they collected about fifty plants in all, among which were *Epilobium angustifolium, Valeriana officinalis, Solidago Virgaurea, Crepis virens, Gentiana campestris, Digitalis purpurea, Melampyrum pratense, Habenaria chlorantha, Gymnadenia conopsea,* &c.

On another day Dr Macfarlane and Mr M'Bride visited Loch Lundie, and on a subsequent day they visited Beinn Bhan, which had been visited on the previous week by Mr Grieve, but on this occasion they examined the western side of the mountain.

During the absence of Dr Macfarlane and Mr M'Bride on these excursions, I was chiefly engaged collecting *Algæ*, a note on which will be appended to this, and we also visited the greater number of the numerous freshwater lochs between Arrinachrinach and Cuaig. We found the white water-lily (*Nymphæa alba*) growing more or less abundantly in all of them, also *Lobelia Dortmanna* and *Scirpus lacustris. Drosera anglica* was tolerably abundant close by the margins of the lochs, and a few plants of *Pinguicula lusitanica* were also got in the small streams issuing from the lochs.

Visits were paid by both parties to a cave on the shore at Fearnmore. The cave moss (*Eurhynchium pumilum*, Wils.) grew on the sides for some distance in. We visited other two caves close to the point between Arrinachrinach and Eilan Mor, both of which were much smaller in size. We found a few plants of Lovage (*Ligusticum scoticum*) on the rocks over the entrance to one of these; while, on the roof inside, *Asplenium marinum* grew in luxuriant tufts, and a solitary plant of *Scolopendrium* was got. Farther along the shore we gathered *Asplenium Adiantum-nigrum* and *A. Trichomanes;* while inland we found *Hymenophyllum unilaterale* growing plentifully on the roots of decayed trees, and on stones in the wood between. *Lycopus europæus* and *Scutellaria galericulata* were found growing near the shore.

The second party had a strong desire to cross over Loch Torridon to Diabeg, and then ascend Ben Aligin, but were several times prevented by the weather, and by the want of a suitable boat; but they succeeded one afternoon in visiting Diabeg, which is a crofter village most picturesquely situated at the head of a small bay, surrounded by high barren rocks. A small burn descends a deep gorge just behind the village, which we ascended. We found in a small meadow at the foot *Daucus Carota* growing plentifully, and a great many fine clumps of *Osmunda regalis.*

Mr Grieve had the latest edition of the London Catalogue with him, on which had been marked by Mr Bennett of Croydon the plants previously recorded as found in the district. These, excluding mosses, &c., numbered 366, and of these we found 236, while we found 50 additional plants, which are enumerated below:—

Viola canina.
Arenaria peploides.
Lepigonum salinum.
Hypericum Androsæmum.
Vicia Sepium.
Lathyrus pratensis.
Potentilla argentea.
Callitriche verna.
Epilobium angustifolium.
,, alpinum.
Chærophyllum temulum.
Ligusticum scoticum.
Daucus Carota.
Scabiosa Columbaria.
Artemisia Absinthium.
Arctium majus.
Anagallis tenella.
Gentiana campestris.
Symphytum officinale.
Myosotis palustris.
Scrophularia nodosa.
Veronica agrestis.
,, alpina.
,, officinalis.
Lycopus europæus.
Thymus Serpyllum.
Atriplex patula.
Salicornia herbacea.
Polygonum aviculare.
Rumex maritimus.
Salix phylicifolia.
Juniperus communis.
Habenaria viridis.
,, chlorantha.
Juncus Gerardi.
Potamogeton natans.
Eleocharis palustris.
Aira caryophyllea.
Festuca rubra.
Asplenium marinum.
,, viride.
Cystopteris fragilis.
Polystichum aculeatum.
Lastrea dilatata.
Polypodium Phegopteris.
,, Dryopteris.
Equisetum maximum.
,, sylvaticum.
Isoetes lacustris.
Chara aspera.

Note on the Algæ.

We found in all above 50 species. Those of *Fucus* were in great abundance, and seemed to be of a lighter colour than those met with in the Firth of Forth. *Himanthalia lorea*, *Alaria*, and most of the varieties of *Laminaria. L. digitata* and *L. bulbosa* were specially large. Large masses of *Ectocarpus* were found epiphytic on *Fucus nodosus* and *F. vesiculosus. Mesogloia vermicularis, Chordaria flagelliformis, Dictyosiphon hippuroides*, and *Asperococcus echinatus* were got in a pool on the east side of Eilan Mor. Large masses of *Leathesia tuberiformis* were found in the same place clothing the sides of the rocks in dense cushions.

Owing to the absence of suitable rock pools we collected few *Rhodosperms. Chylocladia articulata* and *Delesseria alata* were found abundantly all round the coast, the former in fruit. Specimens of the following were also obtained:—

Callithamnion polyspermum.	Gigartina mammillosa.
Ceramium rubrum and acanthonotum.	Rhodymenia palmata.
Iridæa edulis.	Gelidium corneum.
Furcellaria fastigiata.	Plocamium coccineum.
Chondrus crispus.	Delesseria sinuosa.
	Laurentia pinnatifida.

Report on Temperatures and Open-Air Vegetation at the Royal Botanic Garden, Edinburgh, from July 1886 *to June* 1887. By Robert Lindsay, *Curator of the Garden.*

July 1886.—The month of July was rather cold and wet for the season of the year. Rain fell more or less on sixteen days. A few really warm days occurred during the first week, after which showers and dull weather occurred frequently till the end of the month. The lowest night temperature was 38°, which occurred on the 27th, and the highest 52°, on the 2nd. Herbaceous plants and annuals flowered remarkably well. Roses were also good during the last week of the month. On the Rock Garden 282 species and varieties of plants came into flower during July, amongst which the following were conspicuous:—*Heuchera sanguinea, Cyananthus lobatus, Saponaria cæspitosa, Cacalia alpina, Myosotis capitata, Tropæolum polyphyllum, Meconopis Wallichii, Phyteuma comosum, Pentstemon speciosum, Epilobium obcordatum, Chrysogonum virginianum, Aristolochia rotunda, Spiræa astilboides, S. bullata, Lilium Krameri, Galium rubrum, Calochortus pulchellus, Micromeria piperella, Veronica amplexicaulis,* &c.

August.—During this month the weather was fairly good; there were nineteen dry days, and the wind was westerly throughout.

Several low night temperatures were registered. The lowest were—on the 1st, 40°; 3rd, 36°; 4th, 37°; 5th, 38°; 15th, 39°; The highest morning readings were—on the 6th, 67°; 20th, 68°; 28th, 63°; 29th, 70°; 30th, 66°. Eighty-six species of plants came into flower on the Rock Garden during August, amongst which were the following, viz.:—*Campanula isophylla alba, Hypericum chinense, Umbilicus sempervivum, Erica ramulosa, Calluna vulgaris* fl.-pl., *Olearia Haastii, Potentilla Leschenaulti, Cyclamen hederifolium,* *Centaurea alpina*, *Saxifraga fimbriata*, *Statice minima*, *Digitalis ferruginea*, *Scabiosa graminifolia*, &c.

The Rock Garden was very gay during this month; a large number of the plants which began to flower in July continued longer than usual, in consequence of there being no great heat. Artificial watering was at no time required.

September.—The weather was, on an average, favourable, being dry, but rather cold. The first frost this season occurred on the morning of the 15th, when the thermometer fell to 29°, and on the following morning it registered 32°. Dahlias, and a few other tender plants were injured, but not altogether destroyed. Potatoes were also blackened in some districts. No more frost occurred during this month, the lowest readings being 35° on the 19th, and 36° on the 23rd. The highest morning readings were—on the 1st, 65°; 6th, 65°; 8th, 62°; 9th, 60°; 30th, 62°. The season has been favourable for transplanting, and outdoor operations have had but little interruption throughout the month. On the Rock Garden twenty-four species of plants came into bloom, amongst which were *Hypericum patulum*, *Morina Coulteri*, *Tricyrtis australis*, *Polygonum capitatum*, *Colchicum maximum*, *Gladiolus Saundersii*, *G. purpureo-auratus*, *Oxalis lobata*, *Polemonium flavum*, *Kniphofia MacOwani*, *Colchicum autumnale album* fl.-pl., *Lilium tigrinum*, *Œnothera rivularis*.

October.—This month was remarkable for the absence of frost; only once did the thermometer reach the freezing point, viz., on the 23rd; while in October 1885 frost was registered on four nights, indicating 20° in all. In consequence of the mildness of the season, a large number of autumn flowers are still in fairly good condition—Dahlias, Pelargoniums, Lobelias, Calceolarias, and other tender plants are in flower in the open ground up to the present date, but they are somewhat battered by the severe storms of wind and rain they have undergone. Autumnal tints on deciduous trees and shrubs have been less interesting than usual. Very few have coloured well; the best were species of Maple, Oak, and *Liriodendron*, while many others were scarcely coloured at all, the leaves having fallen or been blown off in an immature condition. The brown tints which many Conifers assume at this season are as yet absent. Want of heat and sunshine during the growing season, causing insufficient ripening, appears to have brought about this result, and from the same cause Rhododendrons, Azaleas, and other Ericaceous plants are but poorly set with flower-buds for next year. Fruit-bearing trees and shrubs have, as a rule, produced moderate crops; the best are Hollies, Cotoneasters, Roses, and *Prunus lusitanica*—the latter is unusually abundant this season.

The lowest readings of the thermometer occurred on the 6th, 34°; 11th, 33°; 13th, 37°; 22nd, 35°; 23rd, 32°. The highest morning readings were—on the 1st, 59°; 2nd, 56°; 6th, 53°; 7th, 56°; 8th, 56°. Rain fell on eighteen days, and there were severe thunderstorms and violent gales in the middle of the month.

On the Rock Garden many plants were in flower. Only sixteen, however, opened their first flowers during October, the best of which were *Armeria canescens, Aster longifolius, Crocus medius, asturicus, byzantinus, Shrundri, and pulchellus; Dianthus arenarius, Helleborus altifolius, Tricyrtis hirta. From* 1*st January till the end of October* 1161 *species and varieties have flowered on the Rock Garden; at the same date last year* 1168 *had flowered.*

November.—This month has been very mild and dry generally. Seldom have we had so little frost to record for the time of year, while throughout the month has been most favourable for all outdoor gardening work. The thermometer was at or below the freezing point on ten mornings, indicating collectively 17° of frost, as against 65° for the corresponding month last year. The lowest readings occurred on the 18th, when the glass registered 30°; 19th, 30°; 21st, 30°; 22nd, 26°; 26th, 30°. The highest morning readings were on the 1st, 45°; 2nd, 45°; 3rd, 50°; 15th, 48°; 24th, 48°. Rain fell on ten days, and the prevailing winds were westerly. During the first week of the month severe storms of wind took place, which cleared off, with but few exceptions, any leaves that still remained on deciduous trees. Many autumn flowering plants and annuals have had their flowering season prolonged to an extent quite unprecedented. At the end of the month large numbers were still in blossom. Early spring bulbs, such as Snowdrops, Scillas, Narcissi, and others, are already pushing through the soil, showing that a considerable amount of growth has taken place. Amongst the finest plants in flower out-of-doors during the month were *Primula capitata*, very dark seedling forms; Christmas Roses of different kinds, Chrysanthemums, and *Jasminum nudiflorum.*

For the handsome varieties of *Primula capitata* we are indebted to Dr King, of Calcutta, one of the local secretaries of the Society, who, in December last, sent to the garden a valuable collection of rare Indian Primrose seeds. Many of the species are entirely new to European gardens. The seeds were gathered in high elevations of the Sikkim Himalayas. Nearly all the kinds have germinated and grown well at the garden, a few have already flowered, but we may expect to see them in greater perfection next spring. The most conspicuous shrubs in fruit were the various Hollies, Cotoneasters, Euonymus, and Snowberries.

The following plants came into flower on the Rock Garden during November, viz.:—*Aster Reevesii*, *Eucomis punctata*, *Gynerium argenteum*, *Helleborus olympicus*, *H. o. albus*, and *H. purpurascens* variety.

December.—The weather of the past month has been of an exceedingly wintry character. The aggregate amount of frost registered has not been exceeded during any December since 1879.

The thermometer was at or below the freezing point on twenty-six mornings, indicating collectively 174° of frost. During the corresponding month of 1885 frost was registered on fourteen mornings, the collective amount being 111°. The lowest readings for last month were, on the 3rd, 18°; 18th, 18°; 19th, 18°; 20th, 14°; 21st, 16°. The highest morning readings were, on the 5th, 40°; 6th, 42°; 9th, 37°; 16th, 35°. There were slight falls of snow and sleet throughout the month, the heaviest being on the 1st and 8th, but at no time was there enough to do any harm. The excessive fall of the barometer on the night of the 8th, when it reached the extremely low point of 27·668 inches, was happily unattended by any bad results in this district. Holly and other fruits were eagerly devoured by birds, owing to the combined hardness of the ground and scarcity of other food; by the end of the month nearly all had disappeared. Not a single plant came into flower in the Rock Garden during December.

The total number of species and well-marked varieties of alpine and dwarf-growing herbaceous plants which have flowered *in the Rock Garden during the past year amounts to* 1165. This is considerably below the number cultivated in the garden, as many of the rarer species fail to flower every year, but it gives a good idea of the large number of alpine plants which may be successfully grown in this country. A record has been kept showing the date when each plant was first observed in flower. The largest numbers flowered during June and July, viz., 300 and 281 respectively.

January 1887.—The weather was upon the whole favourable. Frost was registered on seventeen mornings, indicating collectively 91° for the month, as against 158° for the corresponding month last year. The lowest readings of the thermometer occurred on the 5th, 23°; 6th, 23°; 11th, 22°; 15th, 19°; 17th, 18°. The highest morning readings were, on the 19th, 48°; 26th, 47°; 27th, 49°; 29th, 46°; 30th, 47°. The lowest day temperature was 31°, which occurred on the 5th, and the highest 53°, on the 27th of the month. Comparatively mild spring-like weather ensued from the 17th till the end of the month, which has brought forward the leaf-buds of many shrubs, particularly Flowering Currant, Roses, Honeysuckles, Lilacs, &c. Several herbaceous plants have started into growth. So far very little injury has been done to vegetation this winter. Of the forty selected plants, whose dates of flowering are annually recorded to the Society, five came into flower during January, viz.:—*Dondia Epipaetis,* on the 13th; *Tussilago fragrans,* on the 19th; *Corylus Avellana,* on the 26th; *Galanthus nivalis,* on the 27th; and *Galanthus plieatus* on the 31st. None of these had opened by the end of January last year. On the Rock Garden nineteen species came into flower, amongst which were *Geum aureum, Hepatiea triloba* and *angulosa, Primula acaulis, veris, Aubrietia deltoidea, Croeus Imperati* and *suaveolens, Erica herbaeea alba,* and three species of *Helleborus.*

February.—The month was generally mild and dry; bright sunshine was frequent, causing numerous spring plants to expand their flower-buds earlier than usual. The weather experienced during the month was in marked contrast to that of February 1886, which was extremely wintry, with much snow, and uninterrupted low temperatures. During last month no snow fell. Rain fell, more or less, on nine days only. Frost was registered on twelve mornings, the total amount being 76°, as against 128° for the corresponding month last year.

The lowest readings of the thermometer were on the mornings of the 6th, 7th, 8th, 9th, and 10th, indicating respectively 23°, 23°, 22°, 17°, and 20°. The highest morning temperatures were on the 3rd, 18th, 23rd, 24th, and 27th, when 46°, 45°, 49°, 50°, and 44° were indicated. The lowest day reading was 31° on the 8th; the highest was 58°, on the 27th of the month. Of the forty spring flowering plants, whose dates of flowering are annually recorded, the following seventeen came into flower, viz.:—*Tussilago alba*, on February 3; *Crocus Susianus*, February 4; *Eranthis hyemalis*, February 4; *Daphne Mezereum*, February 5; *Leucoium vernum*, February 14; *Symplocarpus fœtidus*, February 14; *Scilla præcox*, February 16; *Rhododendron atrovirens*, February 17; *Crocus vernus*, February 17; *Nordmannia cordifolia*, February 18; *Bulbocodium vernum*, February 19; *Scilla sibirica*, February 19; *Iris reticulata*, February 26; *Rhododendron Nobleanum*, February 26; *Scilla bifolia taurica*, February 27; *Arabis albida*, February 27; *Omphalodes verna*, February 28. All but two of these have flowered earlier than last season, the average being seventeen days in advance. Several shrubs have flowered most profusely during the month; the finest were the red and white *Mezereon*, *Rhododendron atrovirens* and *R. præcox*, *Andromeda floribunda*, &c. Leaf-buds are not developing so rapidly as might have been expected, probably owing to the dryness of the ground.

On the Rock Garden forty-five species and varieties of plants came into flower during the month, as against twenty during February 1886. The most conspicuous varieties were—*Hepatica triloba*, *Galanthus Elwesi* and *Redoutei*, *Crocus annulatus*, *C. biflorus*, *etruscus*, *Olivieri*, *Susianus*, *Sieberi*, and *vernus*; *Helleborus antiquorum*, *albicans major*, *orientalis*, *guttatus*; *Leucoium vernum* and *carpaticum*, *Cyclamen Coum vernum*, *Colchicum crociflorum*, *Iris reticulata* and *Krelagei*, *Chionodoxa sardensis*, *Saxifraga oppositifolia* and *alba*, *S. Burseriana*, *Rocheliana*, *Muscari lingulatum*, *Scilla bifolia taurica*, *Bulbocodium vernum*, *Scilla sibirica*, *Draba aizoon*, *Doronicum caucasicum*.

March.—The weather was rough, with much snow, wind, and frequent frosts. Vegetation, having been forced on by the unusual mildness of the preceding month, suffered a severe check, and made little progress till near the end of the month. Compared with last year, the season is still considerably in advance. The thermometer was at or below the freezing point on eighteen nights, and 100° of frost were registered for the month as against 134° for the corresponding month last year.

The lowest readings of the thermometer were, on the 12th, 24°; 13th, 18°; 14th, 24°; 15th, 23°; 21st, 24°. The highest morning readings were, on the 2nd, 42°; 3rd, 44°; 7th, 35°; 27th, 39°; 31st, 39°. The lowest day temperature was 29°, which occurred on the 11th, and the highest 52°, on the 30th.

Flowers of *Rhododendron præcox, R. Nobleanum*, and *R. atrovirens* were much injured by the frost on the 9th; Roses, which had started into growth, had their young leaves slightly browned; no other injury was observed. Snow fell more or less from the 10th till the 22nd, which helped to protect spring-flowering plants. Thorns, Poplar, and Lilac were well advanced in leaf. Willows, Alder, Elms, *Pyrus japonica, Ribes sanguineum*, and *Forsythia viridissima* were flowering profusely. *Magnolia* and *Prunus triloba* were well set with flower-buds. Spring-flowering bulbous plants were vigorous and flowering well, although cold drying winds and absence of anything like genial rains was beginning to tell on them.

On the Rock Garden a large number of plants flowered. Sixty-five species came into bloom during March, exclusive of those which opened in the previous month, many of which are still flowering. Among the most interesting which opened in March were the following, viz.:—*Corydalis angustifolia, Primula denticulata, Erica carnea, Chionodoxa Luciliæ, Saxifraga sancta, S. oppositifolia* var. *aretioides, S. Burseriana* var. *Boydii, Puschkinia scilloides, Polygala Chamæbuxus* and *purpurea, Pachystema Canbyi, Draba Mawei, Anemone Pulsatilla*, &c.

Of the forty spring-flowering plants whose dates of flowering are annually recorded to the Society the following fifteen came into flower, viz.:—

Scilla bifolia, . .	Mar.	2	Aubrietia grandiflora, .	Mar.	19
Mandragora officinalis,	,,	2	Erythronium Dens-canis,	,,	10
Scilla bifolia alba, .	,,	4	Hyoscyamus Scopolia, .	,,	23
Sisyrinchium grandiflorum, . . .	,,	4	Narcissus Pseudo-Narcissus, . . .	,,	23
Orobus vernus, . .	,,	6	Ribes sanguineum, . .	,,	23
Sisyrinchium grandiflorum album, .	,,	8	Corydalis solida, . .	,,	26
Narcissus pumilus, .	,,	14	Draba aizoides, . .	,,	28
			Adonis vernalis, . .	,,	29

April.—During the month of April vegetation made comparatively slow progress. Frost occurred much more frequently than it has done for many years during the same period. This, along with a succession of dry cold easterly winds, prevented any very rapid growth from taking place.

The ground also was very dry, until the last week of the month, when a moderate supply of rain fell. This did much good in assisting deciduous trees and shrubs to develop their leaves, but the temperature remained too cold for plants generally deriving the full benefit of the rain. The thermometer was at or below the freezing point on fifteen nights; collectively 58° of frost were registered for the month, as against 15° for the corresponding month last year. The lowest readings were—on the 5th, 24°; 10th, 24°; 15th, 26°; 17th, 27°; 27th, 26°. The highest morning readings were—on the 2nd, 50°; 3rd, 50°; 17th, 50°; 22nd, 50°; 28th, 49°. The lowest day temperature was 44°, which occurred on the 5th, and the highest 62°, on the 17th of the month. The total amount of frost registered this season up to the end of April is 520°; for the same period last season 632° were registered. The following is the distribution for each month, viz., September, 3°; October, 1°; November, 17°; December, 174°; January, 91°; February, 76°; March, 100°; and April, 58°. The lowest point reached at the garden this season was 14° Fahr., or 18° of frost, which occurred on 20th December last.

[TABLE.

Register of Spring-Flowering Plants, showing Dates of Flowering at the Royal Botanic Garden, Edinburgh, during the years 1886 *and* 1887.

No.	Name of Plants.	First Flowers opened. 1886.	1887.
1	Adonis vernalis, ...	April 3	March 29
2	Arabis albida, ...	March 4	Feb. 27
3	Aubrietia grandiflora, . . .	April 6	March 19
4	Bulbocodium vernum, . . .	Feb. 27	Feb. 19
5	Corydalis solida, . . .	April 6	March 26
6	Corylus Avellana, . . .	Feb. 10	Jan. 26
7	Crocus Susianus, . . .	Feb. 12	Feb. 4
8	,, vernus, ...	March 17	Feb. 17
9	Daphne Mezereum, . . .	March 22	Feb. 5
10	Dondia Epipactis, . . .	Dec. 30 1885.	Jan. 13
11	Draba aizoides, ...	March 31	March 28
12	Eranthis hyemalis, . . .	Feb. 10	Feb. 4
13	Erythronium Dens-canis, . .	March 26	March 19
14	Fritillaria imperialis, . . .	April 25	May 4
15	Galanthus nivalis, . . .	Feb. 9	Jan. 27
16	,, plicatus, . . .	Feb. 9	Jan. 31
17	Hyoscyamus Scopolia, . . .	April 3	March 23
18	Iris reticulata, ...	March 20	Feb. 26
19	Leucoium vernum, . . .	Feb. 17	Feb. 14
20	Mandragora officinalis, . . .	April 3	March 2
21	Narcissus Pseudo-Narcissus, . .	April 6	March 23
22	,, pumilus, . . .	March 25	March 14
23	Nordmannia cordifolia, . . .	March 20	Feb. 18
24	Omphalodes verna, . . .	April 3	Feb. 28
25	Orobus vernus, ...	March 28	March 6
26	Rhododendron atrovirens. . .	March 23	Feb. 17
27	,, Nobleanum, . .	April 4	Feb. 26
28	Ribes sanguineum, . . .	April 8	March 23
29	Scilla bifolia.	March 19	March 2
30	,, ,, alba, . . .	March 21	March 4
31	,, præcox, ...	Feb. 13	Feb. 16
32	,, sibirica, ...	Feb. 17	Feb. 19
33	,, taurica, ...	March 20	Feb. 27
34	Sisyrinchium grandiflorum, . .	March 21	March 4
35	,, album, . . .	March 21	March 8
36	Symphytum caucasicum, . .	April 20	April 10
37	Symplocarpus fœtidus, . . .	March 23	Feb. 14
38	Tussilago alba, ...	Feb. 10	Feb. 3
39	,, fragrans, . . .	Feb. 6	Jan. 19
40	,, nivea, ...	April 3	April 4

On the Rock Garden 159 species and varieties came into flower during April, being forty in excess of last April. Amongst the most interesting were *Anemone apennina, Androsace Laggerii, Aubrietia Hendersoni* and *Campbelli, Arum proboscideum, Cheiranthus Menziesii, Corydalis nobilis, Erythronium giganteum* and *roseum, Gentiana verna, Menziesia cærulea* and *empetriformis, Muscari Argæi, Iberis petræa, Nar-*

cissus rupicola, Petrocallis pyrenaica, Primula decora, frondosa, minima, glabra, involucrata, Reidii ; Pulmonaria sp., *Ranunculus insignis* and *amplexicaulis, Saxifraga flagellaris* and *purpurascens, Soldanella montana, Aristolochia pallida,* &c.

Of the forty spring-flowering plants whose dates of flowering are annually recorded to the Society, two came into flower during April, and one in May, thus completing the list given on previous page.

May.—During the month vegetation generally made good progress, although there was a considerable amount of frost during the first week, and cold east winds during the last week of the month. From the 7th till the 24th a spell of fine bright weather took place, during which time vegetation made rapid strides. Ordinary deciduous trees and shrubs developed fine luxuriant foliage, and by the end of the month many of them were in blossom. Amongst those which flowered best were the various species of Pyrus and Prunus, Horse Chestnut, Lilac, Hawthorn, Laburnum, and *Magnolia purpurea.* The quantity and condition of the flowers produced were rather above the average. Late flowering Rhododendrons and *Azalea pontica* were very well covered with flowers, while Ghent Azaleas were very sparse. Bushes of *Erica australis* and *Olearia Gunniana* were unusually fine; both are handsome May-flowering hardy plants, not too well known throughout the country.

The thermometer was at or below the freezing point on four nights, the total amount of frost being 12°, while in last May 4° only were recorded. The lowest readings were—on the 1st, 30°; 2nd, 25°; 4th, 32°: 5th, 29°; 21st, 33°. The highest morning readings were—on the 8th, 57°; 9th, 57°; 16th, 60°; 17th, 60°; 24th, 59°. The lowest day temperature was 52° which occurred on the 20th; and the highest, 74°, on the 24th of the month.

On the Rock Garden a large number of alpine and herbaceous plants were in flower; no less than 326 species and varieties came into flower during May, being 73 in excess of last May. Amongst the most interesting were:—

Andromeda fastigiata.	Alyssum alpestre.
Anemone alpina sulphurea.	Androsace lanuginosa Leichtlinii.
,, narcissiflora.	,, sarmentosa.
Anthyllis erinacea.	

Androsace Chamæjasme.
Aquilegia Stuartii.
Cytisus Ardoinii.
Cerinthe alpina.
Chrysogonum virginianum.
Cheiranthus Marshallii.
Clintonia Andrewsii.
Dianthus gelidus.
Daphne collina.
Enkianthus himalaicus.
Erica australis rosea.
Genista pilosa.
Gaultheria trichophylla.
Haberlea rhodopensis robusta.
Helicophyllum Albertii.
Lamium Orvala.
Linaria alpina.
Oxytropis uralensis.
Phlox nivalis.
Primula pedemontana.
„ geraniifolia.
Pentstemon Menziesii.
Polemonium humile.
Potentilla purpurea.
Rhodora canadensis.
Saponaria ocymoides splendens.
Silene acaulis.
„ pusilla, &c.

June.—Considerable injury was done to many plants from the protracted drought which prevailed. There were twenty-four dry days during the month. On one day only was there much rain, viz., on the 4th.

Late transplanted trees and shrubs suffered most severely. All surface-rooting perennials have been more or less injured. Herbaceous plants rushed suddenly into flower, and went past in an incredibly short time. Many of them became scorched up in a manner which I have never previously observed. Annuals of various kinds do not appear to have suffered at all, and the same may be said of Pelargoniums, Calceolarias, and other bedding plants. Hardy deciduous trees and shrubs have been prolific of bloom. A few have been finer than usual, such as the flowering Ash (*Fraxinus Ornus*), Elder, *Escallonia Phillipiana*, *Olearia ilicifolia*, and several species of New Zealand Veronicas. Roses are very dwarf, and though clean and well budded, have rather a starved-like appearance.

During the month the thermometer did not fall so low as the freezing point at the garden, although in some parts of Scotland it fell several degrees below it. The lowest night readings were—1st, 34°; 2nd, 38°; 3rd, 42°; 21st, 36°. The lowest day temperature was 52°, on the 2nd, and the highest 86°, on the 22nd.

On the Rock Garden 432 species and varieties of plants came into flower during the month, making a total of 1048 for the season, as against 753 at the corresponding date last year. Amongst them were the following :—

Androsace foliosa.
Aciphylla squarrosa.
Arum palestinum.
Calceolaria Kellyana.
,, plantaginea.
Calochortus cœruleus.
Campanula Zoysii.
Cistus formosus.
Dianthus alpinus.
,, glacialis.
,, neglectus.
,, superbus.
Edraianthus serpyllifolius.
Erythræa aggregata.
Gaultheria carnea.
Globularia nana.
Heuchera sanguinea.
Helicophyllum Lehmanni.
Hypericum empetrifolium.
Hypoxis erecta.
Iberis jucunda.
Leontopodium alpinum.
Linaria anticaria.
Lithospermum graminifolium.
Nardostachys Jatamansi.
Orchis maculata superba.
Oxytropis cyanea.
Pæonia tenuifolia fl.-pleno.
Polygonum sphærostachyum.
Pentstemon speciosum.
Ramondia pyrenaica.
Rhododendron ferrugineum album.
Senecio laxiflorus.
,, pulcher.
Saponaria ocymoides Loderi.
Tropæolum polyphyllum.
Vancouveria hexandra.
Vaccinium Mortinia.
Veronica amplexicaulis.
,, anomala.
Wyethia mollis, &c.

MISCELLANEOUS CONTRIBUTIONS AND EXHIBITIONS.

SESSION 1886–87.

November 11, 1886.

Dr Paterson, Bridge of Allan, sent for exhibition a plant of *Dyckia rariflora*. He stated—"I have had the plant for more than twenty years, and it has never thrown an offset, but it flowers every year, and seeds freely. Whether the seeds are fertile or not I cannot say, as I have never tried them."

Mr Simson, Dundee, exhibited a large plant of *Trichomanes radicans*, which had grown from a small rhizome originally found by him in Arran (Clyde) in 1863.

Mr Lindsay exhibited a large number of flowers from the open air, including Dahlias, Geraniums, Lobelias, Calceolarias, *Senecio speciosus*, Aponogeton, &c. He also exhibited from the garden a plant of *Eucalyptus Gunnii*, raised from seed ripened at Whittinghame, East Lothian, last year, and the new *Sagina Boydii*.

Mr John Campbell, Ledaig, sent flowers then blossoming in his garden.

Mr Archibald Gray exhibited a dried plant of *Arenaria norvegica* which he had gathered in West Sutherlandshire.

December 9, 1886.

Dr H. H. Johnston exhibited and presented to the Society specimens of two Orkney plants collected by him last summer. *Sagina maritima*, Don, in a very contracted form, one-third to one inch high and one to three flowered, was collected at the Ness of Ramnageo, Sandwick, on the mainland, on July 23. It grew among the short, densely-matted pasture, within a few feet of the edge of the cliffs, and in a situation exposed to the salt spray of the Atlantic Ocean, and the full force of the westerly gales which are so prevalent in the Orkney Islands. Professor Babington, to whom specimens of the Orkney *Sagina* were sent, wrote that he had apparently the same plant, rather more luxuriant, from Far-out Head. The pasture among which the *Sagina* grew was fully examined by Dr Johnston, who found that it was composed of the following eleven species of plants, all of which were in a very stunted condition:—*Cochlearia officinalis*, Linn.; *β alpina*, Wats.; *Cerastium triviale*, Link.; *Sagina maritima*, Don; *Armeria maritima*, Willd.; *Euphrasia officinalis*, Linn.; *Plantago maritima*, Linn.;

β minor, Hook. and Arn.; *P. coronopus*, Linn.; *Festuca rubra*, Linn.; *Eurynchium prælongum* (Linn.), Sch.; and an undetermined species of fungus, of which only one specimen was observed. The other plant exhibited was *Carex fulva*, Good.; *C. xanthocarpa*, Degl., which is described in *English Botany*, ed. 3, under the name of *C. fulva*, var. *sterilis*, and is synonymous with *C. fulva*, Koch et Auct. plur. (non Smith). The specimens were collected in a marsh near North Dam, in Hoy, on August 9, 1886. The variety *sterilis* is distinguished from *C. fulva* by its denser tufted habit, pale yellower-green coloured leaves, uninflated perigynium, and by never producing mature fruit, either in the wild state or under cultivation.

Dr Boswell, who first found this plant in Orkney, at Piggar, Swanbister, Orphir, on the mainland, contributed notes in the Report for 1876 of the Botanical Exchange Club, on specimens collected by him at that station in August 1875. He then considered *sterilis* to be a hybrid between *C. fulva* and *C. flava*, both of which he found growing in the same marsh with it. Now, however, he is of opinion that *sterilis* is a sterile form of *C. fulva*, though it is possible that it may be a hybrid between *C. fulva* and *C. flava*, but it is certainly very much nearer to the *C. fulva*. Since Dr Boswell's discovery of this interesting plant at Piggar, it has been found at three other stations in Orkney, viz., Navers Dale, Orphir, on the mainland, by Mr W. Irvine Fortescue; near South Dam, in Hoy, on August 20, 1885, by Mr Fortescue, in company with Dr Johnston; and near North Dam, in Hoy, on August 9, 1886, by the Rev. W. R. Ginton, in company with Dr Johnston.

Mr Rattray exhibited a copy—so far as published—of Schmidt's Atlas of the Diatomaceæ.

Mr Lindsay exhibited the stem of a species of *Testudinaria*, from the Cape, which had been presented to the Garden by the Honourable Mrs Hope.

January 13, 1887.

In connection with Mr Moir's paper (see p. 114), in which he described his coffee plantations at Blantyre as successful, Mr Taylor read a letter from Mr John Buchanan, in which he complained of an over-abundance of flowers, but few berries; on the other hand, the Cinchona plantations formed by him were flourishing. The cultivation of tea, which had been successful in Natal, was looked on as hopeful in the Shiré Highlands.

Mr Galletly read a short communication on the the Kauri resin, of which the following is a synopsis:—

The *Dammara australis*, which yields the Kauri resin, is the largest of the New Zealand trees. It is confined to the northern portion of the North Island, and grows on all soils up to the height of 1500 feet, but is said to prefer the dry and sterile clays of the hilly districts. It reaches a height varying from 100 to 140 feet—some few growing as high as 170 feet or rather more. The tree is usually bare of branches for about 50 feet from the ground. A trunk has been occasionally but rarely seen as much as 35 feet in circumference. Laslett saw two exceptionally large trees—one at Wangaroa (a little to the northward of the Bay of Islands), that measured 48 feet in circumference at 3 feet from the ground, and another near Mercury Bay, which was 72 feet in circumference and 80 feet to the branches. As the tree, which is of slow growth, does not add more than an inch to its diameter in six or seven years, Mr Laslett computed the ages of these two giants to be respectively about 1300 and 2000 years.

The so-called Kauri gum—really a resin—exudes spontaneously from every part of the tree, and hardens upon the surface by exposure to the air, immense masses of the resin being often seen on old trees, suspended from the stem at the forked part of the branches. It is believed that the bark, branches, stumps, roots, and even the leaves of the Kauri pine would yield a large amount of resin under proper management. When an incision is made in the bark of the Kauri tree the resin exudes freely, so that here, in the course of a few weeks, a large mass of half-dried resin will have accumulated. This new gum takes about three months to harden properly.

All except a very small portion of the Kauri resin so largely exported from New Zealand is, however, dug out of the ground in a fossil or semi-fossil state, but there is not much of it found more than 10 inches below the surface; that is, it occurs in the present soil. Occasionally it is found at a depth of 3 feet, and it is fished up in bogs or swamps, as well as dug out of dry ground. The resin is found either in small detached lumps, or in considerable quantities deposited in one hole. When dug up its surface is found to be partially decayed, and this portion requires to be scraped off. It is curious that where the buried gum is obtained there are now no remains of Kauri trees except the resin itself. Nevertheless, it is believed that forests of this pine must have formerly grown over the areas where it is found.

The only tools used in procuring the resin are a spear and a spade. The spear is a pointed steel rod, with which the digger pierces the ground, and by this means, after he becomes sufficiently expert, he can tell whether he is touching a stone or a piece of resin.

A few years ago an industrious man could dig out about 2 cwt. per day; now he will hardly obtain one-third of that quantity in the same time. The total annual yield is, however, not yet falling off, owing to the additional number of diggers employed. This quantity is very large for a substance of this kind, amounting to fully 5000 tons, of which 3000 are sent to America, and 2000 to England. The average value of the fossil resin is now about £60 per ton. There are several qualities of it, however, varying in price from £45 to £170 according to its purity. The resin obtained from growing trees—of which, as already remarked, very little has yet been exported—is not worth more than £25 per ton.

Although many specimens of Kauri resin are as beautiful as amber, the Maories, notwithstanding that they have the artistic faculty in a high degree, do not appear to have ever applied the resin in any way as an ornament. As we see by objects handed down to us, amber for this purpose must have been highly prized by the ancient Greeks, the Romans, the Vikings or Norsemen, and the early Celts. The only uses the Maories have made of Kauri resin have been to kindle fires and as a masticatory. In recent years lockets, brooches, and other small ornaments have been made of it by settlers at Auckland and other places in the North Island. They have the serious drawback of being not nearly so hard as amber ornaments.

Unfortunately, it is yearly becoming more difficult to keep up the supply of this highly useful vegetable product. It is estimated that the fossil Kauri resin will be completely exhausted twenty years hence.

The recent gum is not so serviceable as the fossil kind, owing to its softness, though it has a more pleasant odour when heated. But neither can a long-continued supply of the new resin be hoped for. I hear from persons acquainted with the country, and I also see by remarks in papers published in the *Transactions of the New Zealand Institute*, that the existing forests of the Kauri pine itself will more than likely be wholly cut down in another fifty years.

Mr S. Grieve exhibited specimens of Mosses collected by him in the Island of Rum.

Three large and valuable cases of *Cinchona* specimens, which had been presented to the Society by Mr J. Alexander of the Forest Department, Ceylon, were exhibited, and the best thanks of the Society were accorded to that gentleman for his donation.

February 10.

Mr. Taylor exhibited specimens of the Californian Redwood (*Sequoia sempervirens*), and after sketching the history of the plant from its discovery, referred to its present and prospective value for commercial purposes.

Flowers of several species of Orchid were exhibited from W. Sanderson, Esq., Talbot House, Ferry Road.

The bark of *Plagianthus betulinus*, from New Zealand, resembling the Lacebark, *Lagetta lintearia*, was shown by Mr J. R. Hill, Pharmaceutical Society, Edinburgh.

A number of spring flowers, in fine condition, from the open air, including *Rhododendron nobleanum* and *Veronica Andersoni*, in full flower, were sent from Mr J. Campbell, Ledaig, Argyllshire.

March 10.

Mr S. Grieve exhibited, on behalf of Mr A. Bennett, Croydon, specimens of new and rare British Plants which had been presented to the University Herbarium.

There were exhibited a large collection of New Zealand Ferns and allied plants from Miss J. A. Allison. They were fine specimens, beautifully mounted, several rare genera, *Phylloglossum*, *Tmesipteris*, *Schizæa*, &c., being represented.

From Mr D. Brown, of J. F. Macfarlan & Co., came a large box of spent opium, covered with a very luxuriant species of *Mucor*.

Dr Craig showed a specimen of the common Snowdrop, having two flowers on a scape.

Mr J. R. Hill exhibited a bulb of *Urginea Scilla*, which had been in a glass jar in the Museum of the Pharmaceutical Society for more than twenty years, and which was now sending out fresh leaves.

From the Botanic Garden came *Saxifraga fimbriata* and *Stracheyi* in fine flower, along with numerous cut flowers of *Scilla*, *Crocus*, *Iris*, *Helleborus*, &c.

April 14.

Mr. P. Sewell read a paper "On the Size and Number of Wood Vessels in relation to the Amount of Wood Development."

Mr. Bird exhibited twin flowers of *Anemone stellata*.

Mr. Lindsay exhibited plants in flower of *Primula obtusifolia* var. *Gammieana* and *P. glabra*, raised from seeds presented to the Garden by Dr King, of Calcutta, in January last. The former has large flowers, dark purple in colour, and is a great acquisition to this fine family; the latter has small heads of flower, somewhat like a miniature *P. capitata*. Also two plants of *P. Reidii*, figured in the *Gardeners' Chronicle* November 27, 1886, p. 693, raised from seeds presented by Miss Reid in October 1885; *P. denticulata erosoides*, *P. Olgæ*, *P. viscosa*, seedling varieties, having large, well-coloured flowers.

May 12.

W. B. Boyd, Esq. of Faldonside, brought to the meeting cut flowers of *Adonis pyrenaica*, *Arnebia echioides* (seedlings having large flowers), *Primula scotica*, *farinosa*, and the intermediate variety *Warei*, said to be a hybrid between the two former; Chinese Chrysanthemum, still in fine condition; and a lovely red-flowered *Aubrietia*, raised by Mr Ingram, of Belvoir Castle Gardens. W. B. Simson, Esq., Broughty Ferry, exhibited specimens of *Carlina acaulis* and *subacaulis* from Italy.

A number of interesting plants, mostly in flower, were placed on the table from the Garden, amongst which were *Primula elongata*(?), a species from the Himalaya, having yellow flowers (apparently identical with *P. prolifera*); *P. reticulata*, also from the Himalaya (differing but little from *P. sikkimensis*); large pots filled with the handsome *P. Reidii*, *P. purpurea*, of Royle; *P. capitata*, *P. farinosa*, *P. frondosa*, *Daphne striata*, *Gentiana verna*, *Tulipa Greigii*, *Bryanthus erectus*, *Hyacinthus corymbosus*; cut flowers of the handsome *Rhododendron Nuttallii* and *R. aureum superbum* (a hybrid between *R. ponticum* and *Azalea sinensis*); a species of *Cuscuta*, the seeds of which were brought from Ceylon by Professor Bower of Glasgow; and *Raoulia*, the vegetable sheep of New Zealand; along with various alpine plants in flower.

June 9.

Dr Craig read to the meeting draft copy of the proposed congratulatory Address to the Queen, on the occasion of her Jubilee, which was unanimously approved, and it was remitted to the committee, previously appointed for the purpose, to have the address prepared in illuminated form, and signed by the President.

A paper "On the Cultivation and Manufacture of Tea," by T. R. Lawson, Esq., Darjeeling, was read by Dr T. A. G. Balfour.

Mr Rattray gave an exhibition and microscopic demonstration of some rare Algæ.

Mr Taylor read a letter from Mr John Buchanan, who gave his experiences in growing coffee and *Strophanthus hispidus* in the Shiré Highlands, Africa.

W. Sanderson, Esq., Talbot House, Ferry Road, showed several cut blooms of rare Orchids.

Mr Lindsay exhibited plants in flower, from cold frames in the Garden, amongst which were *Nardostachys Jatamansi* (Spikenard), *Primula geraniifolia*, *Heuchera sanguinea*, *Polygonum sphærostachyum*, *Myosotis alpestris*, *Exharbena Lyalli*, *Fritillaria cerissa*, *Silene pusilla*, Saxifraga seedlings from *S. M'Nabiana*, and others, *Potentilla eriocarpa*, &c.

Mr Mackenzie, Warriston Nursery, sent a plant in flower of *Pancratium zeylanicum*.

July 14.

Copy of Address to the Queen on the occasion of Her Majesty's Jubilee:—

"Unto the

"QUEEN'S MOST EXCELLENT MAJESTY

"THE HUMBLE ADDRESS OF

"The Botanical Society of Edinburgh.

"MAY IT PLEASE YOUR MAJESTY,—

"Your Majesty's Loyal and Dutiful Subjects, The President and Fellows of the Botanical Society of Edinburgh, a Society which Your Majesty has graciously honoured with your patronage, beg leave most respectfully to approach the Throne with our warm and heartfelt congratulations on the occasion of the Jubilee of Your Majesty's reign. In doing so we feel that we are addressing not merely the Representative of Institutions of which, as Britons, we are justly proud, or merely a Sovereign whose reign has been one alike of unexampled material prosperity and scientific progress, but one whose personal qualities as a devoted wife and mother, and as a loving and sympathetic Ruler, have commanded the respect and won the affections of her people. That Your Majesty's reign may endure for many years yet to come is the fervent wish and prayer of Your Majesty's devoted and humble servants.

"Signed in name and on behalf of the Botanical Society of Edinburgh, this 17th day of June 1887.

"ALEXANDER DICKSON, *President*."

To which the following reply was received from the Home Secretary:—

"WHITEHALL, *19th July* 1887.

"SIR,—I have had the honour to lay before the Queen the loyal and dutiful Address of the President and Fellows of the Botanical Society of Edinburgh, on the occasion of Her Majesty attaining the fiftieth year of her reign, and I have to inform you that Her Majesty was pleased to receive the same very graciously.—I have the honour to be, Sir, your obedient servant,

"HENRY MATTHEWS.

"*The President of the Botanical Society, Edinburgh, N.B.*"

OFFICE-BEARERS.

At the General Meeting held on Thursday, 11th November 1886, the following Office-Bearers for 1886–87 were elected:—

PRESIDENT.

Professor Dickson, M.D., LL.D., F.R.S.E.

VICE-PRESIDENTS.

Alexander Buchan, M.A., F.R.S.E.
Hugh Cleghorn, M.D., LL.D., F.R.S.E.
Robert Lindsay.
Rev. John Macmurtrie, M.A.

COUNCILLORS.

Symington Grieve.
Andrew Taylor, F.C.S.
William Sanderson.
Rev. J. M. Robertson, M.A.
William Watson, M.D.
Robert Gray, F.R.S.E.
William Craig, M.D., F.R.S.E., F.R.C.S.E.
William B. Boyd of Faldonside.
Thomas Alexander Goldie Balfour, M.D., F.R.S.E., F.R.C.P.E.
Malcolm Dunn, Dalkeith Palace Gardens.

Honorary Secretary—Professor Sir Douglas Maclagan, M.D., F.R.S.E.
Honorary Curator—The Professor of Botany.
Foreign Secretary—Andrew P. Aitken, M.A., D.Sc., F.R.S.E.
Treasurer—Patrick Neill Fraser.
Assistant-Secretary—John M. Macfarlane, D.Sc., F.R.S.E.

LOCAL SECRETARIES.

Aberdeen—Stephen A. Wilson of North Kinmundy.
Berwick—Philip W. Maclagan, M.D.
Birmingham—George A. Panton, F.L.S., 95 Colmore Row.
Calcutta—John Anderson, M.D., F.L.S.
,, George King, M.D., Botanic Garden.
Cambridge—Charles C. Babington, M.A., F.R.S., Professor of Botany.
,, Arthur Evans, M.A.
Croydon—A. Bennett, F.L.S.
Dublin—W. R. M'Nab, M.D., F.L.S., Professor of Botany, Royal College of Science.
Exeter—Thomas Shapter, M.D.
Fife—J. T. Boswell, LL.D., F.L.S., of Balmuto, Kirkcaldy.
Greenock—Donald M'Raild, M.D.
Kilbarchan—Rev. G. Alison.
London—William Carruthers, F.R.S., F.L.S., British Museum.
,, E. M. Holmes, F.L.S., F.R.H.S.
Manchester—Benjamin Carrington, M.D., Eccles.

Melbourne, Australia—Baron Ferdinand von Mueller, M.D.
Nairn—William Alex. Stables.
Norfolk—John Lowe, M.D., King's Lynn.
Nova Scotia—George Lawson, LL.D., Dalhousie.
Ottawa, Ontario—W. R. Riddell, B.Sc., B.A., Prov. Normal School.
Oxford—Professor Bayley Balfour.
Perth—F. B. White, M.D., F.L.S.
Saharunpore, India—J. F. Duthie, B.A., F.L.S., Botanic Garden.
Shrewsbury—Rev. W. A. Leighton, B.A., F.L.S.
Silloth—John Leitch, M.B., C.M.
Wellington, New Zealand—James Hector, M.D., F.R.SS. L. & E.
Wolverhampton—John Fraser, M.A., M.D.
Zanzibar—Sir John Kirk, M.D., F.L.S.

Fellows elected, Session 1886–87.

1886.
Nov. 11. E. A. Ormerod, Dunster Lodge, Isleworth—*Lady Associate.*
C. M. Owen, Knockmullen, Gorey, Ireland—*Lady Associate.*
John Wilson, St Andrews—*Associate.*
Dec. 9. Joseph J. Mooney, F.R.M.S., Manchester—*Res. Fellow.*
Grenville E. Moffat, M.B., C.M., Gibraltar—*Res. Fellow.*
F. O. Bower, University, Glasgow—*Res. Fellow.*
J. Crighton, M.D., Arbroath—*Res. Fellow.*
1887.
Jan. 13. A. H. Gibson, Edinburgh—*Res. Fellow.*
W. B. Simson, Dundee—*Res. Fellow.*
April 14. Rev. W. W. Peyton, Broughty-Ferry—*Res. Fellow.*
James Fingland, Thornhill—*Non.-Res. Fellow.*
May 12. Henry Hay, M.B., Edinburgh—*Res. Fellow.*

ADDITIONS

TO THE

LIBRARY, HERBARIUM, AND MUSEUM,

AT THE

ROYAL BOTANIC GARDEN, EDINBURGH,

FROM 1ST OCTOBER 1886 TO 1ST OCTOBER 1887.

LIBRARY.

BOOKS.

BOHNENSIEG, G. C. M. Repertorium Ann. Literaturæ Bot. periodicæ.—*From the Author.*

DELPINO, FREDERICO. Theoria Generale della Fillotassi.—*From the Author.*

ERNEST, A. Catalogue and Description of National Exhibition of Venezuela in 1883.—*From the Author.*

LISBOA, J. C., GRAY, W., WILSON, G. H. D. Gazette of Bombay Presidency. Botany.—*From the Government.*

LOOMIS, ELIAS, LL.D. Contributions to Meteorology. Revised Edition, 1885.—*From the Author.*

MARSH, O. C. The Dinoceratous Mammals. U.S. Geological Survey Monograph.—*From the U.S. Government.*

MUELLER, BARON FERD. VON. Myoporinous Plants of Australia.—*From the Author.*

ORMEROD, ELEANOR A. Report of Observations of Injurious Insects during the year 1886.—*Presented by Miss Ormerod.*

PENZIG, O. Studi Botanici Gugli Agrumi e Sulle Plante Affini. Letterpress and Plates. Rome. 1887.—*Presented by the Minister of Agriculture.*

POWELL, J. W. Sixth Annual Report U.S. Geological Survey, 1884-85.
——— Mineral Resources of United States.—*From the U.S. Government.*

RUSSELL, J. C. Geological History of Lake Lahontan, U.S. Geological Survey Monograph.—*From the U.S. Government.*

SCHÜBELER, Dr F. C. Norges Vaextrige. Vol. I. and Vol. II. Pt. 1.—*From the Author.*

WEBSTER, A. D. British Orchids.—*From the Author.*

PAMPHLETS, REPRINTS FROM SCIENTIFIC PUBLICATIONS, &c.

Bennett, Arthur, F.L.S. Additional Records of Plants from Scotland. —*From the Author.*

Delpino, Federico. (1) Fondamenti di Biologia Vegetale.

——— (2) Il Materialismo nella Scienza Funzione Mirmecofila nel Regno Vegetale.—*From the Author.*

Duchartre, M. P. (1) Note sur la situation des bulbilles chez le *Bégonia discolor.*

——— (2) Sur un Bégonia phyllomane.

——— (3) Note sur un Bégonia nouveau, à inflorescences epiphylles.

——— (4) Observations sur les fleurs doubles des Bégonias tubereux.

——— (5) Note sur le *Bégonia Socotrana,* Hook. f.

——— (6) Quelques observations relativement a l'influence de la lumière sur la maturation du Raisin.

——— (7) Note sur des Safrans a fleur monstrueuse.

——— (8) Influence de la température sur l'épanouissement et la fermeture des fleurs des Crocus.

——— (9) Note sur des fleurs doubles du grand Muflier.

——— (10) Note sur des fleurs monstrueuses de Grenadier (*Punica granatum,* L.).

——— (11) Observations sur des Marronniers hatifs (*Æsculus Hippocastanum,* L.).

——— (12) Note sur une Poire monstrueuse.

——— (13) Influence de la sécheresse sur la végétation et la structure de l'igname de Chine (*Dioscorea Batatas,* Dene).

——— (14) Note sur des feuilles ramifères de Chau.

——— (15) Observations sur les vrilles des Cucurbitacées.

——— (16) Observations sur les vrilles des Cucurbitacées (2nd note).

——— (17) Note sur deux Roses prolifères.

——— (18) Notice sur le jardin d'essai ou du Hamma près d'Alger.

——— (19) Végétation de quelques Marronniers hatifs en 1879 et 1880.

——— (20) Observations sur la grassette à long éperon (*Pinguicula caudata,* Schlecht).—*From the Author.*

Gray, Asa. (1) A revision of some Polypetalous Genera and Orders.

——— (2) Sertum Chihuahuense : Appendix.

——— (3) Miscellanea.—*From the American Academy of Arts and Sciences.*

Holt, G. A. A List of the Mosses of the Isle of Man.—*From the Author.*

Radlkofer, L. Ueber fischvergiftende Pflanzen. Ueber die durchsichtigen Punkte und andere anatomische Charactere der Connaraceen.

——— Conspectus Sectionem Specierumque Generis *Serjaniæ* Auctus.—*From the Author.*

Reuss, E. L'Exposition Forestière Internationale de 1884 à Edimbourg.—*From the Author.*

Rodrigues, J. Barbosa. O Tamakoare Especis Novas da Ordem das Ternstrœmiaceas.—*From the Author.*

Schwendener, S. Uber Quellung und Doppelbrechung vegetabilischer Membranen. (Extract from "Sitzungberichte der K. P. Academie der Wissenschaften zu Berlin," XXXIV. 1887).—*From the Author.*

Trail, G. W. Marine Algæ of Joppa, Illustrated with Herbarium Specimens.—*From the Author.*

Winter, Dr G. (1) Beitrage zur Pilzflora von Missouri.

——— (2) Exotische Pilze II.

——— (3) Fungi exotici, III.

——— (4) Ueber einige nordamerikanische Pilze II.

——— (5) Extracts from "Revue mycologique," Oct. 1886, and "Journal of Mycology," Vol. I. No. 10.

——— (6) Contributiones ad Floram Mycologicam Lusitanicum.—*From the Author.*

TRANSACTIONS, &c., OF LEARNED SOCIETIES, AND KINDRED INSTITUTIONS.

Adelaide.—Botanic Gardens and Government Plantations.

Report of Progress and Condition during 1886.—*From the Director.*

Amsterdam.—Koninklijke Akademie.

Verslagen en Mededeelingen. Vol. III. Parts 1 and 2.

Belfast.—Naturalists' Field Club.

Annual Report and Proceedings. Series II. Vol. II. Parts 1, 3, 5, and 6.

Natural History and Philosophical Society.

Proceedings for Session 1885–86.

Berlin.—Botanischer Verein fur die Provinz Brandenburg. Verhandlungen. Jahrgang XXVII., XXVIII.

Berne.—Société Helvétique des Sciences Naturelles.

Mittheilungen. 1887.

Actes. Session 1886.—*From the Society.*

Berwick.—Berwickshire Naturalists' Club.

Proceedings, Vol. XI. Nos. 1 and 2, 1879.—*From the Club.*

Bonn.—Naturhistorischer Vereine der Preussischen, Rheinlande, und Westfalen.

Jahrgang, XLII. 2 ; XLIII. 1, 1886-87.—*From the Society.*

Boston.—Boston Society of Natural History.

Proceedings. Vol. XXIII. Part 2.

Memoirs. Vol. III. Parts 12, 13.

Massachusetts Horticultural Society.

Transactions, 1886, Part 2.—*From the Society.*

Braunschweig.—Vereins fur Naturwissenschaft zu fur Geschaftsjahn Jahresbericht, 1886–87.—*From the Society.*

Bremen.—Naturwissenschaftlichen Verein.

Abhandl. Bd. IX. Heft 4.—*From the Society.*

Bristol.—Bristol Naturalists' Society.

Proceedings. Vol. V. Part 2. List of Officers, &c.—*From the Society.*

BROOKVILLE.—Brookville Society of Natural History.
Bulletin No. 2, 1886.—*From the Society.*

BRUSSELS.—Société Royale de Botanique de Belgique.
Bulletin. Tome XXV. Fasc. 2 ; Tome XXVI. Fasc. 1.—*From the Society.*

Académie Royale des Sciences de Belgique.
Bulletin. 3me Série, Tomes IX.–XIII.
Annuaire, 1886–87.—*From the Society.*

CHERBOURG.—Société Nationale des Sciences de Cherbourg.
Memoirs. Tome XXIV. Catalogue de la Bibliothèque, 1883.—*From the Society.*

CINCINNATI.—Society of Natural History.
Vol. IX. No. 4 ; Vol. X. Nos. 1, 2, 3.—*From the Society.*

COPENHAGEN.—Botaniske Forening i Kobenhavn.
Botaniske Tidsskrift (Journal de Botanique). Vol. XV. Parts 2–4, Vol. XVI. Parts 1–3.—*From the Society.*

DUBLIN.—Royal Society.
Transactions. Vol. III. Parts 11, 12, and 13.
Proceedings. Vol. V. Parts 1–6.—*From the Society.*

EDINBURGH.—Botanical Society.
Transactions and Proceedings. Vol. XVI. Part 3, 1886.—*From the Society.*

Royal Society.
Transactions. Vol. XXX. Part 4 ; Vol. XXXII. Part 4 ; Vol. XXXIII. Part 1.
Proceedings, Vol. XII. Parts 3 and 4 ; Vol. XIII. Part 1.—*From the Society.*

Royal Physical Society.
Proceedings. Session 1885–86. Catalogue of the Library.—*From the Society.*

Royal Scottish Society of Arts.
Transactions. Vol. XI. Parts 3 and 4.—*From the Society.*

Geological Society.
Transactions. Vol. V. Parts 2 and 3. Library Catalogue.—*From the Society.*

EPPING FOREST and County of Essex Naturalists' Field Club. Vol. IV. Part 2. The Essex Naturalist. Vol. I. Nos. 1–10.—*From the Club.*

ERLANGEN.—Physikalisch-Medicineschen Sociétät zu Erlangen. Heft 18, 1885–86.—*From the Society.*

FLORENCE.—Nuovo Giornale Botanico Italiano.
Giornale. Vol. XV., Vol. XVI., Vol. XVII. Parts 1 and 2; Vol. XVIII. Parts 1 and 2.—*From the Society.*

GEISSEN.—Oberhessische Gesellschaft.
25th Bericht.—*From the Society.*

GLASGOW.—Natural History Society.
Proceedings. Vol. I. New Ser. Part 3.—*From the Society.*

Philosophical Society.
Proceedings. Vol. XVIII. Session 1886–87.

HAARLEM.—Bevordering van Nijverheid.

Tijdschrift. 4e Reeks. Deel X. Jan. to Dec. 1886. Deel XI. Jan. to Sept. 1887.—*From the Society.*

Koloniaal Museum—(1) Trees of Indian Archipelago; (2) Fibre-yielding Plants of Nederland Colonies; (3) Caoutchouc, &c.

Musée Teyler.—Archives. Série II. Vol. III. Première Partie 1887. Catalogue de la Bibliothèque, Parts 3 and 6.—*From the Corporation.*

HALIFAX.—Central Board of Agriculture. Annual Reports, 1886–87.—*From the Institute.*

HALLE.—Kais Leop. Carol.

Deutsche Akademie der Naturforscher. Leopoldina, Part XXI. Nova Acta. Band L. No. 2.—*From the Academy.*

HERTFORD.—Natural History Society and Field Club.

Transactions. Vol. IV. Parts 4–7.—*From the Society.*

KÖNIGSBERG.—Phyiskal. Ökonom. Gesell. zu Königsberg.

Schriften; XXVII. Jahr. 1886.—*From the Society.*

LIÈGE.—La Belgique Horticole: Annales de Botanique et d'Horticulture. Par Dr Edouard Morren, 1885. Bulletin de la Federation 1887.—*From the Editor.*

LISBON.—Academia Real das Sciencias de Lisboa.

Journal, Nos. 30–44.

LIVERPOOL.—Literary and Philosophical Society of Liverpool.

Proceedings. Vol. XXXIX., Vol. XL.—*From the Society.*

LONDON.—India Office—Forest Department.

Reports for 1886–87.

Reviews of the Forest Administration of the several Provinces under the Government of India for the years 1886–87.—*From the India Office.*

Linnean Society.

Transactions, 2nd Ser. Vol. II. Parts 9–14.

List of Linnean Society, 1886–87.

Journal. Nos. 140–144, 148, 149.

Proceedings, 1886–87, Nov. to June.—*From the Society.*

Pharmaceutical Society.

Calendar for 1887.

Journal and Transactions. Nos. 854–905.—*From the Society.*

Quekett Microscopical Club.

Journal. Series II. Nos. 17–20.—*From the Club.*

Royal Horticultural Society.

Journal. Vol. VII. No. 2; Vol. VIII.

LUND.—Universit. Acta. Tom. XXII., 1886–87.—*From the University of Lund.*

LUXEMBOURG.—La Société Botanique du Grand Duché de Luxembourg. Recueil des Memoires et des Travaux. No. XI., 1885–86.

LYONS.—Société Botanique de Lyons.

Annales, 1886. Bulletin Trimestriel. Nos. 3 and 4, 1886; Nos. 1, 2, 1887.—*From the Society.*

MANCHESTER.—The Botanical Record Club.

Phanerogamic and Cryptogamic Report for the year 1886–87.—*From the Club.*

Melbourne.—Victoria Patents Office.
Patents and Patentees. Vol. XVI.—*From the Officer.*
Geographical Society of Australia (Victoria Branch).
Proceedings at Annual Meeting, Jan. 1886.
Royal Society of Victoria.
Transactions and Proceedings. Vols. XXI. and XXII.
Milan.—Instituto Botanico di Roma.
Annuario. Vol. III. Fasc. 1.
Montreal.—The Canadian Record of Science. Vol. II. Nos. 5 and 6. —*From the Society.*
Geological and Natural History Survey of Canada.
Catalogue of Canadian Plants. Part I. Polypetalæ.
Catalogue of Canadian Plants. Part III. Apetalæ.
Annual Report. Vol. I. 1885, and Maps to accompany.
Moscow.—Société Imperiale des Naturalistes de Moscou. Bulletin. Tom. LXI. Parts 1 and 2; Tom. LXII. Parts 3 and 4; Tom. LXIII. Parts 1, 2, and 3.
Newcastle-on-Tyne.—Tyneside Naturalists' Field Club.
Transactions. Vol. VIII. Part II.; Vol. IX. Part I.
New York.—American Museum of Natural History.
Bulletin. Vol. I. No. 8; Vol. II. No. 1.
Annual Reports, 1886–87.
Torrey Botanical Club.
Bulletin. Vol. XIII. Parts 11 and 12; Vol. XIV. Parts 1–12.—*From the Club.*
Academy of Sciences.
Transactions. Vol. V. Nos. 7 and 8.
Annals. Vol. III. Nos. 11 and 12.—*From the Academy.*
Paris.—Société Botanique de France.
Bulletin. Revue Bibliographique. D, E, and A, B, C.
Comptes rendus. Tom. XXXIII. Part 6; Tom. XXXIV. Parts 1–6.
Session extraordinaire à Millau.—*From the Society.*
Philadelphia.—Wagner Free Institute of Science of Philadelphia.
Transactions. Vol. I.—*From the Institute.*
Academy of Natural Science.
Proceedings. Parts 2 and 3, 1886; Part 1, 1887.—*From the Academy.*
Perth.—Perthshire Society of Natural Science.
Proceedings. Vol. I. Part 6, 1885–86.—*From the Society.*
Plymouth.—Plymouth Institution and Devon and Cornwall Natural History Society.
Annual Report and Transactions. Vol. IX. Part 3.—*From the Society.*
Raleigh, U.S.—Elisha Mitchell Scientific Society.
Journal for 1885–86.
San Francisco.—California Academy of Sciences.
Bulletin. Vol. II. Nos. 5, 6, and 7.
Sydney.—Royal Society of New South Wales.
Journal and Proceedings. Vol. XIX., 1885.

TORONTO.—Canadian Institute.
Proceedings. Vol. IV. Fasc. 2; Vol. V. Fasc. 1.

TRENTON, U.S.—Trenton Natural History Society.
Journal, No. 2.

UPSALA.—Société Royale des Sciences.
Nova Acta. Ser. III. Vol. XIII. Fasc. 2.—*From the Royal Society of Sweden.*

VIENNA.—Annales des K. K. Naturhistorischen Hofmuseums.
Band I. Nos. 1 and 2.

WASHINGTON.—Smithsonian Institution.
Report of Board of Regents, 1885.—*From the Institute.*
U.S. Geological Survey of the Territories.
Bulletins 27–39.—*From the Director U.S. Geological Survey.*

WELLINGTON.—New Zealand Institute.
Transactions and Proceedings. Vol. XIX.—*From the Colonial Museum.*
Colonial Museum and Geological Survey Department.
A Manual of New Zealand Coleoptera. Parts 3 and 4.—*From the Director.*

PERIODICALS.

The Garden. Vols. XXIX., XXX., XXXI.—*From Professor Dickson.*
The Gardeners' Chronicle. Vols. XXV., XXVI., XXVII.—*From Robert Lindsay.*
Nature. Nos. 888–939.—*From the Editor.*

DONATIONS TO HERBARIUM.

BENNETT, ARTHUR. Rare British Plants.
CURRAN, M. K., Curator. N. American Plants, carefully preserved.—*From the Californian Academy of Sciences.*
ELLIOT, G. F. SCOTT. Large parcel of Canary Plants.
FRASER, P. NEILL. Ferns and Flowering Plants from Canaries.
GRIEVE, S. Plants from Rum.
M'ANDREW, JAMES. Rare Plants from Kirkcudbrightshire.
PEARCE, HORACE, Stourbridge. Set of finely preserved British Plants.
TRAILL, G. W. Set of 75 slides illustrating "Marine Algæ of Joppa."
WEBSTER, A. D. Welsh Plants.

DONATIONS TO MUSEUM.

ALEXANDER, JOHN. Three Cases of Cinchona Specimens.
DICKSON, Prof. ALEX. Models of Fungi.

3.

6.

John Wilson, del[t]

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WACHENDORFIA PANICULATA

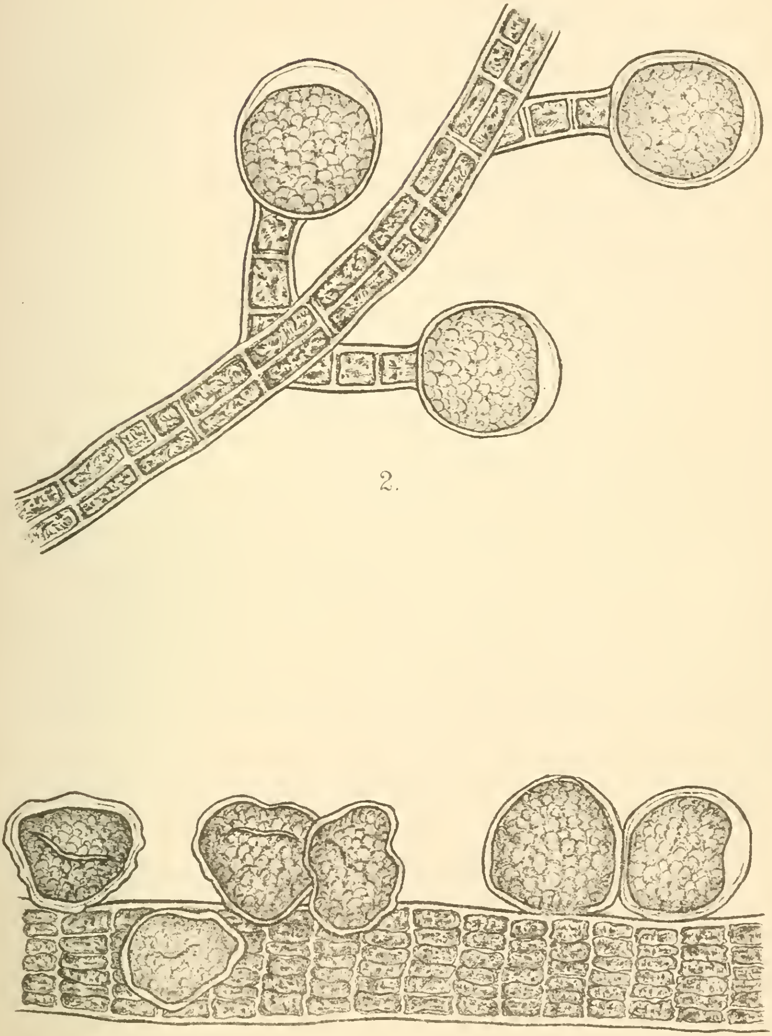

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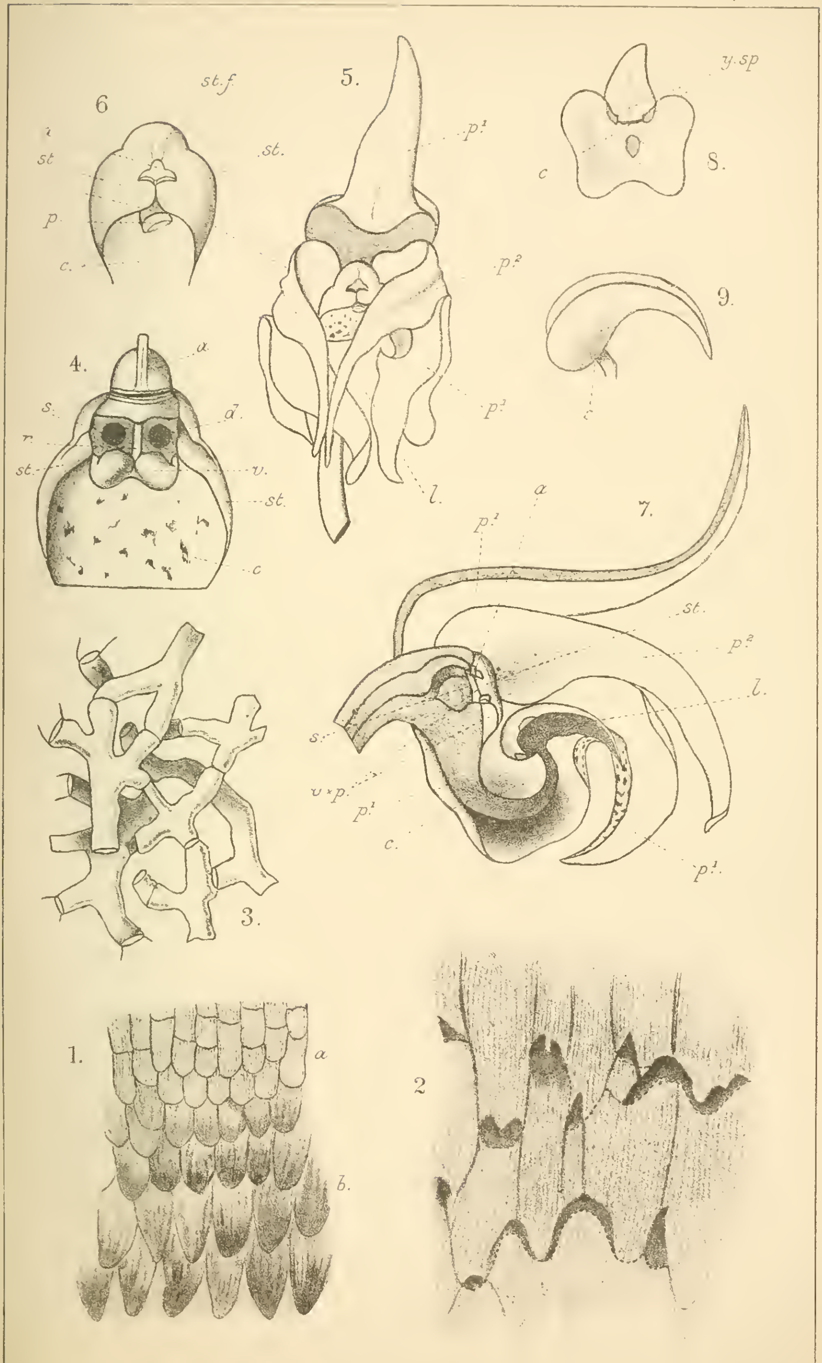
Fig. 1. SPHACELARIA RADICANS, Harv. Fig. 2. S. OLIVACEA, Dillw × 225°



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BOLBOPHYLLUM LOBBI

CONTENTS.

NEILL AND COMPANY, PRINTERS, EDINBURGH.

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY.

VOL. XVII.—PART II.

EDINBURGH:

PRINTED FOR THE BOTANICAL SOCIETY.

MDCCCLXXXVIII.

A complete copy of the Transactions, to Vol. XVII. Part II. inclusive, can be had from the Assistant Secretary. Price £7, 15s.

Dr Spruce's important work, "Hepaticæ of the Amazon and of the Andes of Peru and Ecuador," consisting of 600 pp. letterpress and 22 plates, forms Vol. XV., and may be purchased separately. Price 21s. The work is in Latin, with a few notes in English

TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

SESSION LII.

10*th December* 1887.—WILLIAM CRAIG, M.D., F.R.S.E., F.R.C.S. Ed., President, in the Chair.

The PRESIDENT made the following introductory remarks:—

GENTLEMEN,—My first duty is to return you my sincere thanks for the high honour you have conferred on me by calling me to the Presidential chair. It is an honour to which I could lay no claim, but one which I deeply prize. When I reflect on the long list of distinguished men who have filled this chair, and especially on the high position of my immediate predecessor, who so ably filled the office of President for the past three years, I cannot but feel my own unworthiness to fill such a distinguished position as that of your President. I shall, however, endeavour, so far as I can, faithfully to discharge the duties of the office.

Ever since I became a student in the Botanical Class, under the late Professor Balfour, I have taken a deep interest in this Society, and to my connection with it I am indebted for many of the happiest hours of my life.

This Society owed its origin to the enthusiasm and indomitable energy of the late Professor John Hutton Balfour. On the 8th of February 1836, Dr Balfour entertained to supper in his house, 15 Dundas Street, a few botanical friends, with the object of discussing the formation of a Botanical Society in Edinburgh. The guests were at one with their hospitable entertainer in regard to the formation of such a

Society, and a committee was appointed to make all necessary arrangements. The outcome of this meeting was the formation of the Botanical Society of Edinburgh, on the 17th of March 1836. The Society had twenty-one original members, all enthusiastic botanists. Out of these only three survive—Dr Nicholas Tyacke, Dr George Charles Wallich, and Dr Richard Chandler Alexander-Prior.

As was to be expected from the energy and enthusiasm of the original members, and especially of its founder, Dr Balfour, the Society flourished from its earliest infancy. To such an extent was this the case, that at the end of the first year of its existence the Society had 132 members. The Society has steadily increased ever since, and for more than half a century has occupied a prominent place among the scientific societies of this country.

This success has been due chiefly to three causes—

1. The Society was founded on a truly scientific basis; it was an "Association exclusively devoted to the advancement of botanical science";

2. It adopted the right means to promote this noble end; and

3. The members were true to their membership, and all of them did what they could for the advancement of botanical science.

In the few remarks which I have the honour to make to the Society to-night, it occurred to me that it might be both interesting and profitable to look for a little at the great aims of our Society, and inquire what steps we are taking to further the same.

With regard to the objects for which this Society was formed, we find that in the very foreground it was to bring botanists together, and to promote social intercourse amongst those who are engaged in the pursuit of botanical science. This was specially true of the founders of the Society, and is still perpetuated in the meetings of the Botanical Society Club. Our meetings in this place partake much of the social element, and even our friendly cup of tea, with which our meetings close, is not without its beneficial effects on the members. Our summer meetings, too, in the Royal Botanic Garden, with the delightful walk at the close, conduce much to this same great end. The social character of our meetings is not only a source of pleasure to the members, but is a positive source of great good to us all.

Another object contemplated by the founders of our Society was the concentration of their efforts towards the production of original papers. From the very first this has been a marked feature in this Society. Every volume of our *Transactions* contains scientific papers of great value, many of which, but for the existence of this Society, would never have been written. I am proud to think that, after the lapse of half a century, they still contain papers of the highest scientific value. Quite recently our *Transactions* were enriched by that most valuable contribution to botanical science, "Hepaticæ Amazonicæ et Andinæ," by Richard Spruce; and I trust that, when the volume for the Session on which we are entered shall appear, it will be found that the Fellows of this Society are still zealous workers in this department of science, and that the fruits of their labours are communicated to the world through us. The opening night of the Session gave promise of much excellent work, as evidenced by the able and highly instructive communication of Mr Scott Elliot on "The Flora of the Canary Islands," and the very valuable paper of Mr Traill on "The Marine Algæ of Elie," not to speak of the valuable monthly reports on temperature and vegetation at the Royal Botanic Garden by Mr Lindsay.

A further object contemplated by this Society was the formation of a public herbarium and library. The valuable University Herbarium at the Royal Botanic Garden has been chiefly contributed by the Fellows of this Society; and some years ago the Society made over to Government its valuable library, and annually it still contributes largely to it.

As showing the activity of the members in collecting specimens, I may mention that, during the first year of the Society's existence, "between 4000 and 5000 species and upwards of 60,000 specimens were transmitted to the Society." I would strongly urge on all Fellows of the Society, who have the opportunity of visiting foreign countries, to contribute to the University Herbarium at the Royal Botanic Garden, as has been done by Mr Scott Elliot.

The Society has also done good work by publishing from time to time Catalogues of British Flowering Plants and Ferns.

I find it stated in the early records of the Society, that it would prosecute its objects by "making botanical excursions both in the neighbourhood and to distant parts." These objects are still indirectly pursued by the Society—the former by the Professor of Botany and his students in their regular class excursions, and also by individual members of the Society; and the "distant parts" have not been neglected, for annually the Scottish Alpine Botanical Club, which may be regarded as a branch of this Society, spends a week or ten days examining the Flora of our Scottish Highlands, and for the past seventeen years has done much good work. It was in one of these excursions that the late lamented John Sadler discovered the willow which bears his name, a plant new to science, and the same day *Carex frigida*, a plant new to the British Flora; and last year, in Glen Spean, this Club discovered two new stations for that rare plant *Saxifraga rivularis*, and also a new station for that rarest of British alpines, *Saxifraga cæspitosa*, a plant that had not been previously gathered in Scotland since the foundation of this Society. This work, too, is being taken up and actively prosecuted by the "Camp Committee" of this Society. The members of this Committee have done good work already, and I believe that when they shall be a *Camp* Committee in reality, as well as in name, that still greater discoveries will be made by them.

It was the custom of the Society from the first to appoint *Local Secretaries*, from whom, in their respective districts, all information regarding the Society's objects and proceedings might be obtained. This excellent practice is still observed; but I fear that in not a few cases they are correspondents in name merely, and it is to be hoped that all our local secretaries may from time to time furnish us with such communications as will advance the great objects of this Society.

I wish also to direct attention to the close relation between this Society and the Royal Botanic Garden, which has existed from the very first, and which, I am happy to say, still exists. The members of this Society have done much for the Royal Botanic Garden in the past. They have contributed many seeds of plants from time to time from all parts of the world, and it is hoped will continue to do so more and more. On the other hand, the members have derived much instruction, not to speak of pleasure, from their visits to the Garden.

There is one aspect of this subject to which I wish to direct the special attention of the Fellows, in so far as it bears on the Royal Botanic Garden, namely, to enlist their sympathy and hearty co-operation in securing living plants and seeds of medicinal plants. There has long been in the Garden a part known as the Medicinal Collection, and the curator, Mr Lindsay, is endeavouring to secure specimens of all the medicinal plants of the British Pharmacopœia. Mr Lindsay has already the great majority of the plants in cultivation, and is gradually getting his list completed. I am sure the Fellows of this Society, especially those living in foreign countries, will assist by sending plants or seeds until we have in Edinburgh a complete list of all plants officinal in this country. This is a noble work in which our Curator is engaged, and I hope all of us will assist him so far as lies in our power.

In the interest alike of botanical and medicinal science I plead for this. When we bear in mind that in Edinburgh we have the largest medical school in Britain, a school which is yearly increasing, surely it is of the utmost consequence that the student of medicine should be able to see growing in our Botanic Garden the plants which furnish the various drugs which he is to use in the treatment of disease.

There is another aspect of this question which I must not pass over, because it is of great importance, not only to the profession to which I and many of the Fellows belong, but also to the whole human race. I refer to the propagation and cultivation of important medicinal plants which are either extinct or nearly so in their native habitats. The cultivation of the Cinchonas in India, Java, Ceylon, Jamaica, and many other countries, may be quoted as an illustration. All our supplies of Cinchona are now obtained from cultivated plants, and, as a consequence, the price of that most valuable drug, quinine, is not one-fourth of the price it was a few years ago.

Another most valuable medicinal plant is now largely cultivated in India and other countries, namely, the Ipecacuan plant, *Cephaëlis Ipecacuanha*. This plant is a native of Brazil and other parts of South America, and had been in cultivation in the Royal Botanic Garden for about thirty years prior to 1869. During these thirty years the plants had grown so slowly that the largest specimen was "scarcely one foot in height," and only very few plants were in cultivation.

During August of that year Dr Anderson, Director of the Botanic Garden, Calcutta, visited Edinburgh, and expressed a strong desire to try the experiment of Ipecacuan cultivation in India. By this time the cultivation of Cinchona, another South American plant, had become a complete success, and Dr Anderson thought that a similar success might attend the cultivation of the Ipecacuan, a plant belonging to the same natural family. In the tenth volume of the *Transactions* of this Society, p. 319, we read—"A few of them (rhizomes of Ipecacuan) were taken from one of the plants in the Botanic Garden during the month of August 1869, and after being cut into transverse sections of different lengths, were inserted in a horizontal position over the surface of a pot prepared with drainage and white sand. . . . . . A few weeks afterwards the root-cuttings began to swell, and showed signs of budding. . . . . Young plants so produced are now growing freely in the garden."

This was the beginning of the cultivation of the Ipecacuan from cuttings from the *roots*. By this means, plants can be multiplied indefinitely, and are now cultivated in India and other countries by the thousand, or rather, I should say, by tens of thousands. I believe I am correct in saying that it was Mr Robert Lindsay, the present Curator of the Royal Botanic Garden, who first taught that the Ipecacuan could be propagated by *root*-cuttings, which was an important discovery in connection with the cultivation of medicinal plants, and one for which he has scarcely got sufficient credit. Many of the plants growing in India were sent out from the Royal Botanic Garden, and are now supplying the markets with this valuable medicine. I have in my museum a beautiful specimen of Ipecacuan, sent home from India, and which was obtained from plants sent out from the Royal Botanic Garden. Surely this fact should induce all Fellows of this Society to do what they can to furnish specimens of medicinal plants to our Garden, for it is impossible at present to say how much of our future supply of vegetable drugs will have to be obtained from cultivated plants.

Now that the cultivation of the Ipecacuan plant has become such a success in India, there is a tendency in certain quarters to withhold from Edinburgh the honour which undoubtedly belongs to it. It was from the Royal Botanic Garden here that the knowledge went forth in regard to the cultivation of this plant, and from the Garden also were sent the first plants to India, and which are still growing in India, and have been multiplied so much by the simple means first devised by Mr Lindsay.

You thus perceive that the Society, from its origin, had its attention turned to the whole range of botanical science, and that it adopted the proper means to carry out its noble aims. Let us keep before us the same great objects, and in our several spheres imitate the founders of this Society, and then assuredly that success will be ours which was so characteristic of the Society during the first years of its existence.

The Society during the past year lost by death one Foreign Honorary Fellow, Professor August Wilhelm Eichler, Berlin; three Resident Fellows—Dr J. S. Crichton, Arbroath; Robert Gray; Peterwald Pattison, Trinity; and four Non-Resident Fellows—Sir Walter Elliot of Wolfelee; Dr W. Traill of Woodwick; Dr Andrew Howden Balfour, Portobello; Thomas Moore, Chelsea.

It will thus be seen that the Society has lost several very distinguished members during the past year, Obituary Notices of most of whom have already been presented to the Society; and at last meeting Dr Cleghorn presented an Obituary Notice of a former President of this Society, Sir Walter Elliot.

During the year there were added eight new Resident Fellows, one Non-Resident Fellow, and two Lady-Associates; in all, 11 new members.

The Society now numbers—32 Honorary Fellows, 138 Resident Fellows, 169 Non-Resident Fellows, 68 Foreign Members, 10 Lady-Associates, and 30 Associates;—in all, 447 members.

The Marine Algæ of Elie, with Map of the District (Plate IV.). By GEORGE W. TRAILL, Joppa.

(Read 10th November 1887.)

This locality, extending from the "Lady's Tower" to the "Devil's Cave," is, so far as my experience goes, much more prolific than any other in the Firth of Forth.

It contains, indeed, within little more than three miles of shore, almost as many species as are to be found in the rest of the Firth; and the specimens are, generally speaking, fine.

This unusually favourable growth of Algæ I attribute to the dark basaltic rocks of the locality, together with the southern exposure and sheltered situation.

Finding the shores to be so prolific, I thought it might be advantageous to have a full list of the Algæ, accompanied by an algological map of the district; and I hope that the following attempt may prove of some assistance to botanists in collecting specimens.

The dates given for the fructification and duration of species are necessarily approximate in certain cases, varying according to the maturing influence of the seasons.

1. *Ahnfeldtia plicata*, Ag.
   Common in sandy pools near low-water mark; always submerged. Perennial. Fruit early in winter.
2. *Alaria esculenta*, Grev.
   Common in exposed places at low-water mark; always submerged. Perennial. Fruit in winter.
3. *Asperococcus echinatus*, Grev.
   Common at 7, 9, 12,* &c., in shallow pools near high-water mark; always submerged. Often epiphytic on Algæ. Annual, April to October. Sporangia in summer.
4. *Bangia fusco-purpurea*, Lyngb.
   On smooth stones and on rocks, at 2, at and above half-tide; usually dry at ebb tide, and in the sun. Annual, March to September. Fruit, May and June.
5. *Bonnemaisonia asparagoides*, Ag.
   Cast ashore at 12.
6. *Bryopsis plumosa*, Lx.
   At 2, 4, &c., rare. (Fine at "Shell Bay.") In pools

* The numbers refer to the sections in the accompanying map.

from half-tide to low-water mark; always submerged. Annual, May to October. In best condition in July and August.

7. *Callithamnion arbuscula*, Lyngb.
At 7, 8, 9, and 10, in great abundance, and often in very fine specimens. On vertical rocks in the shade, usually a little below half-tide, in places uncovered for some hours daily. Perennial, but in poor condition and stunted during winter. Fruit from April to Aug.

8. *Callithamnion barbatum*, Ag.
In deep pools at 2, usually on rocks. Sometimes epiphytic on Algæ; always submerged, and in the shade.

9. *Callithamnion Brodiæi*, Harv.
On reefs at 9 in the shade, near low-water mark. Annual, May to October. Fruit, August, September.

10. *Callithamnion corymbosum*, Ag.
In deep pools at 2; always submerged. Annual, June to September. Fruit, July, August.

11. *Callithamnion floridulum*, Ag.
At 7, 8, 9, &c., on sandy rocks near low-water mark; usually dry at ebb tide, and exposed to the sun. All the year. Fruit in autumn and winter.

12. *Callithamnion fruticulosum* ? J. Ag.
On rocks in the shade at 10, at about half-tide level. Fruit in July. Agardh, in writing to me regarding this plant, says—"From examination of the specimen, it looks as if it did not belong to the species with truly distichous branches; and, if so, it may possibly belong to *Callithamnion fruticulosum*, J. Ag."

13. *Callithamnion gracillimum*, Ag.
In deep pools at 2; always on submerged rocks in the shade. Fruit, August, September.

14. *Callithamnion Hookeri*, Ag.
At 3, 7, 8, 9, 12, fine and common. On Algæ near low-water mark, usually in places uncovered for several hours daily. Annual, March to October. Fruit from May to August. This is supposed to be the *Callithamnion roseum* of the *Flora Edinensis.*

15. *Callithamnion plumula*, Lyngb.
"On Algæ, Elie," M'Bain. On rocks and Algæ near low-water mark. Annual, summer. Fruit, July, August.

16. *Callithamnion polyspermum*, Ag.

At 3, 7, 12, &c., at about half-tide level, on shaded vertical rocks and on Algæ; always in places which are uncovered for several hours daily. Annual, March to October. Best months for fruit, May, June, and July. Spores escape at the end of July.

17. *Callithamnion Rothii*, Lyngb.

Common on rocks near high-water mark, usually in the shade, and always at places which are uncovered for several hours daily. Perennial. Fruit in winter.

18. *Callithamnion secundatum*, Ag.

At 7, 8, 12, &c., from about half-tide level to low-water mark, on *Rhodymenia palmata*, &c.; fine. Annual, May to September. Fruit in summer.

19. *Callithamnion sparsum*, Harv.

Cast ashore on stems of *Laminaria Cloustoni*, Le Jolis; rare. Summer and autumn.

20. *Callithamnion Turneri*, Ag.

Chiefly at 4 and 12, on small Algæ at low-water mark; always submerged. Epiphytic on *Polyides rotundus*, *Furcellaria fastigiata*, *Phyllophora Brodiæi*, &c. Annual, May to September. Fruit in summer.

21. *Callophyllis laciniata*, Ag.

Cast ashore from deep water. Biennial. Capsules in spring; granules in summer.

22. *Calothrix confervicola*, Ag.

Common, especially at 7, on small Algæ in shallow pools above half-tide level; always submerged. Annual, summer and autumn.

23. *Calothrix fasciculata*, Ag.

At 12, on vertical rocks near high-water mark, in the shade; rare. Always in places uncovered for many hours daily.

24. *Calothrix pulvinata*, Ag.

At 12, on vertical rocks near high-water mark, in the shade; rare. Sometimes epiphytic on *Fucus canaliculatus*. Always in places uncovered for many hours daily.

25. *Calothrix scopulorum*, Ag.

At 1 and 2, on rocks near high-water mark.

26. *Catenella Opuntia*, Grev.

Fine and abundant at 12, on vertical rocks in the shade, near high-water mark. Perennial. Tetraspores in July.

27. *Ceramium acanthonotum*, Carm.
Common at 3, 10, &c., on rocks in the shade from about half-tide level to low-water mark. All the year. Fruit in winter and spring.

28. *Ceramium ciliatum*, Ducluz.
On rocks at the pier, according to Dr M'Bain.

29. *Ceramium Deslongchampsii*, Chauv.
Common on rocks between tide marks, and epiphytic on the smaller Algæ. All the year. Fruit, July, August, September.

30. *Ceramium diaphanum*, Roth.
At 7, 12, &c., on rocks and the smaller Algæ in pools between tide marks. Annual, March to September. Fruit in July and August.

31. *Ceramium rubrum*, Ag.
Common on rocks and Algæ in pools between tide marks. All the year. Fruit, June, July, August.

32. *Ceramium strictum*, Griff. and Harv.
At 3, 10, &c., on muddy rocks in the shade at about half-tide level. Annual, spring and summer.

33. *Chætomorpha ærea*, Ag.
At the "Fish rock," according to Dr M'Bain.

34. *Chætomorpha arenosa*, Ag.
In shallow pools at 7, at high-water mark, associated with *Enteromorpha percursa.*

35. *Chætomorpha tortuosa*, Ag.
Common, especially at 3, on rocks and Algæ in pools about half-tide level. Very abundant at Rudden's Point, east of Largo Bay. Annual, May to October. Plants sometimes survive the winter. Spores escape end of July.

36. *Chætomorpha melagonium*, Ag.
In pools near low-water mark, especially at 3. Perennial. Fruit in summer.

37. *Chorda filum*, Lx.
Common, chiefly in quiet sandy bays, from a little above low-water mark to 4 or 5 fathoms. Annual, April to December. Fruit in July and August.

38. *Chorda lomentaria*, Grev.
Usually on rocks in pools between the marks. Good at 8. Annual, March to November. Trichosporangia in July and August.

39. *Chorda tomentosa*, Ag.
On submerged rocks a little beyond the low-water mark of spring tides at 4, 5, 8, 9, and 10. Annual. I have seen the plant from May to August only, and two forms would seem to occur.

40. *Chordaria flagelliformis*, Ag.
In pools between tide marks; common. Annual, April to November, and sometimes later. Mr Holmes found capsules in August in one of my Elie plants. A handsome ramillose form occurs here, having its main stem nearly straight, and carried up much higher than in the typical plant, from which it also differs in the ramelli being more numerous, and in their being pointed and sharp at the tips.

41. *Chondrus crispus*, Lx.
Common on rocks between tide marks. Perennial. Fruit in spring and winter.

42. *Chylocladia clavellosa*, Harv.
Growing at 7, at very low tides, on rocks, stones, and Algæ. Annual, April to Oct. Fruit in July and August.

43. *Cladophora albida*, Huds.
At 12, according to Dr M'Bain.

44. *Cladophora arcta*, Kutz.
Not uncommon at 10 and 12, in pools near low-water mark. Annual, March to October.

45. *Cladophora glaucescens*, Grif.
In pools at 12, rare, according to Dr M'Bain. Annual, summer.

46. *Cladophora lætevirens*, Kutz.
Common on rocks and Algæ in pools, usually at about half-tide level. Annual, March to December. Many plants survive the winter. Fruit in summer. Young plants, and new shoots on plants of the previous season, have their ramelli *secund;* all the ramelli being produced on the inner side of the ramulus previously to those on the outer side.

47. *Cladophora lanosa*, Kutz.
Not uncommon, especially at 4 and 12, near low-water mark. Usually epiphytic on *Polyides rotundus*, *Furcellaria fastigiata*, and *Ahnfeldtia plicata*. Annual, April to August (G. W. T.); spring (Crouan).

48. *Cladophora refracta,* Kutz.
In pools near low-water mark at 10 and 12.

49. *Cladophora rupestris,* Kutz.
Common on rocks between tide marks, and at a lower level; rarely epiphytic on other Algæ. All the year. Fruit in summer.

50. *Cladophora uncialis,* Harv.
At 8 and 12, on flat rocks and stones near low-water mark. Life period, from spring one year till summer the next. In best condition in July, old plants losing their gloss, and becoming lighter in shade.

51. *Cladophora* (new species).
In shallow pools at 7, above the high-water mark of neap tides. This is a minute species, much and irregularly branched, with joints from 8 to 12 times as long as broad. It was growing in some abundance in August 1885, but had disappeared a month afterwards, when I returned to the locality in order to watch the plant. None of the specimens were sufficiently perfect to admit of the species being satisfactorily determined, nor has the plant since appeared.

52. *Cladostephus plumosus,* Holmes.
In a shaded pool at 2, often in fine specimens; always submerged. Perennial. Fruit in winter. This species is one of the specialities of the district. It much resembles the *Sphacelaria plumosa* of English botanists, especially when barren, and both were formerly confounded in the *Chætopteris plumosa* of Kutzing. I found it here in 1879, and, noticing some differences in its structure from *Sphacelaria plumosa,* suggested that it was entitled to rank as a sub-species or permanent variety of that plant. I observed the ramuli to be thicker in proportion, and to taper more suddenly towards the apex, and the pinnæ to be longer and less rigid, especially in young plants, also more closely set on the ramuli, and at a more acute angle. Mr Holmes, however, subsequently obtained fruited specimens, and, having thus been enabled to ascertain the true affinities of the plant, has shown that it belongs to the genus *Cladostephus.*

53. *Cladostephus spongiosus*, Ag.
Common on rocks and in pools near low-water mark. Perennial. Fruit in winter.

54. *Corallina officinalis*, Linn.
Common in rock pools between tide marks. Perennial. Fruit in winter and spring.

55. *Cordylecladia erecta*, Ag.
On sandy rocks at very low tides at 4 and 12, accompanying *Phyllophora Brodiæi* and *Plocamium coccineum*. Perennial. Tetraspores in July; capsules in September and October.

56. *Cruoria pellita*, Fries.
On rocks at 3, near low-water mark.

57. *Cystoclonium purpurascens*, Ag.
Common in pools and on exposed rocks from about half-tide level to low-water mark. Annual, April to Oct. (G. W. T.); "July to Oct." (Le Jolis); "spring and summer" (Crouan). Fruit, June, July, August.

58. *Dasya coccinea*, Ag.
Cast ashore. Annual, April to Oct. Fruit, July, Aug.

59. *Delesseria alata*, Lx.
On rocks and Algæ at 3, 4, 7, 8, 12, &c., at and below low-water mark. All the year. Fruit, March, April, May.

60. *Delesseria hypoglossum*, Lx.
"Dredged on Algæ near the Lady's Tower, rare" (M'Bain).

61. *Delesseria sinuosa*, Lx.
Not uncommon on rocks and Algæ in pools between tide-marks, also in deep water. Biennial. Fruit in winter.

62. *Dermocarpa prasina*, Bornet.
At 12, on *Catenella Opuntia*, and at many places on *Polysiphonia fastigiata*.

63. *Desmarestia aculeata*, Lx.
At 4, 9, &c., on stones and rocks in the sea from a little below the low-water mark of spring tides to deep water. Always submerged. Perennial.

64. *Desmarestia viridis*, Lx.
At 4, 9, &c., often accompanying the last mentioned. Annual, spring and summer.

65. *Dictyosiphon fœniculaceus*, Grev.
Common in pools at about half-tide level; epiphytic on Algæ. Annual, April to August. Spores escape in July and August.

66. *Dictyosiphon hippuroides*, Aresch.
Not uncommon in pools at 6, 7, 8, &c., at about half-tide level, where it sometimes grows to upwards of 3 feet in length. Almost always epiphytic on *Chordaria flagelliformis.* Annual, May to September. Spores escape at the end of July and in August.

67. *Dictyosiphon mesogloia*, Ag.
In shallow pools at from the high-water mark of neap tides to about half-tide level, at 2, 3, 6, 7, 12, &c. Annual, May to September. In fruit during July and August, when the spores are enveloped until maturity in gelatinous globules attached to the exterior of the frond.

68. *Dictyota dichotoma*, Lx.
Found by Dr M'Bain "in tide pools near low-water mark." Annual, summer.

69. *Dumontia filiformis*, Grev.
Common in rock pools at about half-tide level. All the year. In best condition from March to October, plants being stunted and comparatively rare during winter. Fruit in summer. The variety *crispata* occurs at places where there are fresh-water streams.

70. *Ectocarpus fasciculatus*, Harv.
At 2, 3, 7, &c., on *Laminaria saccharina* and *Chorda filum;* also on rocks in pools near low-water mark; always submerged. Annual, April to October. Fruit from May to September.

71. *Ectocarpus granulosus*, Ag.
Common on rocks in pools near low-water mark. Annual, April to Oct. Fruit from May to Sept.

72. *Ectocarpus littoralis*, Lyngb.
Common on *Fuci* in pools between tide marks; also on muddy exposed rocks. At all seasons. Fruit in summer.

73. *Ectocarpus secundus*, Kutz.
On limpet shells at 7, in pools between tide marks. Annual, May to September.

74. *Ectocarpus siliculosus*, Lyngb.
Common on Algæ between tide marks. Annual, May to September. Fruit best in June and July.

75. *Ectocarpus sphærophorus*, Carm.
At 7, 9, 12, &c., epiphytic on *Callithamnion arbuscula*, *Ptilota elegans*, &c., on exposed rocks between tide marks. Annual, April to Sept. Fruit from May to August.

76. *Ectocarpus tomentosus*, Lyngb.
Common on *Fuci* between tide marks. Annual, April to September. Fruit in summer.

77. *Elachistea flaccida*, Aresch.
Parasitical on Algæ at 7, at about half-tide level. Annual, June to September. Fruit, July, August.

78. *Elachistea fucicola*, Fr.
Common on *Fuci* between tide marks. Annual, June to September. Fruit, July, August.

79. *Elachistea scutulata*, Duby.
At 8, 12, &c., on *Himanthalia lorea*. Annual, summer and autumn.

80. *Enteromorpha compressa*, Grev.
Common on rocks and stones between tide marks; also epiphytic on Algæ. Vegetates at all seasons.

81. *Enteromorpha clathrata*, Grev.
Common at 7, in pools at about half-tide level. Annual, April to September.

82. *Enteromorpha intestinalis*, Link.
Common, chiefly where there is a mixture of fresh water. Annual, April to September.

83. *Enteromorpha percursa*, Hook.
In pools at 7, near high-water mark. Annual, spring and summer.

84. *Fucus canaliculatus*, Linn.
Common on rocks between half-tide level and high-water mark. Perennial. Fruit from June to Sept.

85. *Fucus nodosus*, Linn.
Common on rocks and boulders at about half-tide level. Perennial. Fruit from December to September.

86. *Fucus platycarpus*, Thuret.
On rocks from near high-water mark to about half-tide level, and occasionally at a lower level. Perennial. Fruit all the year. Spores escape in August.

87. *Fucus serratus*, Linn.
Common on rocks at about half-tide level. Perennial. Best fruit in winter.

88. *Fucus vesiculosus*, Linn.
Common on rocks between tide marks. Perennial. Fruit in winter and summer.

89. *Furcellaria fastigiata*, Grev.
On rocks, chiefly in sandy pools, near low-water mark. Perennial. Fruit in winter.

90. *Gelidium corneum*, Lx.
In pools and on exposed rocks at about half-tide level. Perennial. Typical at 7; var. *crinale* at 9; var. *claratum* at 3.

91. *Gigartina mamillosa*, J. Ag.
Common on exposed rocks and in pools from half-tide level to low-water mark. Perennial. Fruit in winter.

92. *Gloiosiphonia capillaris*, Carm.
At 4, 7, 9, 10, but somewhat uncertain in its appearance. On rocks and stones a little below low-water mark; seldom in pools between tide marks. Annual, June to September. Fruit in July and August. The specimens at 9 and 10 are generally fine, and vary from 12 to 18 inches in height.

93. *Griffithsia corallina*, Ag.
On rocks at and below low-water mark, and epiphytic on *Odonthalia dentata* and other Algæ at 9. Annual. Fruit in summer. Rather rare.

94. *Griffithsia setacea*, Ag.
At 7 and 8 on the perpendicular sides of exposed rocks in the shade, near low-water mark; also in pools. Perennial. Fruit in April, May, and June. Rather rare.

95. *Halidrys siliquosa*, Lyngb.
Common in pools at and below half-tide level; always submerged. Larger plants in deep water. Perennial. Fruit in winter. Spores escape in April.

96. *Hildenbrandtia rubra*, Meneg.
On pebbles and smooth stones in shallow pools, generally at about half-tide level. All the year. Fruit in autumn.

97. *Himanthalia lorea*, Lyngb.
On rocks at low water at exposed places. All the year. Fruit in summer. Spores escape in August.

98. *Hydrolapathum sanguineum*, Stack.
Growing at 8 and 12, under projecting ledges of rock in the shade, near low-water mark; also in deep rock pools: rarely on other Algæ. Larger specimens cast ashore from deep water. Biennial. Fruit from November to March inclusive.

99. *Jania rubens*, Lx.
On Algæ between tide marks, according to Dr M'Bain.

100. *Laminaria Cloustoni*, Le Jolis.
Cast ashore from deep water. Perennial. Fruit in winter.

101. *Laminaria flexicaulis*, Le Jolis.
On rocks at low-water mark. Perennial. Fruit in winter.

102. *Laminaria Phyllitis*, Lx.
In pools near low-water mark, also in deep water. Rather uncertain in its appearance. Annual, spring and summer.

103. *Laminaria saccharina*, Lx.
In pools near low-water mark, also in deep water. Sometimes epiphytic. Fruit in summer and autumn.

104. *Laurencia hybrida*, Lenorm.
Common on exposed rocks, and in pools, at about half-tide level; rarely epiphytic. All the year. Tetraspores in winter and spring; ceramidia in July.

105. *Laurencia pinnatifida*, Lx.
Common on rocks at exposed places at low-water mark; sometimes epiphytic. All the year. Tetraspores in winter and spring; ceramidia in July.

106. *Leathesia tuberiformis*, Gray.
Common, especially at 3, from about half-tide level to low-water mark, on Algæ and rocks in the shade. Annual, May to October.

107. *Litosiphon Laminariæ*, Harv.
Epiphytic on *Alaria esculenta* at 2, 7, 8, 12, &c., in pools near low-water mark; always submerged. Annual, June to October. Fruit in August.

108. *Litosiphon pusillus*, Harv.
Epiphytic on *Chorda filum*, at 3, 6, 7, 8, 9, &c. Annual. Spores escape in July and August.

109. *Lomentaria articulata*, Ag.
At 7, 12, &c., on rocks in the shade, and sometimes on Algæ, near low-water mark. Annual, April to October. Fruit in summer.

110. *Lyngbya æstuarii*, Liebm.
At 7, in pools in the shade, which are flooded only by spring tides; amongst decaying Algæ.

111. *Melobesia Laminariæ.*
On stems of *Laminaria Cloustoni.*

112. *Melobesia Lenormandi*, Aresch.
On stones and shells between tide marks.

113. *Melobesia polymorpha*, Harv.
Common on rocks between tide marks, and in deep water.

114. *Melobesia pustulata*, Lx.
On Algæ between tide marks. Perennial. "Fruit in autumn" (Crouan).

115. *Mesogloia vermicularis*, Ag.
At 3, 4, 5, &c., at low-water mark on stones and rocks; also epiphytic on *Polyides rotundus*, *Furcellaria fastigiata*, and *Phyllophora Brodiæi*. Always submerged. Annual, summer.

116. *Mesogloia virescens*, Carm.
Common on rocks and stones in pools at about half-tide level; very rarely on Algæ. Always submerged. Annual, spring and summer.

117. *Monostroma Grevillei*, Ag.
Not uncommon at 1 on rocks, stones, and Algæ, at about half-tide level. Occurs chiefly where there are fresh-water streams. Annual, March to June (G. W. T.); "spring" (Crouan); "February to April" (Le Jolis).

118. *Myrionema strangulans*, Grev.
At 4, parasitic on *Enteromorpha compressa*, at about half-tide level. Annual, summer and autumn. Fruit in July and August.

119. *Myrionema punctiforme*, Harv.
At 4, parasitic on *Porphyra vulgaris*, at about half-

tide level. Annual, summer and autumn. Fruit in July and August.

120. *Myriotrichia clavæformis*, Harv.
At 7, 10, 12, &c., in pools from near high-water mark to about half-tide level; epiphytic on Algæ. Annual, spring and summer.

121. *Myriotrichia filiformis*, Harv.
Associated with the preceding. Annual, spring and summer.

122. *Nitophyllum laceratum*, Grev.
Cast ashore; sometimes on *Laminaria Cloustoni*. Annual, May to Sept. Fruit in July and August.

123. *Nitophyllum punctatum*, Grev.
Cast ashore, rare. Dredged by Dr M'Bain off the Lady's Tower. Annual, May to September. Fruit in July and August.

124. *Odonthalia dentata*, Lyngb.
At 9, on stones and rocks from a little below low-water mark to deep water. Perennial. Fruit in winter.

125. *Oscillatoria subuliformis*, Thw.
Associated with *Leptothrix radians* on the dark walls of the Devil's Cave, near high-water mark.

126. *Petrocelis cruenta*, J. Ag.
Common on rocks near low-water mark. Perennial. Fruit in winter.

127. *Phlæospora brachiata*, Bornet.
At 2, 7, &c., on *Rhodymenia palmata*, in pools between tide marks. Annual. Fruit, June, July, August.

128. *Phlæospora tortilis*, Aresch.
At 3, 4, 5, 10, in pools at about half-tide level. Annual, March to Sept. Fruit in July and August.

129. *Phyllitis fascia*, Kutz.
At 5 and 6, on rocks and stones in pools at about half-tide level. Annual, March to November. Trichosporangia in spring and summer.

130. *Phyllitis cæspitosa*, Kutz.
Common on rocks and stones in pools at about half-tide level. Annual, March to November. Trichosporangia in spring and summer. The form *debilis* is associated with this.

131. *Phyllophora Brodiæi*, J. Ag.
At 4, 12, &c., usually in sandy pools near low-water mark; also in deep water. Perennial. Fruit in winter.

132. *Phyllophora membranifolia*, J. Ag.
At 4, and very fine at 12, on rocks and stones near low-water mark. Perennial. Fruit in winter.

133. *Phyllophora rubens*, Grev.
At 10 and 12, in fine specimens, in pools, and under shelving rocks near low-water mark; also in deep water. Perennial. Fruit in winter.

134. *Phyllophora Traillii*, Holmes.
At 3, 12, &c., at about the low-water mark of spring tides, on shaded rocks, or in pools; sometimes amongst sponges. All the year. Fruit in winter.

135. *Plocamium coccineum*, Lyngb.
At 4, 7, 8, 12, at low-water mark, but in small specimens, on rocks and acorn shells; sometimes on Algæ. Usually in deep water. Perennial. Fruit in summer.

136. *Polyides rotundus*, Harv.
Common on rocks in pools near low-water mark. Perennial. Fruit in winter.

137. *Polysiphonia atro-rubescens*, Grev.
On sand-covered rocks, also in pools, at 4, near low-water mark. All the year. Fruit in summer and autumn (G. W. T.); "winter and spring" (Crouan); "winter" (Le Jolis).

138. *Polysiphonia Brodiæi*, Grev.
At 1, 2, and 12, on rocks and Algæ in pools near low-water mark. Annual, May to September. Fruit in July and August.

139. *Polysiphonia byssoides*, Grev.
Cast ashore from deep water east of the Lady's Tower. Annual, June to October. Fruit in July and August. Sometimes cast ashore in great abundance at the east of St Monance after S.W. gales in summer.

140. *Polysiphonia elongata*, Grev.
On stones and shells in deep water; seldom between tide marks. Rarely growing at 3 and 4 at the

lowest level of spring tides. Perennial. Fruit in July and August.

141. *Polysiphonia elongella*, Harv.
"Near low water," according to Dr M'Bain.

142. *Polysiphonia fastigiata*, Grev.
Usually epiphytic on *Fuci;* sometimes growing on rocks. Perennial. Fruit from June to September.

143. *Polysiphonia fibrata*, Harv.
At 3, 7, &c., on damp, exposed rocks, and on Algæ, in the shade, a little below half-tide level; sometimes in pools. Annual, summer and autumn. Fruit from June to September inclusive.

144. *Polysiphonia fibrillosa*, Grev.
Chiefly at 7 and 8, on rocks, and on *Cladostephus spongiosus*, in clear sunny pools, usually a little above half-tide level. Very fine, and often abundant in pools a little to the east of the "crooked skerry." Perennial. Fruit in July, August, and September.

145. *Polysiphonia nigrescens*, Grev.
Common on rocks, especially at 2, and on *Corallina officinalis* in pools between tide marks. Perennial, but usual duration from March to October. Young shoots on old plants generally appear in January. Fruit from June to September. The form *affinis* also occurs.

146. *Polysiphonia parasitica*, Grev.
At 2 and 7, on rocks in shaded pools between tide marks; also cast ashore epiphytic on *Laminaria Cloustoni.* Always submerged. Annual, April to October. Fruit in July and August.

147. *Polysiphonia urceolata*, Grev.
On rocks and Algæ at 6, between tide marks, usually in pools. Usual duration from March to October, but plants sometimes survive the winter. Fruit in July and August. The variety *patens* also occurs.

148. *Porphyra laciniata*, Ag.
Common on exposed rocks, and on Algæ, usually between half-tide level and high-water mark. All the year. Fruit best in September.

149. *Porphyra leucosticta*, Thuret.
Epiphytic on Algæ from half-tide level to low-water mark. Annual, May to October. Fruit best in September.

150. *Porphyra vulgaris*, Ag.
On rocks and Algæ in pools between tide marks. Annual, May to October. Fruit in August and September.

151. *Prasiola marina*, Crouan.
On rocks and boulders at about the high-water mark of neap tides. All the year. In best condition in winter and spring, and generally poor in summer and autumn. Fruit in February and March.

152. *Protococcus* (*species?*), Thuret.
At 2 and 3, on rocks and stones in brackish pools above high-water mark; also epiphytic on *Enteromorpha compressa.*

153. *Ptilota elegans*, Bonnem.
At 3, 7, 12, &c., on shaded rocks and boulders, and in dark crevices, from a little below half-tide level to low-water mark. Perennial. Fruit in spring and summer.

154. *Ptilota plumosa*, Ag.
Cast ashore from deep water. Epiphytic on *Laminaria Cloustoni.* Perennial. Fruit, June, July, August.

155. *Punctaria plantaginea*, Grev.
At 5, 6, and 12, in pools from about half-tide level to near high-water mark. Annual, March to July.

156. *Punctaria tenuissima*, Grev.
At 2, in deep pools, epiphytic on *Laminaria flexicaulis* and *Laminaria saccharina.* Annual. Fruit in August and September.

157. *Ralfsia verrucosa*, Harv.
At 3, 12, &c., in shallow pools between high-water mark and half-tide level, incrusting rocks and stones; also on exposed rocks in damp places. Perennial. Fruit in July and August.

158. *Rhodomela lycopodioides*, Ag.
Cast ashore, epiphytic on *Laminaria Cloustoni.* Perennial. Fruit from March to June.

159. *Rhodomela subfusca*, Ag.
Common on rocks and stones in pools between tide marks. Perennial. Tetraspores in swollen ultimate ramuli in summer, in *stichidia* in winter.

160. *Rhizoclonium riparium*, Kutz.
At 3, 11, &c., on rocks and Algæ near high-water mark. All the year (G. W. T.); "winter and spring" (Crouan); "all the year" (Le Jolis).

161. *Rhizoclonium Kochianum*, Kutz.
At 3, on iron-work (Holmes).

162. *Rhodophyllis bifida*, Ag.
"On Algæ; very rare" (M'Bain).

163. *Rhodymenia palmata*, Grev.
Common on exposed rocks, and in pools between tide marks; also epiphytic on Algæ. Biennial. Granules, January, February; tetraspores, August; tubercles, June, July, August.

164. *Rivularia atra*, Roth.
At 6, 7, &c., on rocks, stones, and Algæ in pools near high-water mark. At all seasons.

165. *Saccorhiza bulbosa*, De la Pylaie.
Cast ashore from deep water.

166. *Schizymenia edulis*, Ag.
At 1, 2, 8, 12, &c., on rocks near low-water mark. Perennial. Tetraspores, July, August.

167. *Sphacelaria cirrhosa*, Ag.
At 5, 7, and 12, epiphytic on Algæ in pools at and above half-tide level. All the year. Fruit in June and July; propagula in July.

168. *Sphacelaria olivacea*, Dillwyn.
At 2 and 12, in velvety patches on rocks near high-water mark, accompanying *Callithamnion Rothii*. All the year. Unilocular sporangia, pedicellate, in winter.

169. *Sphacelaria plumigera* (?), Holmes.
At 12, on sand-covered rocks at low-water mark, according to Professor Henderson. The plant, however, was not collected for examination, and as the distinction between it and *Cladostephus plumosus* (Holmes) was not well understood at the time Professor Henderson saw the specimens, it may

have been the latter species which he found, and which occurs in the district.

170. *Sphacelaria radicans*, Harvey.
At 7 and 12, on sand-covered rocks near low-water mark. All the year. Fruit in winter.

171. *Sphacelaria scoparia*, Lyngb.
At 7 and 12, in fine specimens, and in considerable abundance, accompanying *Sphacelaria cirrhosa*, in deep shaded pools above the high-water mark of neap tides. All the year. These, which I discovered in the summer of 1885, are the only Firth of Forth localities recorded.

172. *Streblonema velutina*, Derb. et Sol.
At 8 and 12, parasitic on *Himanthalia lorea*, usually associated with *Elachistea scutulata*. Annual. Fruit, July, August.

173. *Symploca Harveyi*, Le Jolis.
At 2 and 7, in shallow rock-pools near high-water mark, the finest specimens being in the shade. Rarely epiphytic on *Cladostephus spongiosus*. Annual. Certified by Bornet (G. W. T., 1879).

174. *Ulothrix flacca*, Thuret.
At 8 and 12, on rocks and Algæ near high-water mark, usually in the shade; often associated with *Ulothrix isogona*. Annual, November to August. Fruit in winter and spring. Spores escape in May and June.

175. *Ulothrix isogona*, Thuret.
At 8 and 12, associated with the above. Annual, November to August. Fruit in winter and spring. Spores escape in May and June.

176. *Ulva latissima*, Linn.
Common on rocks and stones, and epiphytic on Algæ, in pools between tide marks. All the year. In best condition in May, June, and July.

177. *Ulva Linza*, Linn.
Common in pools at about half-tide level. Annual, May to September.

On the Fruits of the Genus Anemone. By Dr EDWARD JANCZEWSKI, Professor of Botany, Cracow.

(Read 9th February 1888.)

The genus Anemone, notwithstanding the real affinity of the genera which botanists have classified under this name, consists of plants displaying such a decided difference in their nutritive and reproductive organs, that many attempts have been made to divide them into smaller genera or subgenera. These divisions, however, have not proved satisfactory as yet, not having been founded on sufficiently thorough investigations. Entirely different genera have often been classified together, and on the other hand those more nearly allied have been separated; less important characteristics have been remarked, and the most important overlooked.

While studying the genus Anemone monographically, the writer had the opportunity of convincing himself that the difference consists chiefly in the fruit, the structure and form of which are the most remarkable of all the biological characteristics. The confirmation of this thesis will be developed later on.

The fruit of the Anemone is a nut (achene) containing one seed, with a large endosperm without starch, and one embryo, rather small, with two perfectly developed cotyledons, or one very small roundish rudimentary embryo. As an indehiscent and dry fruit, the achene, in the first place, serves to protect the seeds (till the time of their germination) by means of its pericarp, which consists of layers of parenchyma and sclerenchyma; secondly, it aids their dissemination by means of animals, wind, or even water.

That is also the reason why the achenes of the genus Anemone vary in their outward appearance; all possess, however, a persistent though variable style. Even the structure of the pericarp is adapted to certain purposes; so is also the variety in the length and manner of growth of the hair of the achene, which cannot fail to strike us.

On account of the difference in the form of the achene and its embryo, the writer feels justified in distinguishing the following types in the genus Anemone:—

(A) Embryo without any cotyledons rounded; in the first year the main root issues from the fruit, without appearing above ground.

1. *Hepatica,* Dill,* *Cat. Plant. Giss.*, p. 108, Tab. v., 1719.

The second year after the seed has been sown, green cotyledons appear above ground. Fruit short or longish, oviform, short hairy; style short. At the base of the fruit an apophysis is formed from the luxuriantly developed cells of the epidermis. No special organ for the dispersion of the seeds.

2. *Sylvia,* Gaud.,† *Flora Helv.*, iii. p. 490, 1828.
Anemonanthea, DC., *Syst.*, i. p. 196, 1818, pr. prt.

In the second year there appears above ground one leaf, rarely two; cotyledons under ground. Fruit oviform or almost round, covered with short hairs, rare, and of equal length; style short. No special organ for the dispersion of the seeds.

(B) Embryo bicotyledonous; cotyledons generally appear above ground some weeks after dissemination.

3. *Omalocarpus,* DC.,‡ *Syst.*, i. p. 212, 1818.

Achenes flat (flattened at the side), wing-like, hairless; style very short. The petioles of the cotyledons are joined in the germs up to the lamina. Owing to its form, the achene is particularly adapted for being transported to a considerable distance by the wind.

4. *Anemonidium,* Spach,§ *Hist. vég. phan.*, vii. p. 248, 1839.

Achenes flattened at the side, spongy at the margins, which resemble thick wings, hairless or shortly hairy. The spongy margins (or wings), whose air-filled cells are impervious to water, are instrumental as a means of dissemination, not only by wind, but also by water.

* *H. triloba,* Chaix; *H. transsylvanica,* Fuss.; *H. Falconeri,* Thoms.

† *Anemone nemorosa,* L.; *A. ranunculoides,* L.; *A. trifolia,* L.; *A. altaica,* Fisch.; *A. cœrulea,* DC.; *A. umbrosa,* C. Mey.; *A. udensis,* Traut et Mey.; *A. reflexa,* Steph.; *A. nikoënsis,* Max.; *A. deltoidea,* Hook.; *A. appenina,* L.; *A. stolonifera,* Max.; *A. baikalensis,* Turcz.; *A. flaccida,* Fr. Schmidt; *A. Delavayi,* Franch.

‡ *Anemone narcissiflora,* L.; *A. elongata,* Don; *A. polyanthos,* Don; *A. tetrasepala,* Royle; *A. demissa,* Hook. et Thoms.

§ *Anemone pennsylvanica,* L.; *A. dichotoma,* L.

5. *Rivularidium*, nov. sect.* *Anemonospermos*, DC., *Syst.*, i. p. 208, 1818, pr. prt.

Achenes mostly oviform, never flattened, hairless. Style more or less short, generally curved like a shepherd's crook at the end. Either there exist no organs for the dispersion of the seed (?), or the curved style serves to attach the fruits to the hair of mammalia. These fruits being the heaviest in this genus, the influence of the wind as a means of dissemination is excluded.

6. *Pulsatilloides*, DC.,† *Syst.*, i. p. 195, 1818.

Achenes elongated or oviform (1 : 4 or 1 : 5); style of equal length or shorter. The pericarp is densely clothed with stiffish, slanting hair, longer at the base of the style, and shorter at the base of the fruit. By means of this hair the fruit is dispersed by mammalia, and in the same degree by the wind.

7. *Pulsatilla*, Tourn.,‡ *Hist.*, p. 248, Tab. cxlviii. 1700.

Fruit small, generally inverted, oviform, style ten times as long; achene densely clothed with short hair; style, on the contrary, scattered long hairy. Dissemination through wind by means of the hairy styles; the hair of the pericarp, on the other hand, adhering to the hair of mammalia.

8. *Eriocephalus*, Hook. et Thoms.,§ *Flor. Ind.*, i. p. 20, 1835.

Anemonanthea et Anemonospermos, DC., *Syst.*, i. pp. 196 et 208, 1818, pr. prt.; *Phæandra*, Spach., *Hist. vég. phan.*, vii. p. 249, 1839; *Oriba*, Adans., *Fam.*, ii. p. 439, 1763.

Fruit small, roundish-oval or club-shaped, in section

* *Anemone rivularis*, Hamilt.; *A. antucensis*, Kz. Pöpp.; *A. Richardsoni*, Hook.; *A. Sellowi*, Pritz.; *A. rigida*, Gay; *A. hepaticæfolia*, Hook.; *A. crassifolia*, Hook.; *A. rupestris*, Wall; *A. mexicana*, H. B. K.; *A. aequinoctialis*, Pöpp.

† *Anemone capensis*, Lam.; *A. alchemillæfolia*, E. M.; *A. glaucifolia*, Franch.; *A. obtusiloba*, Don.; *A. trullifolia*, Hook. et Thoms.

‡ *Pulsatilla alpina*, Spreng.; *P. albana*, Stev.; *P. cernua*, Spreng.; *P. chinensis*, Bunge; *P. dahurica*, Fisch.; *P. Halleri*, All.; *P. patens*, Mill.; *P. pratensis*, Mill.; *P. vernalis*, Mill.; *P. vulgaris*, Mill.; *P. ajanensis*, Rgl. et Tilling.

§ *A. biflora*, DC.; *A. caroliniana*, Walt.; *A. coronaria*, L.; *A. hortensis*, L.; *A. palmata*, L.; *A. baldensis*, L.; *A. decapetala*, L.; *A. japonica*, Zucc. et Sieb.; *A. multifida*, DC.; *A. parviflora*, Mchx.; *A. rupicola*, Camb.; *A. sylvestris* L.; *A. virginiana*, L.; *A. vitifolia*, Hamilt.

round or lentiform; style short, or of the same length as the achene; pericarp densely clothed with soft long hair, longest at the base of the achene. This kind of hair is especially adapted for transporting the fruit to a considerable distance by means of the wind.

9. *Barneoudia,** Gay, *Hist. Chil. Bot.,* i. p. 29, Tab. i., 1845.

Achene bean-shaped, style of nearly equal length; the parenchyma of the achene has net-like incrassation. Achene covered with erect hair of the same length as itself, but longer than the hair of the style. Means of dissemination, the hair.

10. *Exinvolucratæ,* nov. sect.

Anemone integrifolia, Spreng., occupies a separate place, owing to the entire absence of the involucre. The writer regrets not having been able to see a ripe fruit, but concludes it must be hairy, judging from the style, when in the state of fructification.

The fruit of the genus Anemone originates in the style, which contains in the ovary only one involucral ovulum. The warts, which are to be found in the ovary above this ovulum, and which Baillon † regards as abortive ovula and characteristic of this genus, have no diagnostic value, because they are only to be found in some species, and are of doubtful nature.

The ovulum of the genus Adonis, having two involucres, ‡ cannot be classed with the genus Anemone.

* *Barneoudia chilensis,* Gay ; *B. major,* Ph.; *B. Domeykoana,* Leib.

† *Histoire des Plantes, Renonculacées,* p. 44.

‡ *Adonis æstivalis,* L.

Additions to the Scottish Flora during 1887, *with a Résumé of the Year's Work.* By A. BENNETT, F.L.S., Croydon, Surrey.

(Read 9th February 1888.)

In these notes I have endeavoured to give some of the results of the investigation of Scottish plants, and their distribution during 1887, as kindly supplied to me by correspondents or friends. I propose shortly to notice the work of those I have knowledge of, beginning with the most northern counties. My friend Mr Beeby, in Shetland, has been fortunate enough to gather three additions to our flora, *Callitriche polymorpha*, Lönn., *Hieracium pulchellum*, Lindb., and *Carex cæspitosa*, Lin. (the true plant of Fries and Drejer), besides many additions to the list for the islands; such as *Potamogeton prælongus*, Wulf., *P. pectinatus*, L., *Geum rivale*, *Rumex conspersus*, &c. In Caithness, Mr F. Hanbury has also done good work, adding (with my friends, Dr Ward and Mr W. W. Reeves) some twenty plants to its flora, as *Hieracium argenteum*, *Allium ursinum*, *Oxyria reniformis*, and several Hieraceæ, which are now in Dr Lindberg's hands for determination. Among them I consider he has two (if not three) new to our flora. In West and East Sutherland, the Rev. E. S. Marshall has gathered *Carex aquatilis*, *C. alpicola*, *Equisetum arenarium*, *Salix Myrsinites*, *Carex pelia*, F. O. Lang (a sub-species of *panicea*), and others, especially *Pseudathyrium alpestre*, on the east side of Ben Clibrick, and *Juncus alpinus*, Vill., in West Sutherland.

In the west of Scotland, Mr Ewing and his confrères have done good service in several of the counties by recording many of the commoner species wanting in the 2nd edition of Watson's *Topographical Botany*. As noted in the *Scottish Naturalist*, one of the new plants has been found in the west—*i.e.*, *Arabis alpina*, Linn., in the Isle of Skye—by Mr H. C. Hart, in July last. In Inverness, Mr G. C. Druce has been working that country side of the Cairngorm watershed, and it has proved very rich, especially Glen Eunich. He has there gathered many of the very rare alpines, such as *Hieracium aggregatum*, *globosum*, *melanocephalum*, *senescens*, *eximium*, &c., *Carex aquatilis*, *C. lagopina*, *Phleum alpinum*, *Alopecurus alpinus*, &c. In Perthshire, Dr White and Mr Brebner have again added to our flora by gathering *Juncus* *alpinus*, Vill., in three localities, besides other additions to the county flora. Coming further south, to the counties of Dumfries, Kirkcudbright, and Wigtown, some good additions have been made by Messrs M'Andrew, Fingland, and Professor Oliver, such as *Rhynchospora fusca*, R. et S., *Juncus tenuis*, Willd., a second Scottish station for *Carex punctata*, Gaud., &c.; besides these, many others have been ascertained to have more extended distribution. The full list of these will appear (as usual) in the *Scottish Naturalist;* but I may here say that the aggregate number will amount to more than 600 new records,—a sufficient evidence that botanists were not idle in 1887.

I will now notice the additions to the flora, giving a few particulars and references under each:—

Arabis alpina, Linn., *Spec. Pl.*, t. 2, p. 664 (1753).
Wahl., *Fl. Lapponica* (1812), pp. 181–2.
Babington, *Revision Iceland Flora*, p. 13.
Grœnlund, *Islands Flora* (1881), pp. 46–7.
Rostrup, *Færœrnes Flora* (1870), p. 39.
R. Brown, *Flor. Discoana*, p. 268.
H. C. Hart, *Journal of Botany* (1887), p. 247.

It is figured in the *Botanical Magazine*, and in *Flora Danica*, t. 62.

In Europe it occurs in Lapland, Finmark, Norway! Sweden! Iceland! Spitzbergen! Nova Zemblia, Faroe (and all Europe, except Turkey, Greece, and Sicily). In Canada, Alaska, Greenland! Labrador! Arctic Siberia, and Kamtschatka!

Gathered by Mr H. C. Hart, in July 1887, in three distinct places in the northern part of the Cuchullin range, in the Isle of Skye, on the west coast of Scotland, at the height of 2300 to 2800 feet, in very stony and steep places. Mr Hart gathered very few specimens, but by his kindness I am enabled to show one of the plants then found. Associated with it were *Alchemilla alpina, Arabis petræa, Saussurea alpina, Oxyria reniformis, Saxifraga stellaris, Cerastium alpinum*, and *Azalea procumbens.*

Callitriche polymorpha, Lönnroth, in *Observationes criticæ plantas suecicæs illustrantes* (1854), p. 19.
C. verna, L. suec. p. m. p. fide Lönnroth.
Lönnroth, in *Bot. Notiser*, p. 4, fig. *c. cm.*

Hartman, *Hand. i Skan. Flora* (ed. 11), 1879, p. 383.
Blytt, *Norges Flora*, p. 396.
Nyman, *Consp. Flor. Europ.*, p. 250.

In Europe it occurs in Sweden, in Skane, W. Bothnia, Öland, Gotland, Lapland, and in Norway to 66° 5′.

Gathered by Mr Beeby, in August 1887, in the Shetland Isles, and determined by Dr H. Nilson of the Lund Botanical Museum. Unfortunately, Mr Beeby only gathered two sheets of it, so I am able only to send a Swedish specimen for the Herbarium; but he tells me it occurred in abundance, and he hopes to gather it again next summer.

Juncus tenuis, Willd., spec. 2, 214 (1799).

J. gracilis, Smith, in *English Botany*, No. 2176 (1816).
J. gesneri, Smith, in *English Flora*, vol. ii. p. 167 (1828).
G. C. Druce, in *Scottish Naturalist* (1883–4), p. 264.
H. N. Ridley, in *Journal of Botany* (1885), p. 1.
Fig. Reichenbach, *Ic. Flor. Germ.*, pl. 393, fig. 887.
Ridley, *Journal of Botany*, t. 253 (1885).

In Europe it occurs in Holland, Belgium, France, Germany. In America and in New Zealand; but my friend Mr Cheeseman, who found it there, now thinks it may have been introduced.

Gathered by Mr M'Andrew "on the roadside three-quarters of a mile west of New Galloway, Kirkcudbrightshire, near a house, along with *Juncus squarrosus*, *J. lamprocarpus*, and grasses, &c." There may sound something of suspicion in this station, but the plant occurs in exactly similar places on the Continent, and is scattered in a peculiar way over its area of growth. The interest in this species is that it is "one of Don's reputed discoveries," and said to have been found by him, "in 1795 or 1796, by the side of a rivulet or marshy ground among the mountains of Angusshire, but very rarely." No one has since found this in Scotland, until Mr M'Andrew's interesting find. In 1883 a single tuft of it was found by Mr Towndrow in Herefordshire. Full particulars of Don's plant will be found in Mr Druce's article in the *Scottish Naturalist* for 1883–84.

Juncus alpinus, Villars, *Histoire pl. du Dauphiné*, vol. ii. p. 233 (1787).

J. ustulatus, Hoppe, *Aul. Gräser Gewäsche*, &c. (1819).
J. fusco-ater, Schreb., *Flora Erlangensis* (1811), p. 149.
J. geniculatus, Schrank, *Baier fl.*, i. p. 613, with many other synonyms.
Blytt, *Norges Flora* (1861), pp. 288, 1869.
Koch, *Syn. Fl. Ger. et Helv.*, ed. 2, p. 843.
Lange, *Hand. i Danske Fl.* (1864), p. 265.
Grœnlund, *Islands Flora* (1881), p. 100.
Fig. *Flora Danica*, t. 2171.
Reichenbach, *loc. cit.*, figs. 896, 900.

In Europe it occurs in Spain, France, Belgium, Holland Denmark, Scandinavia, Iceland, Germany, Switzerland, Italy, Austria, and adjoining states, and Russia, Caucasus, Altai Range, Baikal Range in Siberia, Greenland, N. America.

Gathered by Dr B. White and Mr Brebner in three localities in Perthshire, in Sutherland by my friend Rev. E. S. Marshall (and also in East Perth), and recorded by Dr Lees in Record Club Report for 1884–85–86, as for "West Perth found some years ago by Messrs W. Croall and F. M. Webb as *Juncus lamprocarpus*." Further particulars of its occurrence are given by Dr B. White in *Scottish Naturalist* for October 1887.

As long ago as 1843, Professor Babington, in the first edition of his *Manual*, says of this species, "no doubt will be found in Britain." After a lapse of forty-four years, this proves true. Dr White's and Rev. E. S. Marshall's specimens have been confirmed by Dr Buchenau of Bremen, the highest authority on the order we have.

Rhyncospora fusca, R. et S.

A species well known as a native in the southern and western counties of England, and reported from Salop and York, but never confirmed, has been found by Mr M'Andrew "on a moor in Kirkcudbrightshire in 1882." Among other specimens, Mr M'Andrew sent these "for a name" last autumn. There is no antecedent reason why it should not be a Scottish species, growing as it does in Denmark, Sweden and Norway; at the same time, it is a very interesting addition to the flora of Scotland, and may reasonably be hoped for in such counties as Ayr, Dumfries, or Wigtown.

Carex cæspitosa, Linn. (Fries), Sp. Pl., ed. 1 (1753), p. 978.

> *C. pacifica,* Drejer, *Fl. Ex. Hafn.* (1838), p. 29 2.
> *C. Drejeri,* F. O. Lang, *Flora* (1843), p. 548.
> *C. tenuis,* Schum., *Enum.*, i. p. 268, *fide* Drejer.
> Drejer, *Revisio Car. bor.*, No. 31.
> Blytt, *Norges Flora,* p. 215 (1861).
> Hartman, *Hand. i Sk. Flora,* ed. 11 (1879), p. 469.
> Nyman, *Consp. Floræ Europ.*, p. 777.
> Fig. *Flora Danica,* t. 2547.
> Andersson, *Carices Scand.*, t. 6, fig. 59.
> Reichenbach, t. 229.

In Europe, it occurs in Norway, Denmark, Sweden, Germany, Holland, Bohemia, Silesia, Russia, Iceland, Faroes, N. America, Greenland, &c.

Gathered very sparingly by Mr Beeby in the island of Unst, Shetland, in August 1887, by whose kindness I am able to show one of the few specimens gathered.

In our old floras the name *C. cæspitosa* will be found representing sometimes the *C. vulgaris* of Fries, sometimes the *C. stricta,* Goodenough, and in most floras some confusion has arisen from the mixing up of the name with *vulgaris* and *stricta,* &c.

But the species is now well understood in Europe, and in Sweden is one of the most (if not the most) abundant of the Carices, and is known under the popular name of Star-grass.

We have here six additions to the Scottish flora during 1887, beside several Hieracia which remain to be determined, among which are certainly *H. pulchellum*, Lind., and *H. Sommerfeltii,* Lind., and *H. orarium,* Lind., and at least two others, a result which was almost certain, as the extreme north of Scotland has never before been so systematically examined for the genus, as my friend Mr F. J. Hanbury has done in Caithness and Sutherland for the last three years; from whence he has brought a most beautiful collection, of which I hope at some future time to give an account, and present specimens to the Herbarium.

Finally, I will give the approximate number of the addition to the various counties from south to north :—

Dumfries, . . .	18	Brought forward,	241
Kirkcudbright, . .	24	West Inverness, . .	35
Wigtown, . . .	58	Argyll, . . .	90
Ayr, ...	30	Dumbarton, . .	75
Renfrew, . . .	6	South Hebrides, . .	1
Lanark, . . .	5	Mid Hebrides, . .	56
Linlithgow, . .	6	North Hebrides, . .	23
Fife, . . .	5	West Ross, . .	28
Stirling, . . .	26	East Ross, . . .	1
Perth, . . .	17	East Sutherland, . .	5
South Aberdeen, . .	2	West Sutherland, .	16
North Aberdeen, . .	1	Caithness, . . .	24
Banff, . . .	16	Hebrides, Outer, . .	16
Elgin, . . .	25	Shetlands, . . .	16
Forfar, . . .	1	Clyde Isles and Cantire,	24
East Inverness, . .	41		
		Species recorded,	691
Carry forward,	281		

In England, *Vaccinium intermedium* of Rothe has been gathered in Staffordshire by Prof. Bonny and others; it is supposed to be a hybrid between *V. Myrtillus* and *V. Vitis-Idæa.* This should be looked for in Scotland, where the two species grow together. It is very rare in Europe, occurring hitherto in Germany only.

Under Caithness, I should have mentioned that Mr Grant and Mr Hanbury found *Calamagrostis strigosa* in a second station, *i.e.*, around Loch Watten. This is very satisfactory, as although the plant is fairly plentiful at the ground formerly covered by Loch Duran, we never know how soon agricultural improvements may sweep away a rare species in a single locality only.

I need hardly say how greatly I should esteem any additions to county lists, that I may pass over from want of knowledge, my only aim being to help on, however little, the facts connected with the Scottish flora and its distribution.

Excursion of the Scottish Alpine Botanical Club in August 1887, *to the Hardanger District of Norway.* By WILLIAM CRAIG, M.D., F.R.C.S.E., F.R.S.E., &c.

The Annual Excursion of the Scottish Alpine Botanical Club in 1887, was to the Hardanger district of Norway. The members of the Club were anxious to visit this interesting country, not only for the purpose of witnessing its magnificent scenery, but also for the purpose of examining its flora, especially with the view of contrasting the flora of Scandinavia with that of our Scottish Highlands.

Accordingly, on Wednesday 10th August, the following members of the Club:—Professor Dickson, President; Rev. D. Paul, Roxburgh; Dr Charles Stuart, Chirnside; Dr A. P. Aitken; Mr R. Lindsay, Curator, Royal Botanic Garden; Mr Potts of Fettes Mount; and Dr William Craig, Secretary, left for Norway with the "St Sunniva," a fine new steamer which had been specially built for the Norwegian traffic by the North of Scotland Steam Navigation Company. The members of the Club were accompanied by Professor Trail, Aberdeen; Professor Bower, Glasgow; Professor D'Arcy Thompson, Dundee; Rev. W. W. Peyton, Broughty Ferry; Rev. P. M'Kerron, Kelso; Dr John Archibald; Mr Milne of Kevock Tower; and Mr David M'Kerron, Kelso.

The steamer left Leith at 8 A.M. The day was very stormy, and the passage was exceedingly rough. Captain Angus of the "St Sunniva" showed the members of our Club every attention, and during the voyage we received from him many marks of kindness. It is not usual for the steamer to enter Aberdeen harbour, but on this occasion Captain Angus not only went into the quay, but stayed for several hours to allow the passengers time to dine comfortably before crossing the stormy North Sea.

We left Aberdeen about 7 P.M., and the night was very stormy, the sea rough, and most of the passengers were sick; many of whom will not soon forget their first night on the North Sea. About 3 P.M. of Thursday 11th August, we reached the calm waters of the Norwegian Fjords, greatly to the delight of all on board, but especially to those who had been prostrated with sickness during the entire voyage.

Shortly after entering Norwegian waters, the steamer dropped anchor to allow the Customhouse officers to come on board and make their inspection of luggage, &c. This official inspection over, the "St Sunniva" steamed on to Lervik, a small village with a beautiful bay on the east of the island of Stordo. Here the vessel anchored for the night, and early in the morning we weighed anchor, and shortly afterwards entered the great Hardanger Fjord. The morning was lovely, and at an early hour most of us were on deck witnessing the beautiful scenery through which we were passing. The vessel reached Odde about 8 A.M. After breakfast the whole party landed, and having deposited our luggage in Prœstegaard's Hotel, where beds had been previously engaged for our party, we started on a botanical excursion to the Buarbræ. Odde is a small village at the end of the Sör Fjord, a branch of the great Hardanger Fjord. On leaving Odde our path was along the banks of a river which issued from a small lake called "Sandven Vand." We were particularly impressed with the luxuriance of the vegetation, most of the plants being well known in many sub-alpine districts of Scotland. *Linnæa borealis* was growing most profusely everywhere, and was in beautiful flower. We noticed a quantity of *Campanula rotundifolia*, with very small flowers which may possibly be the variety named *parviflora*. After reaching the lake, which is fully a mile from Odde, we rowed across in boats to the mouth of the Jordal, a large river which issues from the Buarbræ Glacier. From the colour of the water we could easily see that it was of glacier origin. The Jordal valley contains several farms. At these fruit appeared plentiful and excellent. The children everywhere were offering us fruit, such as strawberries, cherries, plums, raspberries, &c. Here we saw the "hay telegraph." This consists of a strong wire stretching from the farm-house to a point high up the mountain. On this wire bundles of hay or sticks are slid down as occasion requires.

We kept the course of this stream all the way to the glacier, and saw many rare alpines growing in great profusion, including *Woodsia ilvensis* which here, and in the districts of Norway visited by the Club, appeared to be the most common fern. Having reached the glacier, we were all impressed with the beauty of the deep-blue grottoes of ice, from the chief of which the Jordal river issues with great force. This glacier is a branch of the "Folgefonden," one of the largest glaciers in Norway. The length of the "Folgefonden" is between 30 and 40 English miles, and the highest summit is 5270 feet. Part of this enormous mass of snow and ice has slid over the high precipice at the top of the Jordal valley, and forms the Buarbræ.

Having examined the glacier, we botanised the rocks along its north side. Here we found the best plants in this day's excursion, including *Ranunculus aconitifolius,* Linn.; *Actæa spicata,* Linn.; *Sagina saxatilis,* Wimm.; *Saxifraga oppositifolia,* Linn.; *S. nivalis,* Linn.; *S. stellaris,* Linn.; *S. aizoides,* Linn., and var. *aurantiaca*; *S. rivularis,* Linn.; *S. cæspitosa,* Linn., and var. *palmata,* besides other varieties; *S. Cotyledon,* Linn.; *Cornus suecica,* Linn.; *Erigeron acre,* Linn.; *E. uniflorum,* Linn.; *Gnaphalium sylvaticum,* Linn.; *Hieracium aurantiacum,* Linn.; *Gentiana purpurea,* Linn.; *Bartsia alpina,* Linn.; *Salix lanata,* Linn.; *S. Lapponum,* Linn.; and a species of Salix with small round woolly leaves very like *Salix Sadleri; Maianthemum Convallaria,* Roth.; *Convallaria majalis,* Linn.; *Paris quadrifolia,* Linn.; *Phleum alpinum,* Linn.; and *Polystichum Lonchitis,* Roth. We had only time to examine a very small portion of the rocks to the north of the glacier, but they seemed very productive. Amongst other plants gathered in this excursion, may be mentioned *Silene rupestris,* Linn. This was very abundant all along the road, and up to the very glacier; and in all parts of Norway visited by the Club it appeared to be very common. It is not regarded as a British plant, although it is just such a plant as one would expect to find in Britain. The Rev. A. W. Donaldson, Strathaven, has this plant (*Silene rupestris*) growing on his rockery. He told me that he is confident he picked it during his holidays in the Highlands of Scotland some years ago, he thinks in Glen Spean, and probably near Loch Gulbin. Not being a botanist, he took no special notice of the locality at the time. He regarded it as a nice plant for his rockery. It will be interesting if this discovery can be verified.

The day was exceedingly fine. We were all delighted with our first day's excursion in Norway. We reached our hotel at Odde in good time for dinner. After having dined comfortably in Norwegian fashion, we spent a very agreeable night in Praestegaard's Hotel.

Saturday, 13th August.—We left Odde this morning at 7 A.M. with the steamer for Eide—a small village at the end of Graven Fjord, another branch of the Hardanger Fjord. We had an excellent breakfast on board this local steamer. We spent the day botanising the neighbourhood of Eide. We saw *Woodsia ilvensis* growing on all the rocks around the village. We found many good plants, including *Ranunculus reptans*, Linn., *Actæa spicata*, Linn., in beautiful fruit; *Nasturtium amphibium*, R. Br.; *Arabis perfoliata*, Lamck.; *Tilia parvifolia*, Ehrh, quite wild; *Impatiens Noli-me-tangere*, Linn.; *Rhamnus Frangula*, Linn.; *Potentilla maculata*, Power; *Sedum album*, Linn.; *Circæa alpina*, Linn.; *Carum Carui*, Linn., truly indigenous and very abundant; *Angelica Archangelica*, Linn.; *Cornus suecica*, Linn.; *Viburnum Opulus*, Linn.; *Arctium Lappa*, Linn.; *Lactuca muralis*, Fresen.; *Campanula latifolia*, Linn.; *Pyrola minor*, Linn.; *Lysimachia vulgaris*, Linn.; *Verbascum Thapsus*, Linn.; *Bartsia alpina*, Linn.; *Maianthemum Convallaria*, Roth; *Paris quadrifolia*, Linn.; *Asplenium septentrionale*, Hull; *Struthiopteris germanica*, Willd.; and *Isoetes echinospora*, Dur.

We were never far from the village, but we were particularly impressed with the luxuriance of the alpine vegetation. In an open wood, about one mile above the village, we saw acres covered with *Vaccinium Myrtillus*, *V. Vitis-Idæa*, *V. uliginosum*, *Cornus suecica*, *Actæa spicata*, and all richly clad with ripe fruit. This was a sight such as none of us had ever seen previously, and which none of us will ever forget.

After a pleasant and most successful day we returned to our hotel for dinner, and at 8 P.M. we left with the steamer for Vik in Eidfjord, which we reached about 10 P.M. Here we were comfortably entertained in the hotel kept by the brothers Neishem, both of whom were very intelligent, and spoke English well. Beds were reserved for our party, having been engaged before we left Scotland.

Vik is a small village at the head of Eidfjord. This was our principal quarters during our stay in Norway.

Monday, 15th August.—Our excursion was to the Vøringfos, one of the finest waterfalls in Europe. The waters come down from the "immense ice masses of Hardanger Jøkel (6350 feet high). The Vøringsfos pours down its tremendous volume of frothing water into the grandest cauldron of all in Norway."

After an early breakfast we started on our journey. The first part of the way was across the moraine, on which Vik stands, as far as Eidfjordvand—a lake several miles in length. Along the side of this lake a road is being constructed, which, for the most part, is blasted out of the solid rock. We landed at the head of the lake at a village called Sæbbe. The fields here of barley and rye were much ergotised, and fine specimens of ergot were gathered by our party. Here two valleys meet—the one formed by the river Bjoreia, and the other the Jolmodal. The Vøringfos is on the former, and we accordingly kept the banks of that river. Shortly after leaving the lake we found *Asplenium septentrionale*, Hull; *Verbascum nigrum*, Linn.; *Impatiens Noli-me-tangere*, Linn.; *Aconitum septentrionale*, Køll.—a beautiful plant, which was found both in flower and fruit. On the sides of the road we saw several large patches of *Linnæa borealis*, Gronov., in fine flower. Shortly before reaching the Vøringfos we saw several large beds of *Campanula latifolia*, Linn.; and higher up we passed large quantities of *Mulgedium alpinum*, Less.: and close to the waterfall on the rocks we gathered *Saxifraga oppositifolia*, Linn.; *S. nivalis*, Linn.; *S. stellaris*, Linn.; *S. aizoides*, Linn., and var. *aurantiaca; S. cæspitosa*, Linn., and *S. Cotyledon*, Linn., some specimens of which were very large. The view of this waterfall was grand in the extreme. The volume of water is large, and it makes a clear leap of 500 feet into the cauldron beneath, and the volume of spray rises much higher than the fall itself.

Among the plants gathered in this excursion may be mentioned—*Thalictrum minus*, Linn.; *Arabis petræa*, Lam.; *Silene acaulis*, Linn.; *S. rupestris*, Linn.; *Cerastium alpinum*, Linn., several varieties; *Stellaria nemorum*, Linn.; *Astragalus oroboides*, Hornem.; *Potentilla maculata*, Power; *Sedum album*, Linn.; *Circæa alpina*, Linn.; *Angelica Archangelica*, Linn.; *Cornus suecica*, Linn.; *Scabiosa Columbaria*, Linn.; *Erigeron acre*, Linn.; *Actium Lappa*, Linn.; *Saussurea alpina*, DC.; *Lactuca muralis*, Fresen.; *Pyrola secunda*, Linn.; *Bartsia* *alpina*, Linn; *Calamintha Acinos*, Moench.; *Polygonum tartaricum*, Linn.; *Goodyera repens*, R. Br.; *Maianthemum Convallaria*, Roth; *Juncus trifidus*, Linn.; *J. triglumis*, Linn.; *Phleum alpinum*, Linn.; *Woodsia ilvensis*, R. Br.; *Struthiopteris germanica*, Willd., &c. We were again favoured with a fine day. We reached our hotel in good time for dinner all delighted with our excursion to the Vøringfos.

Tuesday, 16*th August*.—Our excursion to-day was to the Simodal—a valley which has been well called "a gloomy gorge of wild grandeur." To get to the Simodal we had to hire two small boats, in which the whole party was accommodated. Mr Hans Neishem, the younger of the two brothers, accompanied us as our guide. After a row of an hour up the small branch of the fjord, we landed at a village called Sœd. The lower end of the valley is very fertile, and we saw several fields of barley and of rye largely ergotised. For several miles we had a good road. On the sides of the road we saw large quantities of *Verbascum nigrum*, Linn., which is common in this district of Norway. The *Carum Carui*, Linn., was abundant everywhere. On our way up the glen we passed, on our right hand, a magnificent waterfall, called Skytjafos. The river which forms this waterfall comes down from the south of the great glacier called Hardanger Jøkel (6350 feet high). The river has a clear plunge of "700 feet, and then rebounding from a shelf of rock descends, in graceful, lace-like folds, in a twin-fall of some hundred feet to the débris." The volume of water was very great, and the view extremely grand. Having crossed this river, we kept the course of the other river, which is the larger of the two, and we soon came into excellent botanising ground. We saw on the roadside *Woodsia ilvensis*, R. Br., but not so abundantly as on the previous days; also *Struthiopteris germanica*, Willd.; *Polygonatum verticillatum*, All.; *Maianthemum Convallaria*, Roth; *Paris quadrifolia*, Linn. A little higher up the glen, we passed through a ravine literally full of *Campanula latifolia*, Linn., in all shades of colour, from the normal blue to pure white. It was a sight worth going a long distance to see. We found some plants of *Salix Caprea* with very large leaves. We also gathered by the roadside *Rumex alpinus*, Linn. Near this spot Professor Trail gathered *Adoxa Moschatellina*, Linn. a plant which, according to Blytt's *Flora*, had not till now (1876) been observed in this district. On going still further up the glen the vegetation became more luxuriant. We went through immense beds of *Mulgedium alpinum*, Less., in beautiful flower. This was a sight which would have gladdened the heart of the late Professor Balfour. Near this place we passed through immense tracts of *Ranunculus aconitifolius*, Linn., in all states—in flower and fruit; *Actæa spicata*, Linn., also in flower and fruit. *Aconitum septentrionale*, Køll., was also seen in great abundance, and in all stages of flower and fruit, and several plants were gathered nearly white. As we neared the top of the glen we found *Arabis alpina*, Linn.; *Draba hirta*, Linn., var.; *Silene acaulis*, Linn.; *S. rupestris*, Linn; *S. maritima*, With., with white flowers; *Cerastium alpinum*, Linn.; *Sagina saxatilis*, Wimm.; *Impatiens Noli-me-tangere*, Linn.; *Astragalus oroboides*, Hornem.; *Potentilla maculata*, Power; *Fragaria collina*, Ehrh.; *Saxifraga oppositifolia*, Linn.; *S. nivalis*, Linn.; *S. stellaris*, Linn.; *S. aizoides*, Linn., and var. *aurantiaca; S. rivularis*, Linn.; *S. cernua*, Linn., in flower and in considerable abundance; *S. cæspitosa*, Linn., and several varieties, including *palmata; S. Cotyledon*, Linn.; *Angelica Archangelica*, Linn.; *Erigeron acre*, Linn.; *E. alpinum*, Linn.; *Gnaphalium norvegicum*, Gunn.; *Hieracium aurantiacum*, Linn.; *Lactuca muralis*, Fresen.; *Gentiana purpurea*, Linn.; *Veronica alpina*, Linn.; *V. saxatilis*, Linn.; *Bartsia alpina*, Linn.; *Salix lanata*, Linn.; *S. Lapponum*, Linn.; *S. herbacea*, Linn.; *Convallaria majalis*, Linn. This beautiful plant was seen in great profusion amongst rocks near the region of perpetual snow. *Juncus castaneus*, Linn.; *J. triglumis*, Linn.; *Phleum alpinum*, &c. The variety and luxuriance of rare alpines in this valley made a deep impression on all the party. We never got up to the rocks on the side of the valley on account of the abundance of rare alpines growing everywhere near the banks of the river.

It was the intention of the Club to ascend out of the valley and visit the Hardanger Jøkel, in the hope of finding some good plants close to the glacier; but so much time was spent in the valley that we had to retrace our steps without visiting this famous glacier. At the top of the valley we saw another of those splendid waterfalls for which Norway is so famous—the Rembesdalfos. Here the river, which always contains a large volume of water, makes a leap of 400 feet clear of projecting shelves of rock, and this is reported to be "one among the five grandest waterfalls in Norway."

It was a disappointment to some of us that time did not permit us to visit the famous Hardanger Jøkel, nevertheless we were all delighted with this excursion, undoubtedly the most productive the Club made in Norway. The day was again fine; we gradually retraced our steps towards Sœd, where we found our boats awaiting us. The sea was calm, and not a ripple on the water. Some of our party at this place made their first acquaintance with those pests of travellers, called mosquitoes. It was a long excursion, but we all got back in safety to our hotel and enjoyed dinner, spending afterwards a most pleasant evening.

Wednesday, August 17.—This forenoon several of the party, after arranging the plants of the previous day, botanised the rocks immediately to the south of Vik. These rocks seem very productive, but we had no time to examine them properly. Among the plants observed were—*Thalictrum alpinum*, Linn.; *Silene rupestris*, Linn., one plant with a double flower; *Rhamnus Frangula*, Linn.; *Saxifraga Cotyledon*, Linn.; *Sedum annuum*, Linn.; *Linnæa borealis*, Gronov.; *Galium boreale*, Linn.; *Trientalis europæa*, Linn.; *Oxyria digyna*, Hill; *Alnus incana*, DC.; *Asplenium septentrionale*, Hull; *Woodsia ilvensis*, R. Br.; *Struthiopteris germanica*, Willd., &c.

We left Vik about 2 P.M. for Eide, a place visited on the previous Saturday. Here we found conveyances waiting to take us and our luggage on to Vossevangen. These conveyances had been engaged on the previous Saturday, before leaving for Vik. This saved time, and secured conveyances for our whole party. The drive from Eide to Vossevangen is fully 20 English miles. We had seven conveyances for our Club, and there were many other conveyances going the same journey, so this cavalcade of tourists and botanists was a grand sight. The drive was a very pleasant one, and we did a little botanising by the way, especially near the watershed between these two places. Amongst the plants observed may be mentioned *Nymphæa alba*, Linn.; *Arabis perfoliata*, Lamk.; *Silene rupestris*, Linn.; *Lychnis Viscaria*, Linn.; *Impatiens Noli-me-tangere*, Linn.; *Rubus Chamæmorus*, Linn.; *Saxifraga Cotyledon*, Linn.; *Sedum annuum*, Linn.; *Drosera rotundifolia*, Linn.; *Epilobium angustifolium*, Linn.; *Cornus suecica*, Linn.; *Vaccinium Oxycoccus*, Linn.; *V. Vitis-Idæa*, Linn.; *V. uliginosum*, Linn.; *V. Myrtillus*, Linn.; *Andromeda polifolia*, Linn., amongst sphagnum near the summit; *Calluna vulgaris*, Salisb., a plant not at all common in this part of Norway; *Verbascum Thapsus*, Linn.; *Alnus incana*, DC.; *Maianthemum Convallaria*, Roth; *Juncus filiformis*, Linn., &c. We had not much time to botanise, but we made the most of the short time at our disposal, and not without success.

We reached Vossevangen about 9.30 P.M., and were all comfortably put up in Fleischer's Hotel, beds having been previously engaged for our party. We all enjoyed our dinner in Fleischer's Hotel, one of the courses being young reindeer, which was partaken of by all the party. We left at 6.40 A.M. next morning by rail for Bergen. This is the only railway on the west of Norway, and is remarkable for the number of tunnels. The railway is only 66 miles in length; it contains fifty-two tunnels, and the aggregate length of these tunnels is six miles. We reached Bergen early in the forenoon, and after seeing our luggage safely deposited on board the "St Sunniva" (which we found lying in the bay awaiting us), we spent the rest of the day visiting the "lions" of Bergen, the museum and hospital for lepers receiving special attention.

The "St Sunniva" left Bergen about 7 P.M., and reached Aberdeen in less than twenty-one hours, being one of the quickest passages on record. The homeward passage across the North Sea was everything that could be desired; none of us were sick, and all were able to enjoy the voyage. During the homeward passage Captain Angus asked all the members of the Club and also our visitors down to the cabin and hospitably entertained the Scottish Alpine Botanical Club. The vessel reached Leith a little before midnight on Friday 19th August, and after lying all night in Leith harbour to await the inspection by the Customhouse officers next morning, we parted on the morning of the 20th for our several homes, all highly delighted with our excursion.

It will thus be seen that we had only five days' botanising in Norway, including the days spent in travelling, but during these days we succeeded in gathering many rare alpine plants. Professor Blytt of Christiania, who expressed his great regret that he was unable to join our party, sent us a list of all the rare plants known to grow in the Hardanger district of Norway, and also indicated the best mountains to visit. We found, however, that the two mountains specially named by Blytt were so far off that it was impossible for us to visit them with the time at our disposal, and, moreover, it was quite impossible to find accommodation for so large a party near these hills. This was a matter of great regret to us all, but we were richly rewarded by the alpine plants which we gathered in our various excursions, and I believe it will be found that we have contributed something to the Flora of that district of Norway. We gathered several plants not in Blytt's list.

From the hurried way we had to pass over the ground, it is quite probable that several plants were passed unobserved. We were, however, particularly struck with the rarity of several common plants, and the entire absence of others.

Digitalis purpurea, Linn., was only seen at Odde, and that sparingly, although the places visited were just such localities as we would find the plant in this country. *Calluna* and *Erica* were very rare. *Alnus incana*, DC., was common, evidently replacing *Alnus glutinosa*, Gærtn., which was not seen; *Carduus canus*, Linn. (?) was found in every cornfield and by every road-side, and is evidently the common thistle in this district of Norway.

The following Scottish plants were either not seen or only very sparingly:—

RANUNCULACEÆ .	Ranunculus aquatilis, *Linn.*
	,, hederaceus, *Linn.*
	Trollius europæus, *Linn.*
PAPAVERACEÆ .	Papaver, sps.
CRUCIFERÆ . .	Cochlearia officinalis, *Linn.*
CISTINEÆ . .	Helianthemum vulgare, *Gærtn.*
CARYOPHYLLEÆ .	Lychnis Flos-cuculi, *Linn.*
	Cerastium glomeratum, *Thuill.*
	Stellaria Holostea, *Linn.*
	Spergularia rubra, *Pers.*
HYPERICINEÆ .	Hypericum pulchrum, *Linn.*
	,, hirsutum, *Linn.*
MALVACEÆ . .	Malva, sps.

LINEÆ . .	. Linum catharticum, *Linn.*
GERANIACEÆ .	. Geranium molle, *Linn.*
	,, dissectum, *Linn.*
ILICINEÆ .	. Ilex Aquifolium, *Linn.*
LEGUMINOSÆ .	. Ulex europæus, *Linn.*
	Cytisus Scoparius, *Link.*
	Ononis arvensis, *Linn.*
	Medicago lupulina, *Linn.*
	Trifolium repens, *Linn.*
	(T. pratense being the only one seen.)
	Lotus major, *Sm.*
	Lathyrus pratensis, *Linn.*
ROSACEÆ .	. Potentilla anserina, *Linn.*
	Alchemilla arvensis, *Lam.*
	Agrimonia Eupatoria, *Linn.*
SAXIFRAGEÆ .	. Saxifraga hypnoides, *Linn.*
	Chrysosplenium, sps.
CRASSULACEÆ	. Sedum villosum, *Linn.*
UMBELLIFERÆ	. Conium maculatum, *Linn.*
	Ægopodium Podagraria, *Linn.*
	Meum Athamanticum, *Jacq.*
	Daucus Carota, *Linn.*
	Caucalis Anthriscus, *Huds.*
ARALIACEÆ .	. Hedera Helix, *Linn.*
CAPRIFOLIACEÆ	. Lonicera, sps.
RUBIACEÆ .	. Galium saxatile, *Linn.*
DIPSACEÆ .	. Scabiosa arvensis, *Linn.*
COMPOSITÆ .	. Bellis perennis, *Linn.*
	Carduus arvensis, *Curt.* (var. *setosus* was seen at Oifjord).
	Centaurea Cyanus, *Linn.*
	Chrysanthemum segetum, *Linn.*
	Senecio Jacobæa, *Linn.*
	,, sylvaticus, *Linn.*
	,, aquaticus, *Huds.*
	Lapsana communis, *Linn.*
	Sonchus arvensis, *Linn.*
BORAGINEÆ .	. Myosotis versicolor, *Reichb.*
PLANTAGINEÆ	. Plantago maritima, *Linn.*
SCROPHULARINEÆ	. Veronica Beccabunga, *Linn.*
	Bartsia Odontites, *Huds.*
LABIATÆ .	. Thymus Serpyllum, *Fr.*
	Teucrium Scorodonia, *Linn.*
PRIMULACEÆ .	. Lysimachia nemorum, *Linn.*
	Anagallis, sps.
PLUMBAGINEÆ	. Armeria maritima, *Willd.*
POLYGONACEÆ	. Polygonum amphibium, *Linn.*

Euphorbiaceæ .	In this order, Euphorbia Helioscopia, *Linn.*, alone was seen.
Myricaceæ . .	Myrica Gale, *Linn.*
Irideæ . .	Iris Pseud-acorus, *Linn.*
Liliaceæ . .	Narthecium ossifragum, *Huds.*
Juncaceæ . .	Juncus communis, *Meyer.*
	Luzula maxima, *DC.*
Typhaceæ . .	Sparganium ramosum, *Curtis.*
Gramineæ . .	Alopecurus pratensis, *Linn.*
	Arrhenatherum avenaceum, *Beauv.*
	Phragmites communis, *Trin.*
	Kœleria cristata, *Pers.*
	Briza media, *Linn.*
	Bromus sterilis, *Linn.*
	Brachypodium sylvaticum, *Roem. et Schult.*
	Triticum repens, *Linn.*
	Lolium perenne, *Linn.*
Filices . .	Asplenium viride, *Huds.*

Appended is a list of the principal plants collected, with the various localities in which they were found:—

List of the Principal Plants collected in Norway.

Odde to the Buarbræ = 1; Eide and Graven Vand = 2; Oifjord to Vøringfos = 3; Simodal = 4; Vik in Eidfjord = 5; Road from Eide to Vossevangen = 6.

		1	2	3	4	5	6
Ranunculaceæ .	Thalictrum alpinum, *Linn.* .				4	5	
	„ minus, *Linn.* .			3			
	Ranunculus reptans, *Linn.* .		2	3			
	„ auricomus, *Linn.* .			3			
	„ aconitifolius, *Linn.*	1			4		
	Caltha palustris, *Linn.*, in flower				4		
	Aconitum septentrionale, *Køll.*			3	4		
	Actæa spicata, *Linn.* . .	1	2	3	4		
Nymphæaceæ .	Nymphæa alba, *Linn.* . .						6
Cruciferæ .	Nasturtium amphibium, *R. Br.*		2				
	Barbarea stricta, *Andrz.* . .	1					
	Arabis petræa, *Lam.* . .			3		5	
	„ hirsuta, *Br.* . .				4	5	
	„ perfoliata, *Lamk.* .		2		4		6
	„ alpina, *Linn.* . .				4		
	Draba hirta, *Linn.* . .				4		
	Subularia aquatica, *Linn.* .		2				

		1	2	3	4	5	6
CRUCIFERÆ	Thlaspi arvense, *Linn.*	1	2	3			
VIOLARIEÆ	Viola sylvatica, *Fr.*		2	3			
CARYOPHYLLEÆ	Silene Cucubalus, *Wibel.*			3	4		
	„ acaulis, *Linn.*			3	4		
	„ rupestris, *Linn.* (with proliferous flowers in 4)	1	2	3	4	5	6
	„ maritima, *With.* (white)				4		
	Lychnis alba, *Mill.*			3			
	„ diurna, *Sibth.*			3			
	„ Viscaria, *Linn.*						6
	Cerastium alpinum, *Linn.*, var.			3	4		
	Stellaria nemorum, *Linn.*	1	2	3	4		
	Sagina saxatilis, *Wimm.*	1			4		
HYPERICINEÆ	Hypericum perforatum, *Linn.*	1			4		
	„ dubium, *Leers,*	1	2	3	4		
TILIACEÆ	Tilia parvifolia, *Ehrh.*		2				
GERANIACEÆ	Geranium sylvaticum, *Linn.*				4		
	„ pratense, *Linn.*				4		
	Erodium cicutarium, *L'Hérit.*		2			5	
	Impatiens Noli-me-tangere, *Linn.*	1	2	3	4		6
RHAMNEÆ	Rhamnus Frangula, *Linn.*		2			5	
LEGUMINOSÆ	Astragalus oroboides, *Hornem ?*			3	4		
	Vicia sylvatica, *Linn.*	1					
ROSACEÆ	Rubus saxatilis, *Linn.*		2	3		5	
	„ Chamæmorus, *Linn.*			3			6
	Fragaria collina, *Ehrh.*	1			4		
	Potentilla maculata, *Pow.*		2	3	4		
	„ argentea, *Linn.*	1	2	3	4	5	
	Alchemilla alpina, *Linn.*	1		3	4	5	
	Sorbus fennica, *Kalm.*	1					
SAXIFRAGEÆ	Saxifraga oppositifolia, *Linn.*	1		3	4		
	„ nivalis, *Linn.*	1		3	4		
	„ stellaris, *Linn.*	1		3	4	5	
	„ aizoides, *Linn.*	1	2	3	4		
	„ „ aurantiaca,	1		3	4		
	„ rivularis, *Linn.*	1			4		
	„ cernua, *Linn.*				4		
	„ cæspitosa, *Linn.*	1		3	4		
	„ „ palmata, *Hartm.*	1					
	„ Cotyledon, *Linn.*	1	2	3	4	5	6
CRASSULACEÆ	Sedum Rhodiola, *DC.*	1	2	3	4		6
	„ album, *Linn.*		2	3			
	„ acre, *Linn.*	1		3	4		
	„ annuum, *Linn.*	1	2	3	4	5	6

		1	2	3	4	5	6
Droseraceæ .	Drosera rotundifolia, *Linn.* .		2				6
Onagrarieæ .	Epilobium angustifolium, *Linn.*	1	2	3	4	5	6
	„ palustre, *Linn.* .	1	2				
	„ alsinefolium, *Vill.* .	1		3	4		
	„ alpinum, *Linn.* .	1		3	4		
	Circæa alpina, *Linn.* . .	1	2	3	4		
Umbelliferæ .	Carum Carui, *Linn.* . .	1	2	3	4	5	6
	Angelica sylvestris, *Linn.* .		2		4		6
	Archangelica officinalis, *Hoffm.*		2	3	4		
Cornaceæ .	Cornus suecica, *Linn.* . .	1	2	3	4		6
Caprifoliaceæ .	Adoxa Moschatellina, *Linn.* .				4		
	Viburnum Opulus, *Linn.* .		2				
	Linnæa borealis, *Gronov.*. .	1	2	3	4	5	6
Rubiaceæ . .	Galium boreale, *Linn.* . .	1	2	3	4	5	
	Asperula odorata, *Linn.* . .	1	2				
Dipsaceæ . .	Scabiosa succisa, *Linn.* . .		2		4	5	6
	„ Columbaria, *Linn.* .		2	3	4		
Compositæ .	Solidago Virgaurea, *Linn.* .	1	2		4	5	
	Erigeron acre, *Linn.* . .	1		3	4		
	„ alpinum (?), *Linn.* .				4		
	„ uniflorum, *Linn.* .	1					
	Antennaria dioica, *R. Br.*, var. .				4		
	Gnaphalium sylvaticum, *Linn.*	1	2		4		
	„ norvegicum, *Gunn.*				4		
	Tanacetum vulgare, *Linn.* .				4		
	Arctium Lappa, *Linn.* . .		2	3			
	Carduus canus, *Linn.* (?) . .	1	2	3	4	5	
	Cnicus heterophyllus, *Willd.* .		2		4		
	„ arvensis, *Hoffm.;* var. setosus, *Bess.* . .			3			
	Saussurea alpina, *DC.* . .	1		3	4	5	
	Centaurea Scabiosa, *Linn.* .			3			
	Crepis paludosa, *Moench.* .		2				
	Apargia, with handsome capitula and black involucres, .	1					
	Hieracium aurantiacum, *Linn.*	1		3	4		
	„ corymbosum, *Fr.* .		2		4	5	
	„ boreale, *Fr.* . .	1			4		
	Lactuca muralis, *Fresen.* . .	1	2	3	4		6
	„ alpina, *Benth.* . .			3	4		
Campanulaceæ .	Campanula latifolia, *Linn.* .	1	2		4		
	„ rotundifolia, *Linn.*, var. . . .	1					
Vacciniaceæ .	Vaccinium Oxycoccus, *Linn.* .						6
	„ Vitis-Idæa, *Linn.* .	1	2	3	4	5	6

		1	2	3	4	5	6
VACCINIACEÆ .	Vaccinium uliginosum, *Linn.* .	1	2	3	4	5	6
	„ Myrtillus, *Linn.* .	1	2		4	5	6
ERICACEÆ . .	Andromeda polifolia, *Linn.* .						6
	Calluna vulgaris, *Salisb.*, rare .			3	4		6
	Pyrola minor, *Sw.*, . . .		2				
	„ secunda, *Linn.* . .			3			
PRIMULACEÆ .	Lysimachia vulgaris, *Linn.* .		2				
	Trientalis europæa, *Linn.* .	1	2	3	4	5	6
GENTIANEÆ .	Gentiana campestris, *Linn.* .	1	2		4	5	
	„ purpurea, *Linn.* .	1			4		
BORAGINEÆ .	Myosotis sylvatica, *Hoffm.* .				4		
SCROPHULARINEÆ	Verbascum Thapsus, *Linn.* .	1	2				6
	„ nigrum, *Linn.* .			3	4		
	Linaria vulgaris, *Mill.* . .	1	2	3	4	5	6
	Digitalis purpurea, *Linn.* .	1					
	Veronica alpina, *Linn.* . .	1			4		
	„ saxatilis, *Linn.* .				4		
	Bartsia alpina, *Linn.* . .	1	2	3	4	5	
LABIATÆ . .	Mentha arvensis, *Linn.* . .		2	3			
	Origanum vulgare, *Linn.* .		2			5	
	Calamintha Clinopodium, *Benth.*	1	2		4		
	„ Acinos, *Clairv.* .	1		3			
	Scutellaria galericulata, *Linn.* .	1	2				
	Galeopsis Tetrahit, *Linn.*, wild	1	2	3	4	5	
	„ versicolor, *Curt.* .						6
	Lamium intermedium, *Fr.* .			3			
POLYGONACEÆ .	Polygonum Convolvulus, *Linn.*		2	3			
	„ aviculare, *Linn.* .	1	2	3	4	5	
	„ Hydropiper, *Linn.*				4		
	„ Persicaria, *Linn.* .	1	2		4		
	„ viviparum, *Linn.* .	1	2	3	4	5	6
	„ tartaricum, *Linn.* .			3			
	Oxyria digyna, *Hill.* . .	1	2	3	4	5	6
	Rumex alpinus, *Linn.* . .				4		
EUPHORBIACEÆ .	Euphorbia Helioscopia, *Linn.* .			3		5	
URTICACEÆ .	Urtica urens, *Linn.* . .		2	3	4		
	„ dioica, *Linn.;* var. angustifolia, *A. Blytt.* .	1	2			5	
CUPULIFERÆ .	Alnus incana, *DC.* . .	1	2	3	4	5	6
SALICINEÆ . .	Salix aurita, *Linn.* . .	1	2			5	
	„ Caprea, *Linn.;* very large		2		4		
	„ lanata, *Linn.* . .	1					
	„ Lapponum, *Linn.* . .	1			4		
	„ Myrsinites, *Linn.* . .	1					
	„ nigricans, "*Sm.*" . .	1			4		

		1	2	3	4	5	6
SALICINEÆ	. Salix herbacea, *Linn.* . .	1			4		
	„ Sadleri, *Syme* (?) . .	1					
	Populus tremula, *Linn.* . .	2	3		5		
CONIFERÆ .	. Juniperus communis, *Linn.* .	1	2	3	4	5	6
ORCHIDEÆ .	. Goodyera repens, *R. Br.* . .			3			
	Habenaria viridis, *R. Br.* .				4		
LILIACEÆ .	. Polygonatum verticillatum, *All.*				4		
	Maianthemum Convallaria, *Web.*	1	2	3	4		6
	Convallaria majalis, *Linn.* .	1			4		
	Paris quadrifolia, *Linn.* . .	1	2		4		
JUNCACEÆ .	. Juncus trifidus, *Linn.* . .	1		3	4		
	„ filiformis, *Linn.* . .	1					6
	„ castaneus, *Linn.* . .				4		
	„ triglumis, *Linn.* . .	1		3	4		
	Luzula spicata, *DC.* . .	1		3	4		
TYPHACEÆ	. Sparganium natans, *Linn.* .		2				
CYPERACEÆ	. Carex vulgaris, *Fries* . .	1					
	„ alpicola, *Wahl.* . .				4		
	„ ovalis, *Good.* . .	1	2				6
	„ atrata, *Linn.* . .	1		3	4		
	„ pallescens, *Linn.* . .	1	2	3		5	
	„ capillaris, *Linn.* . .				4		
	„ ampullacea, *Good.* .	1	2				6
	„ extensa, *Good.* . .			3			
GRAMINEÆ	. Milium effusum, *Linn.* . .				4		
	Phleum alpinum, *Linn.* . .	1		3	4		
	Calamagrostis Epigeios, *Roth.* .		2	3	4	5	
	Aira alpina, *Linn.* (viviparous)	1		3	4		
	„ cæspitosa, *Linn.* . .	1					
	Melica nutans, *Linn.* . .				4		
	Poa alpina, *Linn.* . . .	1	2	3	4		
	„ glauca, *Sm.* . . .	1			4	5	
	Festuca loliacea, *Huds.* . .				4		
	„ vivipara, *Eng. Bot.* .	1		3	4	5	
	„ pratensis, *Huds.* .	1		3			
	Agropyron caninum, *Beauv.* .				4		
FILICES .	. Cryptogramme crispa, *R. Br.* .				4		
	Asplenium Adiantum-nigrum, *Linn.* . .		2	3			
	„ Trichomanes, *Linn.*		2	3	4		
	„ septentrionale, *Hull*		2	3		5	
	Athyrium alpestre, *Milde* .	1					
	Woodsia ilvensis, *R. Br.* .	1	2	3	4	5	
	„ hyperborea, *R. Br.* (?)		2?		4		
	Polystichum Lonchitis, *Roth.* .	1			4		

		1	2	3	4	5	6
FILICES .	. Polystichum aculeatum, *Syme* .	1	2	3			
	„ angulare, *Presl.* .				4		
	Polypodium vulgare, *Linn.* .	1	2	3	4	5	6
	„ Phegopteris, *Linn.*		2	3	4		
	„ Dryopteris, *Linn.*	1	2	3	4		6
	Struthiopteris germanica, *Willd.*	1	2	3	4	5	
	Botrychium Lunaria, *Sw.* .		2		4		
EQUISETACEÆ	. Equisetum pratense, *Ehrh.* .	1	2		4		
	„ limosum, *Sm.* .		2				
LYCOPODIACEÆ	. Lycopodium Selago, *Linn.* .	1	2	3	4		
	„ annotinum, *Linn.*		2	3			
SELAGINELLEÆ	. Selaginella selaginoides, *Gray* .		2	3		5	
	Isoetes echinospora, *Dur.* .		2				

Professor Trail of Aberdeen, who accompanied us in our excursions, has prepared two papers, one on the Galls and another on the Fungi gathered during our excursion. These papers I now communicate to the Society. They will in due time be published in our *Transactions*, and will form most valuable contributions to scientific botany.

The Galls of Norway. By James W. H. Trail, M.A., M.D., F.L.S., Professor of Botany, University of Aberdeen.

(Read 8th March 1888.)

During two visits which I made to Norway—the first in 1878, to the fiords near Bergen, Trondhjem, and Christiania, and the second, in August 1887, to the upper part of Hardanger with the Scottish Alpine Botanical Club,—I collected such galls as I could discover, chiefly with a view of comparing them with the species that I had found in Scotland. On working them out I found a great general similarity to the Scotch species, though with minor differences; but I was still more interested to find that very little had been published that threw light upon the galls of Norway, and that my observations seemed to add considerably to previous records, slight though my collections were. In the hope that they may prove of some value as a contribution towards a knowledge of the geographical distribution of European galls, though no actual novelties have to be put on record, I have prepared an exhaustive account of the galls brought home by me, restricting the descriptions to those characters of diagnostic value. For each I have given the localities in which the specimens were found by me in Norway, the localities in Scotland, when Scotch, and the recorded distribution on the Continent of Europe.

For the sake of easy reference, the galls are arranged primarily in the order of the plants on which they occur (following the arrangement in use in English books); and where several galls were found on any host, *e.g.*, on *Tilia parvifolia*, they are arranged in the order of the relative rank of the gall-makers, beginning with the higher insects, and passing downwards to the mites. A list is added, in which the gall-makers are arranged in their relative rank, without reference to the host-plants.

In an Appendix a summary is given of all the information that I have been able to gain with reference to any previous records of galls or gall-makers in Norway.

Cerastium triviale, Link.—Pseudo-galls of an homopterous insect, *Trioza Cerastii*, H. Loew, were of very frequent occurrence at Vik, Eide, and other places in Hardanger, in August 1887. They are produced by the irritation due to the continued attacks of the larvæ and pupæ, which may be found in multitudes living amid a whitish woolly secretion, between the inflated and imbricated leaves of the terminal buds. The pseudo-galls may reach the size of a large walnut, though frequently not exceeding that of a hazel-nut; but for a while they do not change colour from the normal green. The inflorescences are very often involved, and remain stunted and abortive. This gall has not been recorded as British; but there is a gall of very frequent occurrence on various species of *Cerastium* in Scotland that very much resembles its smaller forms. The Scotch gall is the work of an aphis (*Brachycolus Stellariæ*, Hardy), which lives upon *Cerastium* sps. and *Stellaria Holostea* in early summer, and produces similar galls on *Holcus lanatus*, *Agrostis alba*, and other grasses in autumn. *Trioza Cerastii* has been recorded previously from Bohemia, Thuringia, Silesia, Bavaria, the Tyrol (where I have found its galls in the Brenner Pass), Lower Austria, and Åbo in Finland. I have also found it on the Rigi in Switzerland.

Tilia parvifolia, Ehrh.—All the galls about to be mentioned from this tree were found in the vicinity of Eide, on 13th August 1887. They all appear to be identical with galls already described from Central Europe, some of which also are found in Scotland; but from several of them the makers have not yet been reared, and they bear only provisional names.

1. A leaf bearing several of the unmistakable galls of *Hormomyia Reaumuriana*, F. Loew, was found by Professor Bower, and given by him to me. The galls are scattered in the leaf-blade, projecting like a cone both above and below, the lower cone being the more acute. When mature they open (to allow the larva to emerge) by a kind of lid on the upper surface. Though not known as Scotch, these galls are not rare in Central Europe.

2. On several trees the leaves and bracts bore numerous examples of the very inconspicuous blister-like galls of *Cecidomyia Frauenfeldi*, Kalt. From two to eight may be found on a leaf, scattered over the surface. When fresh they can hardly be detected, except on a close search, as they project very little above the general surface, and do not differ from it in colour. Their lower surface is rather the

more prominent, and bears a small central umbo. After a time they become far more conspicuous, owing to changing to a pale brown colour. The larva have not yet been reared from them.

3. Upward-rolled thickened leaf-margins that appear to be the galls of *Cecidomyia Tiliæ* (Schranck), H. Loew; but I found them only on one tree, and in too withered a condition to permit of certainty, as there was no trace of the larvæ in them. Similar galls occur near Aberdeen.

4. On a twig I found two galls that agree well with some of the galls of *Sciara tilicola*, Winnertz, that I possess from other localities. They are rounded, fleshy, but hard swellings, about 6 or 8 mm. in diameter, and situated near the tip of the twig. This gall occurs in Britain, and is common on the Continent.

5. *Ceratoncon extensum*, Bremi, or the "nail-galls" of limes.—These well-known galls are widely distributed in Europe, and are found in various parts of Scotland. Their peculiar form, like small nails or rifle-bullets projecting from the upper surface of the leaf, renders their recognition easy; they are the work of a gall-mite (*Phytoptus* sp.).

6. *Erineum tiliaceum*, Persoon, originally described by Persoon as a fungus, but now known to be the work of gall-mites of the genus *Phytoptus*, was not uncommon in the form of patches, 4 to 10 mm. across, on the lower surface of the leaves. These are pale, or tend to become violet or purple, and have a velvety appearance, due to the numerous erect simple hairs that form the gall; between the hairs live the mites. This gall has been found in various places in Scotland, and it is recorded from Germany and from Austria.

7. On a single leaf that I brought from Eide, and which may belong to *T. grandifolia*, Ehrh., are several galls about the size of hemp-seed, in the axils of the chief veins. They are hard and rather prominent, but smooth, above; their lower surface is covered with a considerable tuft of rusty-brownish hairs, similar to, but much more abundant than the usual hairs in the axils of the chief veins. This gall also is the work of a species of *Phytoptus*. It is probably the *Erineum bifrons* of Le Pelletier de St Fargeau. I have specimens of this gall from Perthshire. It is recorded from Germany and from Austria.

8. *Legnon crispum*, Bremi.—In this gall the margins of the leaves are rolled into narrow warty tubes, in the interior of which live the mites (*Phytoptus* sp.) that produce them. The tubes are very irregular in width, but do not resemble any of the other mite-galls of the limes. They may be readily overlooked, being inconspicuous, as they seldom exceed 2 or 3 mm. in breadth, and 20 mm. in length. Examples are in my possession from Bonn, and from Salzburg in the Tyrol. I am not aware of the occurrence of this gall in Scotland.

Of the above galls on *T. parvifolia* some leaves bore Nos. 2, 6, and 8, and others bore 5, 7, and 8.

Geranium sanguineum, Linn.—In 1878 I brought home with me, from Hardanger, a single example of the mite-galls produced by *Phytoptus Geranii*, Thomas. The galls are involute leaf-segments, which become slightly thickened and fleshy, and form tubes in which the mites live. Usually a mass of the galls is clustered at the tip of a stem, where it is very conspicuous, some masses reaching the size of a large walnut. The galled leaves are often bright red or yellow. These galls are very frequent on the coast south of Aberdeen, and they have also been found at Allonby in Cumberland. On the Continent of Europe they are recorded from Thuringia, Austria, Croatia, and Switzerland (Lugano).

Acer Pseudo-Platanus, Linn.—In the town of Bergen, both in 1878 and in 1887, I observed the leaves of several trees almost covered with multitudes of the small red "nail-galls" known as *Ceratoneon vulgare*, Bremi, the work of gall-mites of the genus *Phytoptus*. Frequently a single leaf bears hundreds of these galls, usually crowded in patches as closely as they can be packed together. They are widely distributed over Europe, and are common in Britain.

Lotus corniculatus, Linn.—The well-known and common galls of *Cecidomyia Loti*, De Geer, were found upon this plant at Vik, on the Hardanger Fiord, last August. They consist of flower-buds much swollen and fleshy, which do not open, are almost always more or less deep purple-red in colour, and are very conspicuous. They are common in Britain, and are widely distributed throughout Europe.

Astragalus alpinus, Linn., was found on the way from Oifiord to the Voringfos, last August, bearing numerous galls of a midge (*Cecidomyia ? Onobrychidis*, Bremi), in the form of inflated, conduplicate, yellowish-green, rather fleshy, isolated leaflets, or terminal swellings on the young stems, made up of a mass of ill-formed young leaves of the bud, the whole mass being often about the size of a large pea. Often a number of leaflets are galled on each leaf. No midge-gall has been recorded previously from this species of *Astragalus*, so far as I can learn.

Vicia Cracca, Linn.—Masses of galls occur on the tips of the stems, reaching the size of a large hazel-nut. These galls consist of the pinnæ of the younger leaves, near the tips of the stems, all crowded into masses, the larger of which are sometimes as much as 30 mm. in diameter. Each leaflet is conduplicate, inflated, rather fleshy, and yellowish-green or dull yellow. Occasionally some of the separate leaflets of an otherwise healthy leaf are galled in this same way, but remain isolated. Each leaflet is tenanted by one or more larvæ of a midge, probably *Cecidomyia Viciæ*, Kieffer. Similar galls are common on *V. Cracca*, as well as on allied Leguminosæ, in Scotland; *C. Viciæ* has been recorded from *V. sepium* in Lorraine.

Prunus Padus, Linn.—In 1878 I found the leaves of this tree near Christiania much infested with the galls known as *Ceratoneon attenuatum*, Bremi, caused by mites (*Phytoptus*); and last August I met with the same galls even more plentifully in the Jordal valley, near the Buarbræ in Hardanger. They belong to the type of "nail-galls," standing erect on the upper surface of the leaf, to which they are fixed by a narrow base. Usually each leaf bears a considerable number of the galls scattered irregularly over it. They vary a good deal in form, some being spindle-shaped, others being turbinate or oval, and warty. They are dull-green, yellow, or red. In the Jordal the leaves very often bore the galls intermixed with large spots of the fungus *Polystigma fulvum*, Tul. The galls are abundant in Scotland, and are widely distributed throughout Europe.

Spiræa Ulmaria, Linn.—On this plant I found at Eide, in 1878, galls of the midge *Cecidomyia Ulmariæ*, Bremi. They are scattered in the substance of the leaves, are about the size of small shot, and are turbinate in form, the rounded end projecting from the upper surface, and the conical end below the leaf-blade. They are very common in Britain and throughout Central Europe.

Geum urbanum, Linn.—Near the Buarbræ, in Hardanger, at about 1500 feet above the sea, I found numerous leaves bearing an abundant coating of *Erineum gei*, Fries, originally regarded as a fungus. It is the work of mites (*Phytoptus*), and consists of patches of silky or woolly hairs, on either surface of the leaf, but far more frequently on the lower. Occasionally they are bounded by the veins, but more often they thin out round their edges. The reverse surface of the leaf, opposite each patch, is wrinkled and discoloured, becoming yellowish or dull red. The hairs are usually white, but show a tendency to become violet or rusty brown. Often the leafstalks and stems also are affected. This gall is not known as British, but has been recorded from Sweden (on *G. rivale*), Thuringia, Austria, Switzerland, and France.

Sedum Rhodiola, Linn.—Galls formed by a *Phytoptus* were common in Hardanger last August, in the Simodal, near Eide, and on the way to Vossevangen, on the leaves and inflorescences of this Sedum. They are apt to form crowded masses, which deform greatly the organs attacked; all the young leaves, or the flowers at the tip of a stem, may be so distorted that the individual parts are scarcely distinguishable. Where they occur singly on the leaves they are usually about 1 to 4 mm. in length, and rather less in breadth. Each consists of a circular ridge of hypertrophied cellular tissue, with an irregular warty or fissured edge, bent inwards so as to leave only a narrow opening into the space within the ridge. Into this space project small outgrowths from the epiderm of the leaf, and between these the mites may be found. The galls are yellowish green, or violet passing into purple. Specimens were sent to me in 1881, by Dr Buchanan White, from Ben Blabhein, in the island of Skye. The gall was originally described by Dr F. Loew from specimens collected in Lower Austria.

Epilobium angustifolium, Linn.—Last August I found upon this plant, in the Simodal in Hardanger, the pseudo-galls of one of the *Psyllidæ*. They consist of the leaf-margin folded abruptly backwards, and flattened against the lower surface, so as to leave only a narrow space, in which were larvæ of the insect. The tissue of the gall becomes slightly thickened and fleshy, and either yellowish green or reddish yellow, passing into purple on the surface most exposed to light. The reduplicated margin does not exceed 2 mm. in breadth, but it varies much in length, though usually between 25 and 60 mm. As a rule, most of the leaves on a stem are more or less galled. It was, of course, impossible to identify the gall-maker from the larvæ alone, and the only mention that I can find of a Psyllid as living on Epilobium is the enumeration by Mr J. Scott, in a list of "Food Plants of the species of Psyllidæ found in Great Britain" (*Ent. M. Mag.*, xix. p. 14), of *Aphalara nebulosa*, Zett., as living on *E. angustifolium*, but without any indication of his grounds for the statement, or of the habits of the insect, whether gall-making or otherwise.

Lonicera Xylosteum, Linn.—On this honeysuckle, in September 1878, I found, near Christiania, numerous examples of deformities produced by a *Phytoptus* on the leaves. These pseudo-galls consist of irregular wavy folds of the margins, and of scattered patches on any part of the surface of the leaf, which is thereby caused to assume a crumpled appearance, evidently due to the irritation produced by the suction of the mites, inducing hypertrophy of the diseased spots, the lateral expansion of which is restrained by the healthy portions around them. The mites live in the folds thus formed, which open on the upper surface of the leaf. This gall has been recorded from various parts of Germany, Lower Austria, the Tyrol, and Switzerland. I am not aware of the occurrence of galls on *L. Xylosteum* in Britain; but I have found at Cawdor, near Forres, a mite-gall on *L. Periclymenum*, which is regarded by Dr Thomas as the work of the same species of mite, the difference in form being attributed to the stage of development and the position of the leaves in the bud when the mites begin operations. In the latter plant the galled portion is a furrow nearly parallel to the edge of the leaf, and separated from it by a border of healthy tissue from 1 to 5 mm. broad. The furrow opens on the upper surface of the leaf, as in *L. Xylosteum;* but the appearance of the affected leaves is markedly distinct in the two plants. The galls on *L. Periclymenum* have been found near Gothenburg, in Sweden.

Galium verum, Linn.—Near Vik, in Hardanger, last

August, I picked up a stem of this Bedstraw, the leaves of which were almost all rolled by a *Phytoptus* lengthwise to form narrow tubes, in which the mites live. The deformity is very inconspicuous. It is of frequent occurrence in Scotland, and has been recorded from many localities in Germany and the Tyrol.

G. boreale, Linn.—Last August I found numerous plants between Eide and Graven, affected with a diseased condition approaching that described by Dr F. Loew (*Verh. Zool. Bot. Ges. Wien*, xxxvii. pp. 25–27), from Lower Austria. The leaves towards the tips of the affected stems bear rather stiff hairs, sometimes in streaks, sometimes covering their surface and extending along the internodes between the whorls. The leaves, especially when seriously attacked, remain stunted, and show a tendency to curve upwards along the sides; and they may be found occasionally forming a scarcely complete tube. The hairs vary a good deal in length (the longest being about 7 mm.), and in colour they vary from hyaline to pale rusty, brown, or dull violet. Last October I met with the same deformity on *Galium boreale* beside the Dee, a few miles from Aberdeen. It has been recorded from Siberia also.

Valeriana officinalis, Linn.—A single leaf picked up last year at Odde, in Hardanger, was distorted to form a pseudo-gall. The midrib in the middle of the leaf, and three or four of the middle segments, are twisted and thickened, so as to surround a space in which were some white larvæ of a *Cecidomyia*. The galled portion of the leaf is yellowish green, changing through dull red to brown. Galls similar to this occur in Aberdeenshire and Kincardineshire; but I know of no record of their occurrence elsewhere.

Achillea Millefolium, Linn.—Galls of a nematoid worm (*Tylenchus Millefolii*, F. Loew), were found by me last August, at Odde, on a plant of the Yarrow. They were first described by Dr Loew in 1873 (*Verh. Zool. Bot. Ges. Wien*, xxiv. pp. 18–24), from near Vienna. They especially affect the base leaves of stunted plants in dry situations, and are very inconspicuous, except when they twist the leaves, the appearance of which then indicates the presence of the galls. The latter are oval, or irregularly rounded fleshy swellings, sometimes on the midrib, sometimes on the large veins in the segments. They seldom exceed 4 mm. in length. On section they are found to enclose a narrow irregular cavity, filled with the minute worms. I have found these galls in the Brenner Pass in the Tyrol, in very fine condition, as many as twenty occurring on a leaf, two or three sometimes on a single segment. I have looked for them in Scotland without success; but Mr Cameron told me that he had found them in the neighbourhood of Glasgow.

A. Ptarmica, Linn.—In 1878 I found, near Bergen, and near Christiania, the galls of a midge (*Hormomyia Ptarmicæ*, Vall.) on Sneezewort Yarrow. They are inflorescences, which, in consequence of the suction of the gall-makers, become swollen, but remain abortive, and are covered with a coating of pale woolly hairs. A section of the galled flower-head shows numerous larvæ of the gall-midge. These galls are common in Scotland, and have been recorded from all the countries of Central Europe. On the Norwegian examples there also occurred small ovate galls in the axils of the upper stem-leaves. They are nearly smooth, and are purple in colour; but from observations on these galls, in Scotland, where also they are associated with the galled inflorescences, I believe that they are the work of the same midge, the woolly coating being produced only in the inflorescences, from the organs situated there.

Hieracium murorum, Linn.—Near the Buarbræ glacier, in Hardanger, last August, I gathered several leaves of a Hieracium, which appears to be this species, bearing galls of *Cecidomyia Hieracii*, F. Loew (= *C. sanguinea*, Bremi, named from the galls alone). The galls are mere low blisters in the leaf-blade, slightly convex on the lower surface, but almost flat above; yet they are very conspicuous, since each is situated in a dull red-purple spot, which is surrounded by a border of reddish yellow. Seldom does a gall stand quite alone; far more often from three to ten are grouped so close that the coloured spots touch or partially coalesce to form an irregular line, sometimes near the midrib, sometimes near the margin. Each spot is from 4 to 6 mm. across. When full-fed the larvæ burrow underground to become pupæ. These galls have been recorded from Austria, Germany, and France.

H. corymbosum, Fries.—In the Simodal, in Hardanger, last August, I picked up two or three galls of *Aulax Hieracii*, Bouché. They are rounded or oval swellings of the stems, most often situated at the point where the branches of the inflorescence arise; there they may be the size of a large hazel-nut. Less often they involve the base of the individual capitula, but are smaller in this situation. The surface is like that of the stem. A section shows that the gall consists of cellular pithy tissue surrounding numerous oval spaces, each of which has a more compact wall around it. In each cavity lives a larva. The galls of this insect are common in Scotland—on *H. corymbosum* and *H. sylvaticum*; and they have been recorded from various localities in Central Europe—on *H. murorum*, *H. umbellatum*, &c.

Campanula rotundifolia, Linn.—At Odde, in Hardanger, last autumn, the ovaries of this plant were not seldom swollen, forming the galls of a weevil, *Gymnetron Campanulæ*, Gyll. One side of the ovary is almost always more deformed than the other, and this, together with their larger size, renders them fairly conspicuous among the healthy seed vessels. This gall is common in the north-east of Scotland, and it has also been recorded from several localities on the Continent of Europe.

Veronica Chamædrys, Linn.—The only Norwegian specimen that I possess of the very common mite-gall known as *Calycophthora Veronicæ*, Kirchner, is from Christiania, where I picked it up in 1878. The ovate terminal bud, about the size of a large pea, with its pinkish-grey colour, due to its coating of woolly hairs, is one of the most easily detected and identified among mite-galls. The makers (*Phytoptus* sp.) live between the imbricated leaves of the bud, and frequently one finds along with them the larvæ of a midge (*Cec. Veronicæ*, Bremi), which was formerly regarded as the gall-maker, but is only an inquiline. This gall is very common in Scotland, and has been recorded from many places in Germany, Austria, and Switzerland.

Nepeta Glechoma, Benth.—I have a specimen, gathered near Trondhjem in 1878, which bears several galls of a midge (*Cec. bursaria*, Bremi) on the leaves. They are placed, usually in groups of two or three together, on the upper surface, on which they stand erect. They resemble rifle bullets in form, and are 3 or 4 mm. in height. Their surface is covered with hairs. When mature they break away from the leaves, carrying a portion of the tissue with them, so that the situation of each is then marked by a round hole through the leaf. I have this gall from Perthshire, and have seen it common in England. It has been recorded from France, Germany, and Austria.

Populus tremula, Linn.—I have a leaf of this tree, picked near Christiania in 1878, which bears the gall known as *Heliazeus Populi*, Kirchner, the work of a mite (*Phytopus* sp.). It is always situated on the base of the upper surface of the lamina, just where the petiole joins it, and is probably a distortion of the leaf-glands that normally occupy this situation. The galls are rounded warty outgrowths, 1 to 2 mm. high by 1 to 3 mm. broad, and are usually red or yellow. They are rather common in the north-east of Scotland, and I have thus been able to examine the development in fresh specimens. When full grown they are of firm texture, and inclose small irregular cavities, tenanted by the mites. At first each consists of two swellings (the glands), one on each side of the midrib, which are soft and fleshy. These soon overlap, until at last the two look like a single gall. The galls have been recorded from numerous localities in Germany and Austria.

Salix Caprea, Linn.—1. I have examples, gathered near Christiania, of galled petioles, swollen for the greater part of their length to more than twice the natural thickness, but otherwise little changed externally. On section each is found to enclose a cavity occupied by a larva of a sawfly, probably *Euura venusta,* Zaddach. I have found similar galls in Glen Gairn, in Aberdeenshire; and Mr Cameron records them from near Glasgow. *E. venusta* was described from German examples.

2. Galls of a midge (*Cec. Capreæ*, Winn.) were gathered by me in 1878 near Christiania, and in 1887, at Odde, in Hardanger. They are about the size of small shot, and are woody in texture, rounded, but rather more conical below (where there is a small hole formed when the gall is mature), and yellowish in colour. They are scattered irregularly over the leaf, the conical part below, and the rounded part above the general surface. Each is occupied by a single larva. These galls are plentiful in Scotland, and they have also been recorded from France, Germany, and Austria.

3. Bushes of this willow near Christiania also bore very numerous examples of the galls named *Cephaloneon umbrinum*, Bremi (the work of *Phytoptus* sp.), scattered irregularly over the upper surface of the leaves. They are dull reddish or brown "nail-galls," irregularly rounded in form, attached by a narrow neck to the leaf. Each opens on the lower surface of the leaf, but the opening is nearly closed by a dense tuft of grey woolly hairs. The galls vary from 1 to 2 mm. in diameter. I have these galls from Aberdeenshire, and they are recorded from Vienna.

S. ? phylicifolia (Linn.), Sm.—I have what seems to be a branch of this species of willow from the Simodal, in Hardanger, bearing on the leaves several galls, which agree very closely in their structure with those of *Nematus ischnocerus*, Thoms. They are almost always in pairs, one on each side of the midrib. They are about 12 mm. long by 4 mm. broad, with the sides parallel and the ends rounded; they do not project at all below the leaf, but are prominent above. The upper surface is dark green or purplish red, and the lower surface resembles that of the leaf. Each gall is tenanted by the larva of a sawfly, probably *N. ischnocerus*, Thomson. I have found galls that I cannot distinguish from this in Braemar, Aberdeenshire, on *S. phylicifolia*, *S. nigricans*, and *S. arbuscula*, and on *S. lapponum*. In the same locality were galls similar in form, but of rather smaller size. Mr Cameron (*Brit. Hymenopt.*, ii. pp. 196–197) says that the only localities he knows for *N. ischnocerus* in Britain are Braemar, Rannoch, and New Galloway; and he names as its food-plants *S. purpurea* and *S. laurina*. It was first recorded from Sweden.

S. nigricans, Sm.—On this willow near Vik, and in the Simodal, last August, I found a profusion of galls on the leaves, in the form of globular bodies about the size of peas, attached to the lower surface of the leaves, and scarcely showing at all on the upper surface. They are smooth, shining, and yellowish green, sometimes with red patches where exposed to the sunshine. The central cavity in each is at first rather small, but is rapidly enlarged as the sawfly larva within eats away the substance of the walls; and when the larva is full fed the gall is little more than a shell. These galls are so entirely similar to those of *N.*

Salicis-cinereæ, Retz., on various species of smooth-leaved willow, and that sawfly is so widespread, that the galls from Hardanger probably belong to this species.

Betula alba, Linn.—1. *Erineum betulinum*, Schum., was common on the lower surfaces of the leaves near Trondhjem and Christiania in 1878, and near Eide in 1887. This *Erineum* sometimes forms small spots along the midrib and the larger veins, sometimes isolated patches of densely crowded hairs scattered on the lower (rarely the upper) surface of the leaf, and sometimes it occupies almost the whole of the surface. The hairs are at first nearly white, but become rusty brown. The mites live between them. *E. betulinum* is very common in Scotland, and is recorded from France, Germany, and Austria.

2. In the same localities as the last-mentioned gall I also found another gall formed by a species of *Phytoptus*, but of markedly distinct structure. The latter galls resemble hard little warts in the tissue of the leaves, as many as fifty or sixty occasionally existing in a single leaf, but they very seldom coalesce. Though scarcely reaching 1 mm. in diameter, they project on both surfaces of the leaf-blade, especially in the dried leaves, as their hard texture prevents shrinkage. Each surrounds a relatively large cavity, which opens by a narrow outlet below, protected by a small tuft of hairs. The mites live in the cavity of the gall. I have found the galls very frequently in Scotland; they occur also in England, and have been recorded from many places in Germany and Austria.

Alnus incana (Linn.), D.C.—This alder in Hardanger seems to take the place filled by *A. glutinosa* in Scotland. I have found on it two kinds of mite-galls (*Phytoptus* sps.).

1. *Erineum alnigenum*, Lk., described by Link as a fungus under the name *Phyllerium alnigenum*, was of frequent occurrence near Christiania, and near Eide in Hardanger. It is far more frequent on the lower than on the upper surface of the leaf, and assumes the form either of well-defined spots of hairs, or patches diffused irregularly along the midrib and larger veins. At first the hairs are pale, but the spot becomes rusty brown, approaching a russet brown, surrounded by a narrow pale border. The hairs are slender, bent, and blunt. This gall has been recorded from Saxony, from the

neighbourhood of Vienna, and from the Tyrol. On *Alnus glutinosa* an *Erineum*, very similar in appearance to the above, is very common in Scotland, and also occurs in Saxony and near Vienna, but the hairs in it are different from those of *E. alnigenum*. It is known as *E. alneum*, Persoon.

2. Another mite-gall is frequently met with on the leaves of *A. incana*, along with the *Erineum*, very often even on the same leaves. It is known by the name *Cephaloneon pustulatum*, Bremi, and belongs to the "nail-gall" type. Often a leaf bears upwards of a hundred of the galls on its upper surface, some scattered singly, others crowded into groups as closely as they can stand. They are irregularly oval, rough, and red, or yellowish-red; and do not exceed 2 mm. in diameter. Each communicates with the lower surface of the leaf by a narrow hole, which is surrounded with a warty lip. This gall occurs on *A. incana* in Switzerland, in Germany, and in Austria. It is even more common in the same countries on *Alnus glutinosa*, upon which tree it is also very plentiful in many localities in Scotland.

Juniperus communis, Linn.—At Oifiord in Hardanger, last August, I found galls of a midge (*Hormomyia juniperina*, Linn.) on juniper twigs. They resemble green cones at the tips of the smaller twigs, and are ovate, about 6 mm. long by 4 broad, and externally consist of three broad scale-like needles, which surround three smaller needles, between which is the cavity occupied by the larva. This gall is plentiful in Scotland, and has been recorded from France and Germany; and the midge is also stated in Siebke's *Enumeratio* to occur on the Dovrefield mountains.

List of Makers of Galls found by me in Norway in 1878 and 1887.

COLEOPTERA.

Gymnetron Campanulæ, Gyll., galled ovaries of *C. rotundifolia*.

HYMENOPTERA.

Though I did not rear the makers, I venture to refer the galls to the undermentioned insects, as they agree entirely with galls of these species from other localities.

Euura venusta, Zadd., . .	galled petioles of *Salix Caprea.*
Nematus ischnocerus, Thoms.,	galls on leaves of *S. ?phylicifolia.*
N. Salicis-cinereæ, Retz., .	pea-galls on leaves of *S. nigricans.*
Aulax Hieracii, Bouché, .	stem-galls of *Hieracium corymbosum.*

HEMIPTERA.

Trioza Cerastii, H. Loew, .	galled branches of *Cerastium triviale.*
Aphalara sp.? . . .	folded leaf-margins of *Epilobium angustifolium.*

DIPTERA.

Sciara tilicola, H. Loew, .	twig of *Tilia parvifolia.*
Hormomyia Reaumuriana, F. Loew.	leaf of *Tilia parvifolia.*
H. Ptarmicæ, Vall., . .	flower-heads of *Achillea Ptarmica.*
H. juniperina, Linn., . .	on twigs of *Juniperus communis.*
Cecidomyia Frauenfeldi, Kalt.,	leaves of *Tilia parvifolia.*
C. ? Tiliæ, Schrk., . . .	leaves of *Tilia parvifolia.*
C. Loti, De Geer, . . .	flower-buds of *Lotus corniculatus.*
C. Viciæ, Kief., . . .	leaflets of *Vicia Cracca.*
C. ? Onobrychidis, Bremi, .	leaflets of *Astragalus alpinus.*
C. Ulmariæ, Bremi, . .	leaves of *Spiræa Ulmaria.*
C. sp.?	leaf of *Valeriana officinalis.*
C. Hieracii, F. Loew, . .	leaves of *Hieracium ? murorum.*
C. bursaria, Bremi, . .	leaves of *Nepeta Glechoma.*
C. Capreæ, Winn., . . .	leaves of *Salix Caprea.*

ACARIDA.

All the mite-galls belong to the genus *Phytoptus*, distinguished from other mites by the long slender body, and the possession of only four legs. The species are so much alike that it is scarcely possible to distinguish between them, save by the differences in the galls produced by them; but fortunately the galls are readily distinguished from one another, even where two or more species occur on the same leaf. Before the true nature of the galls was detected many of them received names, without reference to the makers; and these names are still retained for convenience of reference, and are given in brackets below. They fall naturally into well-marked divisions, *e.g.*, "nail-galls" (*Ceratoneon* and *Cephaloneon*), scattered over the upper surface of the leaves;

hairy patches (*Erineum*), on either surface, though usually below, originally regarded as imperfect fungi; tubes formed of involute leaf-segments, with or without the growth of hairs; galled buds (*Calycophthora*, &c.), often covered with a thick coat of hairs; folds in leaves or margins closely rolled into narrow tubes (*Legnon*); and other forms for which special names have not been suggested, and that need not be more fully discussed.

(*Erineum tiliaceum*, Pers.), .	all on leaves of *Tilia parvifolia.*
(*Ceratoneon extensum*, Bremi), .	
(*Legnon crispum*, Bremi), .	
(*?Erineum bifrons*, Le Pell.), .	leaf of *Tilia ?grandifolia.*
(*Ceratoneon vulgare*, Bremi), .	leaves of *Acer Pseudo-platanus.*
Phytoptus Geranii, Thomas, .	rolled leaf-segments of *Geranium sanguineum.*
(*Ceratoneon attenuatum*, Bremi),	leaves of *Prunus Padus.*
(*Erineum Gei*, Fries), . .	*Geum urbanum.*
Warty galls of *Phytoptus*, .	*Sedum Rhodiola.*
Rolled leaves, ...	*Galium verum.*
Hair-growths and curvature of	leaves of *Galium boreale.*
Leaf-crumpling (*Legnon*), .	*Lonicera Xylosteum.*
(*Calycophthora Veronicæ*, Kirchner.)	bud-galls of *Veronica Chamædrys.*
(*Heliazeus Populi*, Kirchner), .	gland-gall at base of leaf-blade of *Populus Tremula.*
(*Cephaloneon umbrinum*, Bremi),	leaves of *Salix Caprea.*
(*Erineum betulinum*, Schum.),	leaves of *Betula alba.*
Warty galls, ...	leaves of *Betula alba.*
(*Erineum alnigenum*, Link), .	leaves of *Alnus incana.*
(*Cephaloneon pustulatum*, Bremi.)	leaves of *Alnus incana.*

NEMATOIDEA.

(*Tylenchus Millefolii*, F. Loew),	leaves of *Achillea Millefolium.*

With a view to render this paper of greater value, I have sought out previous records about the galls and gall-makers of Norway, but only to find that but little has been put on record concerning the one or the other. Indeed, the only works in which I have succeeded in finding information are—

1. A paper of two pages by Steenstrup in *Forhandlingars ved de skandinaviske Naturforskeres syvende Mode i Christiania*, 12–18 July 1856, pp. 189–190, entitled *Om de paa skandinaviske Traaer og andre Planten forekommende Traeemider* (*Phytoptus*, Duj.). (On the Tree-mites occurring on the Scandinavian Trees and other Plants.)
2. *Enumeratio Insectorum Norvegicorum*, by H. Siebke, begun in 1874, and still going on under the editorship of J. Sparre Schneider.
3. *Bygaalen* (*Tylenchus Hordei*, n. sp.), by W. M. Schøyen (*Christiania Videnskabs-Selskabs Forhandlinger*, 1885, No. 22, pp. 1–16, pl. i.).

Taking these in the above order, the first is known to me only by a summary in one of the valuable papers by Professor Thomas of Ohrdruf. In Steenstrup's paper he says, with regard to galls of *Phytoptus* on Scandinavian plants, "the peculiar hairy outgrowths which they (the mites) produce on the leaves of *alders, birches, limes, elms, beeches, walnut*, species of *maple, sloe, plum* trees escaped from cultivation, *willows, hazel* bushes, *wild thyme, bedstraw*, &c.," are, as regards form and situation, characteristic for each species. He distinguishes between the chief types of mite-galls, *e.g.*, pouches, rolled leaves, hairy growths, &c.; but does not enter into details with respect to the special forms of galls on any particular species of plant, so that it is uncertain which of the forms of mite-galls he alludes to in the case of such plants as bear more than one. He says also, with regard to their origin, "the patches of hairs, *e.g.*, on the beech leaves, which have been taken for fungi, and described under the genus *Phyllerium*, and the elegant folding of the leaves of the hornbeam, have the same origin" as the other mite-galls.

In Siebke's *Enumeratio* there is no mention of the galls made by any of the insects; but I find the following species enumerated as Norwegian, and as they are known to be gall-makers in other countries, we cannot doubt that they are so in Norway also. I have added the notes in brackets to each :—

Coleoptera.

Ceuthorrhynchus sulcicollis, Gyll., on flowers of *Erysimum hieracifolium*, at Christiania (galls roots of various species of *Brassica*).

C. contractus, Marsham, on flowers at Christiania (reared from galls on roots of *Brassica Sinapistrum*, in Britain).

Gymnetron Linariæ, Panzer, at Christiania (galls roots of *Linaria vulgaris*).

G. noctis, Herbst., on flowers of *Linaria vulgaris*, at Christiania and at Drammen (larva lives in slightly deformed ovaries of *Linaria vulgaris*).

Hymenoptera.

Nematus Salicis-cinereæ, Retz (sub nom. *N. cinereæ*, De Geer), at Christiania and at Tromsø (produces pea-galls on willows, see above).

N. gallicola, Westw. (sub nom. *N. Vallisnieri*, Hart.), at Christiania (produces oblong galls in the leaves of various willows, projecting from both surfaces).

N. Salicis-pentandræ, Retz. (sub nom. *N. pentandræ*, De Geer), at Christiania (produces woody swellings on the twigs of various willows, especially on *S. pentandra*).

N. dolichurus, Thomson, taken at Fokstuen, in Dovre (probably makes galls on one or more of the alpine willows).

Hemiptera.

Livia juncorum, Latr., on various flowers, especially on Compositæ, at Christiania (galls young shoots of *Juncus communis*).

Schizoneura Ulmi, Linn., on *Ulmus campestris*, near Christiania (causes the leaves to become fleshy, and to form wide tubes, in which the Aphides live).

Tetraneura Ulmi, De Geer, on leaves of *Ulmus campestris*, near Christiania (the galls are oval bodies, about 12 by 6 mm., rising from the upper surface of the leaf, to which they are attached by a narrow pedicle; the Aphides live in the large central cavity).

Pemphigus bursarius, Linn., on *Populus pyramidalis*, near Christiania (produces flask-shaped galls, about 12 mm. in height, on the petioles; an opening at the upper end leads into the cavity occupied by the Aphides).

DIPTERA.

Trypeta solstitialis, Linn. (sub nom. *Tephritis solstitialis*), at Christiania and Eidsvold. (I have reared this fly from galled flower-heads of *Centaurea nigra*, gathered near Aberdeen; it is said by Kaltenbach to gall *Carduus nutans*, *C. crispus*, *C. acanthoides*, *Cnicus lanceolatus*, *Centaurea Scabiosa*, *C. Jacea*, and *C. montana*.)

Lauxania ænea, Fallen, at Christiania, and in several other localities. (This fly is said by Winnertz to gall the ovaries of the *Viola arvensis* and of V. *tricolor;* but I have not found confirmation of this statement by any other author; and I have never found galled ovaries on these plants, though the fly is not scarce in the vicinity of Aberdeen.)

Hormomyia juniperina, Linn. (sub nom. *Lasioptera juniperina*), at Nystuen and at Kongsvold (galls *juniper* buds, see above).

Herr Schøyen gives an account of a disease called *Krok*, which he observed in 1885, to be prevalent in the district of Lom, where it had been observed as early as 1849 by Moe and Norman. He traced the cause to the formation of very numerous small galls on the roots. In these he found a profusion of Nematoid worms, both sexes of which were mature, so that he was able to determine that they belonged to a previously undescribed species, which he named *Tylenchus Hordei.* The galls of this species have also been detected on barley at Pajala in the north of Sweden, and at Karasjok in Norwegian Finmark. Herr Schøyen compares the galls with those found by Dr Warming on *Elymus arenarius* on the coast of Zealand in Denmark, and by myself on the same plant near Aberdeen, and comes to the conclusion that all are the work of the same species of *Tylenchus.* His description and figures quite support this conclusion.

[*Note.*—Since the above has been put in type I have observed in the *Botanisches Centralblatt* (vol. xxxiv. p. 18) a short notice of a work by Herr J. Brunchorst, entitled *De vigtigste Plantesygdomme*, published in Bergen last year. It is said in the notice that the work is a popular account of diseases of plants, and that in the last part of it the hurtful gall-growths are described. Not having seen the book, I do not know in how far it adds to the above records.]

A List of Plants observed in West Sutherland (108), by Mr ARCHIBALD GRAY; *with Notes on the Flora*, by LIONEL W. HINXMAN, of H.M. Geological Survey. Communicated by B. PEACH, F.R.S.E., F.G.S., &c.

(Read 10th May 1888.)

The following list, though not pretending to be an exhaustive Flora of West Sutherland, is the result of a careful examination of the large district of Assynt, together with the western portion of the parish of Tongue, by Mr A. Gray, during the summer and autumn of 1886.

A few additional species have been added from notes made by Mr B. N. Peach and myself in Durness and Eddrachillis in 1883–84.

Had Mr Gray not been unfortunately prevented from revisiting Sutherland, this list would no doubt have been considerably enlarged, both by the examination of the more interior parts of the county and by the working out in fuller detail of such genera as *Hieracium* and *Chara*. The same cause has prevented Mr Gray from doing full justice to the subject in a paper such as he would have liked to lay before the Society. He has, however, handed me his materials, and I have endeavoured from these and from my own observations to furnish a few notes on the chief characteristics of the plant life of this part of Sutherland.

The total number of species recorded (474) is a large one, when the general character of the country is taken into consideration, bare rocky hills alternating in dreary monotony with wet peat flows over the greater part of the district.

In striking contrast to the barren desolation that surrounds them are the green oases formed by the limestone areas of Durness, Inchnadamph, and Elphin. These are peculiarly rich in flowering plants, and during the short spring and summer of these northern latitudes the rich grassy covering of the limestone knolls is strewn with a wealth of flowers, whose profusion of bloom and intensity of colouring recall to one's mind the flora of alpine regions.

Amongst these such species of orchid as *Habenaria viridis*, *Gymnadenia albida*, *Listera ovata*, *L. cordata*, and *Epi-*

pactis latifolia are abundant, and every hillock is carpeted in early June with the beautiful flowers of *Dryas octopetala*.

The plants of cultivation are also almost entirely confined to these districts, and it is, therefore, not surprising that a large proportion of the whole flora is found within a very limited area. Natural wood is very scanty, and although scattered clumps of stunted birch occur in most of the glens and around the larger lochs, it is only along the shores of Loch Assynt and about Tongue that anything deserving the name of a wood can be found. The plantations at Loch Inver and Tongue afford such non-indigenous species as *Fagus, Pyrus Malus, Fraxinus, Ligustrum, Acer, Populus nigra,* and possibly some of the *Salices*.

It is curious to note how, on the wind-swept ledges of the cliffs of the Whiten Head, the holly and aspen have adapted themselves to the situation, crawling along the ground and clinging to the face of the rock, as though not daring to lift their heads against the fury of the winter gales.

The coast-line, though of great extent, presents a nearly unbroken line of precipitous cliffs, and with the exception of Bagh Torrisdail, at the mouth of the river Borgie, affords no salt marshes or muddy flats, such as are the favourite habitat of maritime plants. These are therefore mainly represented by such species as can best flourish on the ledges and in the caves and crevices of the cliffs, as *Sedum Rhodiola, S. anglicum, Silene acaulis, S. maritima, Asplenium marinum;* while *Primula scotica* and *Scilla verna* occur abundantly on the short-cropped turf that clothes the cliff-tops of the Farrid Head.

The Kyle of Tongue and the mouth of the river Borgie afford a few littoral species, including *Hippophae, Aster Tripolium,* and one or two *Chenopodiums* and *Atriplices*.

Although none of the mountains of West Sutherland attain any great elevation (Ben More, Assynt, with a height of 3200 feet, being the most lofty), the list of alpine and sub-alpine plants is a fairly numerous one. It includes *Caltha palustris* var. γ *minor, Cochlearia officinalis* var. *alpina, Draba rupestris, D. incana, Viola palustris, Cerastium latifolium, Cherleria sedoides, Sibbaldia procumbens, Alchemilla alpina, Epilobium alpinum, Saxifraga oppositifolia, S. stellaris, S. aizoides, S. hypnoides, Cornus suecica, Saussurea alpina,* *Gnaphalium supinum, Hieracium holosericeum, Arctostaphylos alpina, A. Uva-ursi, Loiseleuria procumbens, Veronica humifusa, Oxyria reniformis, Betula nana, Salix herbacea*, and *Juniperus nana.* Of the Juncaceæ, *Luzula arcuata,* found by Barry in 1833 on Ben More and Foinaven, was obtained on Ben Loyal, and *Luzula spicata, Juncus trifidus,* and *J. triglumis* on Ben More.

With the exception of *C. rigida,* from Ben More, no alpine Carex was obtained, though *C. rupestris, rariflora, vaginata, fulva,* var. *speirostachya,* and *pulla* are recorded by Watson and Campbell. The alpine Lycopodiaceæ include *L. alpinum, L. Selago,* and *Selaginella selaginoides.*

The whole of this district is included in the superagrarian zone of Watson, and consequently many plants of an alpine and subalpine character, such as *Silene acaulis, Sedum Rhodiola, Thalictrum alpinum, Alchemilla alpina, Draba incana,* and *Dryas octopetala* descend to the shore-line; while *Rubus Chamæmorus* and *Saussurea alpina* are found respectively as low as 800 and 400 feet above sea-level.

The most important discovery made by Mr Gray is the occurrence of *Arenaria norvegica* near Inchnadamph. This plant is recorded from Unst, in Shetland; but Mr Gray has, as far as I am aware, been the first to discover it on the mainland of Britain.

It remains to notice a few of the more noteworthy plants in the list, which have not been hitherto mentioned:—

Subularia aquatica, in Loch Awe, Assynt.

Spergularia neglecta, from Tongue (new species, for 108).

Montia fontana, var. b. *rivularis,* Quinog (new species).

Radiola millegrana, found at a single locality only, on Eilean Losal (new species).

Oxytropis Halleri, Torrisdale Bay (new species).

Rosa mollissima, Inchnadamph (new species).

Epilobium tetragonum (new species).

Myriophyllum spicatum, at Elphin (new species).

Ligusticum scoticum, common along the coast-line.

Myrrhis odorata, Tongue; perhaps not native.

Viburnum Opulus, Inchnadamph (new species).

Solidago, var. c. *cambrica,* on Beinn-na-Cnaimheag.

Hieracium prenanthoides, Loch Roe. This plant is recorded by Hanbury (*Bot. Jour.,* Nov. 1886) but not by Watson.

Lobelia Dortmanna, abundant in the shallow lochans.

Pyrola minor, Tongue Wood.

Mentha viridis, hirsuta, sativa, and *arvensis;* these are all new records.

Ajuga pyramidalis, Torbreck.

Trientalis europæa, in one locality only, near Inchnadamph.

Salix pentandra, Loch Inver and Tongue. This, with *S. purpurea, S. viminalis*, and *S. caprea*, are new species, but are perhaps doubtfully native.

Sparganium affine, ditches at Elphin (new species), and *S. minimum*, on Ben Loyal.

Of the Gramineæ—*Avena flavescens, Holcus mollis, Catabrosa aquatica*, in a loch at Clachtoll; *Festuca elatior, Brachypodium sylvaticum, Triticum acutum*, and *Melica nutans* are new records.

Filices.—The commoner ferns are fairly well distributed throughout the district, while the limestone rocks at Inchnadamph and Knockan yield the more interesting forms in considerable variety. *Polypodium Dryopteris, P. Phegopteris, P. alpestre, Polystichum Lonchitis*, and *Asplenium viride* occur abundantly; and *Hymenophyllum unilaterale* is found in the Allt Poll an Droighinn at Inchnadamph. *Scolopendrium* is very rare, and has only been noticed in three localities—in Glen Dhu, Inchnadamph, and Glen Coul. *Osmunda regalis*, in spite of the tourist, is still fairly plentiful in several spots both in Assynt and Eddrachillis; but the one plant known to us in Durness in 1884 has, I believe, met with its fate at the hands of some unscrupulous collector.

Four species of *Chara* were collected by Mr Gray, including *C. crinita* and *C. fragilis*, both new records; and he was of the opinion that further careful examination of this difficult genus would recognise several other species as occurring in this district.

In conclusion, as probable garden escapes, must be considered—*Clematis Vitalba*, in Tongue Wood; *Astrantia major*, at Inchnadamph; *Ægopodium Podagraria*, covering a small island in Loch Assynt, to which tradition points as the garden of the former occupants of Ardvreck Castle; *Narcissus Pseudo-Narcissus*, at Ardvreck; and *Polemonium cœruleum*, in Tongue Wood.

The total number of species recorded for this county, 108

(West Sutherland) in Watson's *Topographical Botany*, 2nd edition, 1883, together with additional records in the *Scottish Naturalist*, 1886, and the *Journal of Botany*, Nov. 1886, amounts to 489.

Of these Mr Gray has obtained 400, and in addition to these, 74 not hitherto recorded, making an aggregate of 563 species now recorded for the district.

The appended list, based on the 7th edition of the *London Catalogue*, gives those plants observed by Mr Gray, those not hitherto recorded being denoted by an asterisk. Approximate localities are given for the less common or local species.

I may add, that Mr Gray also made a large and interesting collection of lichens, which have been submitted to Dr Stirton of Glasgow for identification.

List of Plants observed in West Sutherland in 1886 *by Archibald Gray.*

Names.	Approximate Localities and Remarks.
RANUNCULACEÆ.	
Clematis Vitalba	Tongue Wood (garden escape ?).
Thalictrum alpinum	Durness (descends to sea-level at Durness).
minus	Loch Assynt—Clachtoll.
Anemone nemorosa	
Ranunculus Flammula	
b. pseudo-reptans*	
acris	
repens	
bulbosus	Culbackie, Tongue.
Ficaria*	
Caltha palustris	
c. minor*	Ben More, Assynt (at 2500 feet).
Trollius europæus	Achumore, Assynt—Elphin.
NYMPHÆACEÆ.	
Nymphæa alba	Abundant in Assynt and Eddrachillis.
PAPAVERACEÆ.	
Papaver dubium*	Culbackie—Tongue.
FUMARIACEÆ.	
Corydalis claviculata*	Elphin.
Fumaria officinalis	
CRUCIFERÆ.	
Cakile maritima	Culbackie.

Names.	Approximate Localities and Remarks.
Raphanus Raphanistrum	
Sinapis arvensis	
Sisymbrium officinale*	
Cardamine pratensis	
hirsuta	
sylvatica	Tongue Wood.
Cochlearia officinalis	
b. alpina	Coinne mheall—Ben More (at 2000 feet).
Draba verna	
incana	(Descends to sea-level).
rupestris	Ben More, Assynt.
Subularia aquatica	Loch Awe—Assynt.
Capsella bursa-pastoris	
VIOLACEÆ.	
Viola palustris	Coinne mheall, Assynt (wet alpine meadow, 2500 feet).
sylvatica	
canina*	Clachtoll.
tricolor	
b. arvensis	Tongue.
lutea *b.* amœna*	Inchnadamph.
DROSERACEÆ.	
Drosera rotundifolia	
anglica	More abundant in Assynt than rotundifolia.
POLYGALACEÆ.	
Polygala vulgaris	
depressa*	Assynt.
CARYOPHYLLACEÆ.	
Silene maritima	
acaulis	Knockan; cliffs at Durness.
Lychnis diurna	
Flos-cuculi	
Cerastium tetandrum	Clachtoll.
glomeratum	
triviale	
latifolium	Ben More, Assynt (at 3000 feet).
Stellaria media	
Holostea	
graminea	
uliginosa	
Arenaria serpyllifolia	
norvegica*	Inchnadamph.

Names.	Approximate Localities and Remarks
Honckenya peploides	Clachtoll.
Cherleria sedoides	Ben More, Assynt (at 2500 feet
Sagina maritima	Sgulomie Harbour.
procumbens	
subulata	Culbackie.
nodosa*	Durness and Achmelvich, Tongue.
Spergula arvensis	(This weed often almost entirely usurps the corn-fields).
Spergularia neglecta*	Torrisdale—Tongue.
PORTULACEÆ.	
Montia fontana	
b. rivularis	Allt bradhan, Quinaig.
HYPERICACEÆ.	
Hypericum pulchrum	
LINACEÆ.	
Radiola millegrana*	Eilean Losal—Tongue (only locality noticed).
Linum catharticum	
GERANIACEÆ.	
Geranium molle	
Robertianum	
Oxalis acetosella	
ILICACEÆ.	
Ilex aquifolium	Loch Assynt.
SAPINDACEÆ.	
Acer Pseudo-Platanus	Inchnadamph (probably not native).
LEGUMINIFERÆ.	
Ulex europæus	Inchnadamph — Loch Inver—Rispond (very local).
Sarothamnus scoparius	
Ononis arvensis	
Anthyllis Vulneraria	
Trifolium pratense	
repens	
procumbens*	Inchnadamph.
minus	
Lotus corniculatus	
Oxytropis Halleri	Torrisdale Bay—Tongue.
Vicia Cracca	
sylvatica*	Clachtoll.
Sepium	
sativa	Tongue.

Names.	Approximate Localities and Remarks.
Lathyrus pratensis	
Orobus tuberosus	
ROSACEÆ.	
Prunus spinosa	Torbreck—Inchnadamph.
Padus	Calda Burn—Assynt—Ledbeg.
Spiræa Ulmaria	
Alchemilla arvensis	Tongue (very local).
vulgaris	
alpina	(Descends to sea-level).
Sibbaldia procumbens	Ben More, Assynt (at 2500 feet).
Potentilla Fragariastrum*	Torrisdale ?
Tormentilla	
anserina	
Comarum palustre	Loch Awe—Loch Inver—Durness.
Fragaria vesca	
Rubus Idæus	
saxatilis	
Chamæmorus	(Descends to 800 feet).
Geum urbanum*	Torrisdale.
rivale	
Dryas octopetala	(Very abundant at Durness and Inchnadamph, also on the sea shore at Torrisdale Bay).
Rosa spinosissima	
mollissima*	Traligill Burn—Assynt.
tomentosa	Unapool.
canina	Inchnadamph and Unapool.
Cratægus Oxyacantha	Tongue.
b. monogyna*	North side of Loch Assynt (one bush only).
Pyrus Aucuparia	
Malus*	Tongue Wood (probably introduced).
ONAGRACEÆ.	
Epilobium angustifolium	Allt Ellag (properly in Ross-shire, but counted as 108).
montanum	
tetragonum*	
palustre	
alpinum	Ben More, Assynt.
Circæa alpina	Inchnadamph.
HALORAGACEÆ.	
Myriophyllum spicatum*	Elphin—Inchnadamph.
alterniflorum	R. Loanan—Inchnadamph.

Names.	Approximate Localities and Remarks.
Callitriche verna	
hamulata	
GROSSULARIACEÆ.	
Ribes rubrum	Loch Inver.
CRASSULACEÆ.	
Sedum Rhodiola	Mountain tops to sea-level.
anglicum	Kylesku—Clachtoll.
acre	Achmelvich Bay, Tongue.
SAXIFRAGACEÆ.	
Saxifraga oppositifolia	(Common on mountain tops in Assynt).
stellaris	
aizoides	
hypnoides	Beinn an Thurain, Ben Loyal.
Chrysosplenium oppositifolium	
Parnassia palustris	Loch Awe—Torrisdale (very local).
UMBELLIFERÆ.	
Hydrocotyle vulgaris	Clachtoll.
Astrantia majór	Inchnadamph (garden escape ?).
Sanicula europæa	
Ægopodium Podagraria*	Island in Loch Assynt (garden escape ?).
Bunium flexuosum	
Pimpinella Saxifraga	Torrisdale Bay.
Ligusticum scoticum	(Common along the coast).
Angelica sylvestris	Durness and Assynt.
Heracleum Sphondylium	
Daucus Carota	
Chærophyllum sylvestre	
Myrrhis odorata*	Tongue.
ARALIACEÆ.	
Hedera Helix	Durness—Assynt (very local).
CORNACEÆ.	
Cornus suecica	Quinaig, Ben More, Beinn nan Cnaimheag, Assynt; Ben Stomino, Tongue.
CAPRIFOLIACEÆ.	
Sambucus nigra	
Viburnum Opulus*	Inchnadamph (truly wild).
Lonicera Periclymenum	
RUBIACEÆ.	
Galium boreale	

Names.	Approximate Localities and Remarks.
Galium verum	
saxatile	
uliginosum*	
Aparine	
Asperula odorata	Assynt—An Coilean.
Sherardia arvensis	Torrisdale.
VALERIANACEÆ.	
Valeriana officinalis	Islands in Loch Awe.
Valerianella olitoria	Achmelvich Bay—Tongue.
DIPSACACEÆ.	
Scabiosa succisa	
arvensis	Torrisdale.
COMPOSITÆ.	
Carduus lanceolatus	
palustris	
heterophyllus	Elphin.
arvensis	
Saussurea alpina	Ben More, Assynt—Cama Loch (descends to 400 feet).
Centaurea nigra	
Scabiosa	
Chrysanthemum segetum	
Leucanthemum	
Matricaria Parthenium	Tongue.
inodora	
b. salina	Clachtoll.
Tanacetum vulgare	Loch Inver.
Achillea Millefolium	
Ptarmica	
Artemisia vulgaris	
Gnaphalium uliginosum*	Tongue.
sylvaticum	
supinum	Coinne mheall, Assynt—Ben Loyal.
dioicum	
Senecio vulgaris	
Jacobæa	
aquaticus	
Bellis perennis	
Aster Tripolium*	Bagh Torrisdale—Tongue.
Solidago Virgaurea	
c. cambrica	Beinn Cnaimheag (at 1000 ft.).
Tussilago Farfara	
Lapsana communis	
Hypochæris radicata	
Leontodon autumnalis	

Names.	Approximate Localities and Remarks.
Tragopogon pratensis	
b. minor	Culbackie.
Taraxacum officinale	
Sonchus oleraceus	
asper*	
arvensis*	
Crepis virens*	
paludosa	
Hieracium Pilosella	
holosericeum*	Beinn Cnaimheag (at 1000 ft.).
prenanthoides*	Loch Roe—Assynt.
rigidum	
CAMPANULACEÆ.	
Lobelia Dortmanna	
Campanula rotundifolia	Assynt—Durness—sea-cliffs.
ERICACEÆ.	
Vaccinium Vitis-idæa	
Myrtillus	
Arctostaphylos alpina	Beinn nan Cnaimheag.
Uva-ursi	Quinag—shore at Kylesku.
Loiseleuria procumbens	Ben Reidhe—Quinag (at 1300 ft.).
Erica Tetralix	
cinerea	
Calluna vulgaris	
Pyrola minor	Tongue Wood.
JASMINACEÆ.	
Fraxinus excelsior	
Ligustrum vulgare	Tongue.
GENTIANACEÆ.	
Gentiana Amarella	Inchnadamph.
campestris	Loch Assynt.
Menyanthes trifoliata	Durness—Assynt.
SCROPHULARIACÆ.	
Scrophularia nodosa*	Loch Assynt—Loch Inver.
Digitalis purpurea	
Veronica hederæfolia*	Elphin.
agrestis	
arvensis	
serpyllifolia	
humifusa	Coinne mheall, Assynt.
officinalis	
Chamædrys	
scutellata	Torrisdale.
Anagallis	Cromalt Hills.

Names.	Approximate Localities and Remarks.
Veronica Beccabunga	
Euphrasia officinalis	
Bartsia Odontites	
Pedicularis palustris	
sylvatica	
Rhinanthus Crista-galli	
Melampyrum pratense	
LABIATÆ.	
Mentha viridis*	Loch Inver.
hirsuta*	Loch Assynt—Loch Awe.
sativa*	Tongue.
arvensis*	Culbackie.
Thymus Serpyllum	
Prunella vulgaris	
Scutellaria galericulata*	Shingle beach, Inverkirkaig.
Stachys palustris*	
sylvatica	
Galeopsis Tetrahit	
Lamium amplexicaule	
purpureum	
Ajuga pyramidalis	Torbreck, Assynt.
Teucrium Scorodonia	
BORAGINACEÆ.	
Mertensia maritima	Inverkirkaig—Tongue Bay.
Myosotis cæspitosa	
repens	
arvensis	
versicolor	
Anchusa arvensis	Clachtoll—Culbackie.
sempervirens*	Elphin.
PINGUICULACEÆ.	
Pinguicula vulgaris	
lusitanica	Loch Inver—Beinn Garbh—Durness.
Utricularia minor	Achumore, Assynt.
intermedia	Loch Awe.
PRIMULACEÆ.	
Primula vulgaris	Abundant on sea-cliffs at Durness.
scotica	Farrid Head, Torrisdale.
b. acaulis	Torrisdale.
Trientalis europæa*	Stronchrubie, Assynt (very local only this one locality known).
Lysimachia nemorum	
Glaux maritima	

Names.	Approximate Localities and Remarks.
PLUMBAGINACEÆ.	
Armeria maritima	
PLANTAGINACEÆ.	
Plantago major	
lanceolata	
maritima	
Coronopus	
CHENOPODIACEÆ.	
Chenopodium album	Inverkirkaig.
rubrum*	Loch Inver.
Atriplex angustifolia*	Sgulonie, Tongue.
Babingtonii	
hastata (?)	
POLYGONACEÆ.	
Rumex nemorosus (spec. ?)*	
obtusifolius	
crispus	Elphin.
Acetosa	
Acetosella	
Oxyria reniformis	Ben More, Assynt—Tongue (descends to shore-line at Tongue).
Polygonum Convolvulus	
aviculare	
Persicaria	
lapathifolium*	Clachtoll.
amphibium	Clachtoll.
b. terrestre*	Clachtoll.
viviparum	
ELÆAGNACEÆ.	
Hippophae rhamnoides	Tongue Ferry (native ?).
EMPETRACEÆ.	
Empetrum nigrum	
EUPHORBIACEÆ.	
Euphorbia Helioscopia	
URTICACEÆ.	
Urtica dioica	
urens	Achmelvich.
Ulmus montana	Allt Chalda mhor, Assynt (very local).
AMENTIFERÆ.	
Quercus Robur	Loch Letteressie, Assynt.
Fagus sylvatica	Plantations, Loch Inver (introduced).

Names.	Approximate Localities and Remarks.
Corylus Avellana	
Alnus glutinosa	
Betula alba	
b. glutinosa*	
nana	Beinn Tormaine—Tongue.
Myrica Gale	
Populus alba	Altnaharra (introduced ?).
tremula	Loch Assynt, Whiten Head.
nigra	Loch Inver—Tongue Wood (introduced).
Salix pentandra*	Loch Inver—Tongue (introduced ?).
alba	Achumore—Assynt.
purpurea*	River Kirkaig.
viminalis*	Tongue.
cinerea	
aurita	
caprea*	Unapool—Inchnadamph.
repens	Calda Burn, Assynt.
a, genuina	Calda Burn, Assynt.
herbacea	Ben More, Assynt—Ben Loyal.
CONIFERÆ.	
Pinus sylvestris	Islands in Loch Awe (native ?).
Juniperus communis	
nana	Beinn nan Cnaimheag.
TYPHACEÆ.	
Sparganium ramosum*	Elphin.
affine*	Elphin.
minimum	Ben Loyal.
NAIDACEÆ.	
Potamogeton natans	Elphin.
polygonifolius	
heterophyllus	
lucens*	
perfoliatus	Loch Borrolan, Assynt.
pectinatus	Loch Urigill, Assynt.
ALISMACEÆ.	
Triglochin palustre	
maritimum	
ORCHIDACEÆ.	
Orchis mascula	
incarnata	
maculata	
Gymnadenia conopsea	
albida	Durness—Inchnadamph.
Habenaria viridis	Durness—Assynt.

Names.	Approximate Localities and Remarks.
Habenaria bifolia	Beinn Garbh—Assynt.
chlorantha*	
Listera cordata	Assynt.
ovata	
Epipactis latifolia	Durness—Inchnadamph.
IRIDACEÆ.	
Iris Pseud-acorus	Abundant in Assynt.
AMARYLLIDACEÆ.	
Narcissus Pseudo-narcissus	Ardvreck Castle (garden escape).
LILIACEÆ.	
Scilla verna	Skerry—Eilean nan Roan—Durness.
nutans	
Allium ursinum	Achumore—Ardvreck Castle (very local; only localities observed).
Narthecium ossifragum	
JUNCACEÆ.	
Luzula sylvatica	
campestris	
multiflora*	
b. congesta	
arcuata	Ben Loyal.
spicata	Ben More, Assynt.
Juncus trifidus	Ben More, Assynt.
triglumis	Coinne mheal, Assynt.
conglomeratus	
effusus	
acutiflorus	
lamprocarpus	
supinus	
bufonius	
Gerardii	Inverkirkaig.
squarrosus	
CYPERACEÆ.	
Schœnus nigricans	
Rhyncospora alba	
Blysmus rufus	Skerray Bay, Tongue.
Scirpus acicularis*	Loch Awe.
palustris	
multicaulis	Tomore, Assynt.
pauciflorus	
cæspitosus	
setaceus	
lacustris	Lochan feòir, Assynt.

Names.	Approximate Localities and Remarks.
Eriophorum vaginatum	
angustifolium	
latifolium	Achumore, Assynt.
Carex dioica	
pulicaris	
pauciflora*	Allt Ellag (prop. in Ross-shire, but incl. in 108).
arenaria	Achmelvich Bay, Tongue—Durness.
stellulata	
ovalis	
rigida	Coinne mheal, Quinaig.
vulgaris	
glauca	
præcox	
pallescens	Loch Assynt (frequent).
capillaris	Loch Assynt (frequent).
binervis	
fulva	Tomore—Loch Inver.
extensa	
b. minor*	
flava	
filiformis	Lochan feòir, Assynt.
ampullacea	Lochan feòir, Assynt.
GRAMINEÆ.	
Anthoxanthum odoratum	
Digraphis arundinacea	Elphin—Inchnadamph.
Alopecurus geniculatus	
pratensis	Torrisdale.
Phleum pratense	
Agrostis vulgaris	
Psamma arenaria	Durness and elsewhere.
Phragmites communis	
Aira cæspitosa	
flexuosa	
caryophyllea	Allt Ellag.
præcox	
Avena flavescens*	
pubescens	
elatior	
Holcus mollis*	
lanatus	
Triodia decumbens	
Kœleria cristata	Eilean Losal—Tongue.
Molinia cœrulea	
Melica nutans	Allt Ellag.

Names.	Approximate Localities and Remarks
Catabrosa aquatica*	Clachtoll.
Glyceria fluitans	
Poa annua	
pratensis	
trivialis	
Cynosurus cristatus	
Dactylis glomerata	
Festuca ovina	
rubra	
b. arenaria	Eilean Losal—Tongue.
elatior*	
pratensis*	Allt Ellag.
Bromus mollis	
Brachypodium sylvaticum*	Tongue.
Triticum repens	Elphin.
acutum*	
junceum	
Lolium perenne	
Elymus arenarius	Culbackie—Tongue.
Nardus stricta	
FILICES.	
Hymenophyllum unilaterale	Allt Pollan Droighinn, Assynt.
Pteris aquilina	
Lomaria spicant	
Asplenium Ruta-muraria	
Trichomanes	
viride	Inchnadamph—Elphin (abundant on the limestone).
marinum	Loch Inver—Eilean-nan-Roan—Durness.
Adiantum-nigrum	
Athyrium Filix-fœmina	
Scolopendrium vulgare	Glen Dubh—Loch Glen Coul (very local; only two localities observed).
Cystopteris fragilis	Loch Glen Coul—Stronchrubie.
Aspidium Lonchitis	Inchnadamph—Knockan Cliff.
Nephrodium Filix-mas	
dilatatum	
Oreopteris	
spinulosum (?)*	
Polypodium vulgare	
Phegopteris	
Dryopteris	
Osmunda regalis	Assynt—Stoer—Eddrachillis—Durness? (very abundant in certain localities.)

Names.	Approximate Localities and Remarks.
Botrychium Lunaria	Durness—Assynt (abundant in limestone districts).
LYCOPODIACEÆ.	
Lycopodium clavatum	Elphin—Ben Loyal (at 1500 ft.).
alpinum	
Selago	
Selaginella Selaginoides	Ben More, Assynt.
EQUISETACEÆ.	
Equisetum arvense	
sylvaticum	
palustre*	
limosum	
hyemale*	Achumore, Assynt.
CHARACEÆ.	
Chara syncarpa	Elphin.
crinita*	Knockan, foot of Coul Mòr.
fœtida	Achumore.
fragilis*	Loch Awe.

Report on a Visit to Glenure by the Members of the Summer Camp. By WILLIAM COATS.

(Read 12th April 1888.)

I am very pleased to bring before you to-night the following Report on the excursion held last year to Glenure:—

The visit, which lasted a fortnight, viz., from the 26th of July till the morning of the 9th August, was made by five Fellows of the Society and Mr Webb (son of the late Mr F. M. Webb) from Staffordshire—six in all.

There were two detachments of three each. The first, consisting of Drs Watson and Macfarlane and Mr Webb, arrived at Glenure on the evening of Tuesday the 26th July, and remained till the morning of Thursday the 4th August. Dr Watson, however, returned home on Tuesday, the 2nd August.

The second detachment, consisting of Messrs Grieve, Allan, and Coats, met by arrangement at Crianlarich on Tuesday forenoon, the 2nd August, arriving at Glenure the same evening, and remained till the morning of the 9th August.

Train in each case was taken to Connal Ferry, the last station short of Oban, and after crossing the ferry we had to drive 16 miles to Glenure. The road from Connal Ferry is a beautiful one, skirting the shore of Loch Creran the greater part of the way, and afterwards passing Fasnacloich Loch, a very pretty sheet of water, a mile from Glenure.

Glenure is a wild, very slightly wooded glen in the Appin district of Argyleshire, lying almost at sea-level, and surrounded on every side by high mountains, whose bare summits are seldom without a covering of mist. The name signifies the glen of yew trees, and tradition has it that at one time a large number of yews grew in the glen. This is to a small extent borne out by the fact that, at present, a fine old yew flourishes close to the house of Mr Mackay, the present tenant of Glenure sheep-farm, in whose house the members of the camp had most comfortable quarters.

Mr Mackay, who is now over sixty-five years of age, also informed us that about forty years ago, when there were many more natives about Glens Ure and Creran than now, the young men of that day took a mania for bagpipe playing. To make their pipes they cut down the yew trees then existing on the south-west side of An Grinan, near the head of Glenure, each one taking as much wood as would make two sets of pipes. This extravagance is accounted for by the fact that the wood for the second set formed the payment or part payment they made to a turner who lived at that time near the glen, and made their pipes. But the times are changed, and there are now neither many young men nor yew trees in this wild district.

That this must once have been a beautifully wooded glen is evidenced by two facts—first, that the bleached stumps of many large trees yet remain about the mountain sides; second, there are to be seen in one or two places among the hills what resemble the remains of forts, but what are in reality the ruins of buildings or platforms formerly used for converting the oak wood into charcoal, and must have been built where plenty of wood was close at hand. This charcoal was then conveyed to the iron furnaces at Bunaw on Loch Etive.

The following mountains were botanised over very carefully, notwithstanding the fact that wet weather greatly prevailed:—

Ben Sguliaird, 3058 feet in height; Stob Gaibhre, 2000 feet; An Grinan, 1795 feet; also, Lochan-na-Fola, at an elevation of 1170 feet; Cairn Deirg, 2000 feet; Ben Fraochaidh, 2883 feet, on the north-west side of Glen Creran; a mountain to the eastward of it, not named, 2250 feet; Beinn Fhionnlaidh, 3139 feet; and Fasnacloich woods, with their small but very beautiful waterfalls; and the head of Loch Creran.

On the southern side of the Ure the mountains are mostly granitic, while on the northern or Ballahulish side of the glen slate seems to prevail.

On these mountains, which show many evidences of ice action, are to be seen numbers of travelled or perched boulders, some of them of large size. One near Fasnacloich Loch bears two small Scotch firs on its top, and is well known to geologists; another noticed on Cairn Deirg, weighing many tons, was supported on several small stones by which it was lifted entirely from the ground.

Of the 378 plants marked by Mr Bennett on the London catalogue as already recorded in the Watsonian county in which Glenure lies, there were identified 226; besides these, there were also identified 59 plants not hitherto recorded, making a total of 285 plants, classified under fifty-seven orders.

Of purely alpine plants we found very few, and those forms most ordinarily met with. In fact, the whole district, botanically considered, is a very poor one. The Saxifrages noted were—*S. oppositifolia, stellaris, aizoides, hypnoides.*

On Ben Fhionnlaidh and Ben Sguliaird there was a large quantity of *Gnaphalium supinum*, but all in fruit.

On Ben Fraochaidh we found good specimens of *Tofieldia palustris*, also in fruit.

The difference in the richness and variety of the Breadalbane mountains, with their mica-schist, and the Glenure mountains, with little else than hard, rough granite, was distinctly noticeable. Yet the climate must be almost precisely similar, and being in close proximity, the paucity of the flora seems to be simply a question of soil.

One find I would mention was made at Lochan-na-Fola, viz.,—*Malaxis paludosa.* For this inconspicuous plant we had been looking more or less every day, when Mr Grieve pounced on it as we were examining a boggy piece of ground at one end of the loch, and within a yard Mr Allan got other two specimens.

This plant was noted as having been found on these mountains more than a century ago, by the then minister of Killin. He has left a record of the rarer plants only, found by him, and since then, I understand, the plant has not been again observed in this district.

Ferns are not plentiful in the district. We noted 22 species, but of these there is only one fact worth mentioning, viz., that wherever we came across slaty limestone strata cropping out, there we were sure to find *Asplenium viride* growing luxuriantly. On Ben Fhionnlaidh we came across a beautiful patch of parsley fern growing in a sheltered gully, almost the only fern I think we found on that mountain. This fern was likewise got by the first party, but on Ben Sguliaird.

On the morning of Wednesday, the 3rd August, Messrs Grieve, Webb, and Coats set out before 9 A.M. to botanise that day over Ben Fhionnlaidh—Dr Macfarlane and Mr Allan going in an opposite direction. There had been rain during night; the morning did not look very promising, and mist covered the tops of the surrounding mountains, but by eleven in the forenoon the day had improved considerably.

At the base of the mountain we separated, and soon lost sight of each other, each taking a different course, to cover as much ground as possible, with the intention of meeting on the plateau shown on the Ordnance Survey map at the 2000 feet level. This we ultimately did. At this time, about 2 P.M., thin mist was covering the whole top of the mountain. We soon got into it without our progress being impeded. Above 2250 feet the ground was very rough, with large detached granite boulders, but very little vegetation of any kind.

At 3.15 P.M. we gained the summit, and sat down to rest ourselves by the edge of a precipice overlooking a corrie of great depth.

The mist had now nearly cleared away from the summit, but was being driven in large masses into the corrie far below. All at once we saw our shadows distinctly thrown by the sun on the mist away down in the abyss in the centre of a brilliant triple circular rainbow, a small segment of which was cut off by the edge of the precipice where we were sitting. This phenomenon, which was new to all of us, appeared and disappeared at short intervals several times, after which the sun's light came out stronger than before, and it disappeared altogether.

The movements made by the party were of course reproduced within this brilliant band of colour, the centre of which appeared to be from 40 to 50 feet in diameter.

There was little wind at the time, but what there was was blowing in a circular direction, carrying the mist over the summit in one direction, and up the valley leading to this corrie, and over an adjoining neck, in exactly the opposite way. We were, of course, considerably impressed with the spectacle, and noted all the points as carefully as we could.

This phenomenon is almost precisely similar to that known as the Ulloa circle, first described by the Spanish traveller Francisco Ulloa.

This very pleasant holiday came to an end on the 9th August, when the second detachment returned home.

List of Plants noted at the Botanical Camp in Glenure in 1887, *as additions to previous records.*

Anemone nemorosa.
Nymphæa alba.
Cardamine hirsuta.
Viola tricolor.
Sagina procumbens.
    nodosa.
Hypericum Androsæmum.
    quadrangulum.
Potentilla Fragariastrum.
Circæa lutetiana.
Conium maculatum.
Conopodium denudatum.
Viburnum Opulus.
Solidago Virgaurea *var.* cambrica.
Aster Tripolium.
Filago germanica.
Gnaphalium uliginosum.
Chrysanthemum Leucanthemum.
Petasites vulgaris.
Armeria maritima.
Glaux maritima.
Anagallis arvensis.
Ligustrum vulgare.
Menyanthes trifoliata.
Borago officinalis.
Anchusa officinalis.
Myosotis arvensis.
Utricularia vulgaris.
    intermedia.
Mentha hirsuta.
Thymus Serpyllum.
Stachys sylvatica.
Lamium Galeobdolon.
Plantago maritima.
Atriplex littoralis.
    hastata.
Euphorbia Helioscopia.
Fagus sylvatica.

Juniperus nana.
Taxus baccata.
Orchis latifolia.
Habenaria viridis.
Tofieldia palustris.
Potamogeton natans.
Carex paniculata.
glauca.
Deschampsia cæspitosa.
Melica nutans.
Asplenium Adiantum-nigrum.
Ruta-muraria.
Scolopendrium vulgare.
Cystopteris fragilis.
Polystichum aculeatum.
Lastrea Oreopteris.
Osmunda regalis.
Equisetum palustre.
Chara fragilis.

Heterophylly in New Zealand Veronicas. By ROBERT LINDSAY, Curator, Royal Botanic Garden. (Plates V. and VI.)

(Read 14th June 1888.)

The shrubby species of Veronica, which abound in New Zealand, are of great interest both from a botanical and from a horticultural point of view. A large number of species have proved to be thoroughly hardy, and well adapted for cultivation in our climate. Forming, as most of them do, small, compact, evergreen bushes, they are found to be invaluable for the decoration of rock-gardens or other situations where dwarf-growing shrubs are required. One of the first to recognise their value in this respect was the late Mr Isaac Anderson Henry, who from time to time exhibited these plants at our meetings, and from whose garden at Hay Lodge, Trinity, many of the species now in cultivation in this country can be traced. The late Mr Gorrie was also an assiduous collector of New Zealand plants, including Veronicas. But the feature I wish specially at present to notice is, that some of the species, viz., those which have been termed "Whip-cord" Veronicas, present remarkable instances of heterophylly. My attention was first directed to this occurrence in a rather peculiar manner. In the summer of 1881 Mr Henry exhibited a plant, under the name of *Veronica salicornioides*, at a meeting of the Scottish Horticultural Society, for which he was awarded a first-class certificate. An objection was afterwards raised on the ground that, as this plant was more like a Conifer than a Veronica, the certificate should have been withheld until the plant had been seen in flower. Mr Henry had no doubt that the plant was what he represented it to be; still, in the absence of flowers, it was somewhat difficult to convince those who were inclined to be sceptical. Various means were therefore adopted to induce the plant to flower, but it remained obstinate. A plant which I received from Mr Henry was placed near the glass in a stove, with the view of trying to force it to flower. Very soon it began to alter in appearance, and ultimately it produced, not flowers, but leaves of a kind which showed that the plant was really a Veronica. The plant afterwards flowered, though sparingly, first at Easter Duddingston Lodge, in 1885, and in the following year at Hay Lodge (after Mr Henry's death), and also in the Garden here. This circumstance led me to experiment upon other allied species which we had under culture, with the remarkable result that, when treated in a similar manner, each species produced leaves quite distinct both from the normal type and from each other. Mr N. E. Brown of Kew, in an article which appeared in the *Gardener's Chronicle* in January last, has shown conclusively that the plant grown in gardens as *Veronica salicornioides* is not the true plant of that name, as it does not agree with the type-specimen in the Kew Herbarium, a portion of which plant he figures. Being under the impression that the so-called *V. salicornioides* is a very variable plant, Mr Brown has given it the name of *V. cupressoides* var. *variabilis.* For our present purpose, however, it will be more convenient to distinguish it by the better known though erroneous name. In cultivation, *V. salicornioides* of gardens forms a dense low-growing bush. Our largest plants have never exceeded 10 inches in height, and are at present from 2 to 3 feet in diameter, but appear as if they would become more widely spread. In the adult condition the leaves closely resemble those of a Cupressus, and are yellowish-green in colour. The whole plant, indeed, has a fine golden appearance, which it retains throughout the year, but this hue is rather more pronounced in spring. The flowers are white, with pink anthers. When a plant of this species is put into heat, or becomes weakened by any other means, the leaves then produced are entirely different from the normal form. They become expanded into flat blades, usually entire, but often lobed; a three-lobed leaf appears to be the limit which this species is capable of producing. I regard this as being a reversion to the juvenile condition of the plant. In the illustrations on Plates V. and VI. (for photographs of which I am indebted to Mr Richardson), the two forms, marked Nos. 1 and 1*a*, are very well shown. *V. cupressoides* in cultivation is an erect growing shrub, attaining a height of from 3 to 4 feet, the diameter being about 1 foot. It has very dark green Cupressus-like leaves in the adult condition, these being arranged in opposite pairs, and so distant from each other as to show the stem. The flowers are dark violet coloured. When weakened, the majority of the leaves become pinnatifid, sometimes either lobed or entire. Illustrations 2 and 2*a* show the different forms very clearly.

Veronica lycopodioides is a most curious species. In the adult condition the branches are square, while the leaves are sharp pointed, closely set, and imbricated. A plant which has been grown here for nine years is only now beginning to develop adult foliage. The juvenile leaves are of two kinds; the majority are markedly pinnatifid, with acute lobes, while others are entire and subulate. The three forms of leaf are still all to be seen on the same plant, but the two last will in all probability eventually disappear. Cuttings taken from branches having adult leaves and rooted in heat develop, for the most part, pinnatifid leaves with acute lobes, a few being entire, as seen in illustration 3, while 3*a* shows a portion of the adult plant.

If we are correct in supposing that the form of leaf produced by all these weakened plants, or portions of plants, is a reversion to the juvenile condition, seedlings from those species ought to develop similar leaves. I have never seen seedlings of any of the above-named species, seeds of these interesting plants being difficult to procure. A short time ago, however, I was fortunate enough to receive from a friend in New Zealand good seeds of a nearly allied species, named *Veronica Armstrongii*, which have germinated. The young seedlings show flat pinnatifid leaves, closely resembling those mentioned as having been found on weakened plants of other species. There can be little doubt, therefore, that seedlings of these species would at first produce exactly similar leaves. Illustration 4 is taken from a seedling of *Veronica Armstrongii*, while 4*a* shows the adult condition of the same taken from a dried specimen. The manner in which these Veronicas shed their leaves is also interesting. The smaller branches are articulated with the stem, and fall off bodily, leaving a well-marked scar, resembling some conifers in this respect as well as in general appearance.

It may reasonably be conjectured that the remote ancestors of the Veronicas mentioned originally had leaves of one form only, resembling more closely than they at present do the ordinary species of the genus, and that, through change of environment or some such cause, these leaves have become altered as we now find them. The heterophyllous condition might thus be explained as being a tendency to revert to the original type.

Observations on the Annual Increase in Girth of Trees in the Royal Botanic Garden, and at Craigiehall, near Edinburgh, from 1878 *to* 1887. Part I. By Dr Christison, Edinburgh.

(Read 12th July 1888.)

In March 1883 I communicated to the Royal Society of Edinburgh the results of five years' observations on the increase in girth of trees, begun in 1878 by Sir Robert Christison, and completed by myself in 1882. The same trees having been under observation for five additional years, I now present the results for the whole decennial period, 1878–87. In the later years of that period monthly as well as annual observations were taken; but, as the former were fully discussed in a paper read to this Society last summer, the present investigation is confined entirely to the annual observations.

In estimating the value of the results, two disturbing elements have frequently to be taken into account. One is, that a considerable number of the trees seem to have been selected at too great an age for the purposes in view; not that they were actually of great age, but because the thin sandy soil of the Botanic Garden seems incapable of supporting tree life in full vigour after a moderate age, in most cases. The other disturbing element is the occurrence, early in the decennial period, of three successive seasons of almost unprecedented severity, which left their impress on the girth increase, not only at the time, but in some species to the very end of the period, if not permanently. The general effect of this has, no doubt, been to unduly depress many of the averages, and to prevent us from accepting this decennial period as representative of decennial periods in general.

These two disturbing elements have greatly complicated a subject which otherwise might have been simple enough, and in the sequel I shall have constantly to point out their effects in modifying or annulling the value of results in trees or even in whole species.

In presenting the numerous and somewhat complex results arrived at, the method I have adopted is, first to give a tolerably complete history of each species separately; secondly, to give comparative results and general conclusions derived from this record of facts. It is to the first of these divisions that the present paper is confined.

At the outset it is necessary to explain certain rules carried out through the work for convenience and economy of space.

1. The girth of a tree invariably signifies the girth of the stem at its narrowest part within easy access, which is generally about 5 feet from the ground.

2. All measurements are in inches and decimal parts of an inch, unless otherwise stated.

3. Trees at Craigiehall are distinguished by an asterisk from those in the Botanic Garden.

PART I.

GENERAL HISTORY OF THE SPECIES THROUGH THE DECENNIAL PERIOD.

The chief points to be considered in this Part are the general condition and progress of the trees and species; their average annual increase; the annual range of their increase; and their share in the depressions which occurred in 1879–80–81, 1883, and 1887. Only the first of these depressions is treated in detail in this Part, as its effects were so great and general. The share taken by the species in the other depressions will be more conveniently considered in the Second Part.

A. Deciduous Trees.

Betula alba.

No. in List.	Girth when first measured.	Annual Increments.										Girth, Oct. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
1	55·40	0·25	0·05	0·05	0·10	0·10	0·00	0·10	−0·05	0·10	0·00	56·05	0·70	0·07
5*	56·20	...	...	·40	·55	·45	·45	·45	·40	·45	·50	59·85	3·65	0·45

The results for this species, as a whole, are rendered nugatory by the complete break down of No. 1.

This weeping birch, transplanted from the former Botanic Garden, and long a chief ornament of the present one, was first measured in November 1874. In the three following years its girth increased at the annual rate of 0·41, but in 1878 the increase dropped to 0·25, and although the tree still retained a handsome and healthy appearance, it had probably passed its prime. Then came the three consecutive disastrous seasons, which completely checked the growth. Rapid degeneration ensued, and now not half the proper proportion of foliage remains. The table shows the apparently deadly effect of these seasons upon the girth increase, which in nine years amounted in all to barely half an inch.

No. 5* is a fine healthy tree of the same size as No. 1. It was first measured in 1880, so that the effects of the severe seasons upon its girth-increase cannot be precisely ascertained; but apparently it was little affected, and the increase has on the whole been exceptionally steady.

In the spring of 1880 this tree was noted as being in full leaf so early as the 1st April; on the other hand, in 1886 the buds had not begun to open on the 1st May, yet the increase in the two seasons was nearly the same. The variation in its annual increase has been remarkably small, ranging between 0·55 and 0·40.

Fagus sylvatica.

Of all deciduous trees the beech attains the greatest perfection throughout Scotland in general, and the neighbourhood of Edinburgh is no exception to the rule. For this reason, and because its regularly formed trunk and smooth bark peculiarly favour accuracy of measurement, Sir Robert experimented on a larger number of this species than of any other. The selected beeches were originally twelve in number, varying between 5 and 15 feet in girth, but two of them have no place in the table, as they proved ineligible. One of these, No. 18*, the largest beech at Craigiehall, measured upwards of 15 feet in girth, in spite of having had nearly one-third of the circumference of its stem laid bare by some violent storm, and is still otherwise handsome and perfectly healthy-looking. A split in the exposed wood, however, made the measurements for annual growth unreliable. The other, No. 13*, was a splendid tree, standing quite free in Craigiehall Park, and was 12 feet 7 inches in girth when measured in 1880. It was killed apparently by a plague of insects, and its sad fate is recorded in a paper in our *Transactions* by the late Mr Sadler.

No. in List.	Girth when first measured.	Annual Increments.										Girth, Oct. 1887.	Total increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
7	71·40	1·20	·95	·65	·85	1·15	1·05	1·15	1·15	1·20	1·00	81·75	10·35	1·03
8	60·50	1·20	·80	·90	·90	1·10	1·00	1·05	·90	·95	1·10	70·40	9·90	·99
14	75·80	·60	·65	·25	·50	·60	·40	·65	·45	·50	·25	80·70	4·85	·48
38	60·30	·60	·45	·15	·50	·50	·45	·60	·35	·45	·25	64·60	4·30	·43
9*	116·35	·80	·60	·35	·35	·65	·55	·60	·60	·45	·30	121·60	5·25	·52
14*	61·75	·60	30	·50	·55	·70	·45	·55	·45	·45	·35	66·65	4·90	·49
15*	71·85	·70	·50	·60	·65	·85	·55	·75	·50	·60	·70	78·25	6·40	·64
8*	135·00	...	...	·50	·65	·60	·40	·50	·35	·45	·15	138·60	3·60	·45
20*	136·50	...	...	·80	·90	·90	·85	·95	·85	·65	·60	143·00	6·50	·81
22*	97·90	...	...	...	·45	·45	·35	·40	·30	·35	·20	100·40	2·50	·36
Total of seven,		5·70	4·25	3·10	4·30	5·55	4·45	5·35	4·40	4·60	3·95	...	...	...
Total of ten,		...	...	...	6·30	7·50	6·05	7·20	5·90	6·05	4·90	...	...	...

Of the other ten beeches seven were measured for the whole decennial period, two for eight, and one for seven years. They have all been vigorous and healthy-looking throughout. As to position and surroundings, they may be thus grouped: Nos. 7 and 8 are situated in the lowest ground of the Botanic Garden, and stand, No. 7 entirely, and No. 8 almost entirely, free from other trees or shrubs; Nos. 14 and 38 form part of a short double row of beeches within the enclosure of Inverleith House, and are on the highest ground of the

Arboretum, but are well sheltered. No. 20* is a fine tree, standing clear in the park at Craigiehall; Nos. 8* and 9* are also in the park, but close to the river Almond, the latter having its roots laid bare on one side to ordinary floods: they both stand clear of other trees. The remaining three, Nos. 14*, 15*, 22*, form part of a beautiful grove of beeches on a low well-sheltered quasi-island of the Almond.

No. 8 comes into leaf a week or ten days before No. 7, or, I believe, any other beech in the Botanic Garden. Its foliage also is twice as dense as that of No. 7; nevertheless its rate of growth is a trifle less than that of No. 7. No. 20* is the first beech in leaf at Craigiehall. It is also the quickest grower of the six measured trees there.

The *average annual increase in girth* of the ten beeches varied between 1·03 in No. 7 and 0·36 in No. 22*. These variations can in some cases be accounted for. Thus Nos. 7, 8, and 20*, the quickest growers of all, averaging 0·94, stand clear, have stems of moderate height, and wide-spreading heads of foliage; while 14*, 15*, and 22*, averaging only 0·47, although now clear of neighbours, originally grew in a dense grove, and are 100 feet high, with stems clear of branches for 30 feet, and small heads of foliage. In estimating the proportional differences in the increase of timber in the two groups, we must remember that the growth is distributed over a greater length of stem in the latter; but, on the other hand, the stems of Nos. 7 and 8 are by no means short, being 11 and 15 feet in length to the first branch, and the growth in these trees is distributed over a much greater extent of large branches, so that the proportions given may express pretty fairly the difference in addition of wood.

Other variations, however, are not so easily accounted for, such as the slow growth of No. 22* compared with 14* and 15*, all three being trees equally healthy in appearance, and growing in precisely the same circumstances; or the slow growth of Nos. 14 and 38 compared with 7 and 8, for although the former are in a short double avenue, they are not crowded. Perhaps differences of soil or position, 14 and 38 being on the highest ground of the Arboretum, while 7 and 8 are on the lowest ground of the Botanic Garden, may account for the difference in their increase.

On the whole, we may conclude that, under the given conditions of soil and climate, beeches of so considerable a girth as 7 feet, *may* continue to grow at the rate of 1 inch a year, and even when 12 feet in girth, at the rate of 0·80, and that the average of healthy beeches of mature age should be at least 0·60. The average of the seven measured in the favourable season of 1878 was 0·80.

The *range of the annual increment* varied much in the different trees, the lowest, 1·20 to 0·80, being in No. 7, and the highest, 0·60 to ·0·15, in No. 38. The *aggregate range* was also considerable. In the seven trees measured for ten years, it lay between 5·70 in 1878 and 3·40 in 1880. Including the three trees which were measured only in the last seven years, it was between 7·50 in 1882 and 4·90 in 1887.

None of the measured beeches suffered lasting injury either in appearance or growth from the three consecutive bad seasons; but the effect at the time was distinct enough on growth, the girth-increase of the seven trees then under observation having dropped from 5·70 in 1878 to 4·25 in 1879, and 3·40 in 1880, rallying, however, to 4·30 in the third severe season, 1881, and further in 1882 almost to the standard of 1878. It is worthy of remark that all seven, without exception, fell off in 1879, but only four of them continued to fall off in 1880, the fall in some, however, being very great, while in 1881 every one either improved, or at least suffered no further loss. This general improvement in the third of three trying seasons seems very remarkable, but was common to the deciduous class in general. It is not easy to account for the escape of three in 1880, unless situation had something to do with it; two of the three were on the island at Craigiehall, and actually improved substantially in their increase in that year. The species apparently did not entirely escape from the depression of 1883; and the increase was low in 1885, 1886, and 1887, but particularly in the latter year.

Quercus Robur.

The British oak, in the neighbourhood of Edinburgh, as in most parts of Scotland, rarely takes very kindly to the soil. The stem, indeed, often attains a considerable size, and is well shaped, but there is generally a marked scantiness in the branches and foliage. As there was not a single eligible specimen in the Botanic Garden, five trees were selected at Craigiehall, where oaks are both numerous and fairly well grown, although many of them are "stag-horned," and display the other faults just mentioned. The selected trees vary in girth from 5 to 10 feet, and all stand clear, or nearly so, of other trees, Nos. 10*, 11*, and 16* in the park, the two former close to the river, the latter at a considerable height above it, and Nos. 16*, 17*, also on low ground near the river.

No. in List.	Girth when first measured.	Annual Increments.										Girth, Oct. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
11*	65·40	·10	·50	·00	·15	·20	·15	·20	·30	·20	·10	67·30	1·90	·19
12*	69·45	·65	·50	·20	·35	·35	·25	·45	·35	·30	·35	73·20	3·75	·37
16*	120·35	1·00	·70	·45	·45	·65	·80	·80	·95	·60	·50	127·25	6·90	·69
10*	112·90	...	...	·10	·20	·35	·35	·30	·30	·35	·25	115·10	2·20	·27
17*	94·50	...	...	·10	·15	·20	·15	·30	·30	·20	·25	96·15	1·65	·20
Total of three, .		1·75	1·70	·65	·95	1·20	1·20	1·45	1·60	1·10	·95			
Total of five, .		...	...	·85	1·30	1·75	1·70	2·05	2·20	1·65	1·45			

The *average annual rate of increase* was only 0·35, and excluding No. 16*, which grew nearly twice as fast as the best of the others, the average of the remaining four is but 0·25. This evidently abnormally low rate was no doubt produced by the disastrous and lasting effects of the low winter temperatures at the beginning of the period, and particularly in 1880, for if we take the year 1878, which preceded these disastrous seasons, and rejecting the low increase of 0·10 in No. 11* as altogether exceptional in a year of universal prosperity, substitute 0·50, its increase in the subsequent year, we get the average of 0·71 for the three trees then under observation. Moreover, we know that No. 16*, the largest of the five, actually did grow at the rate of 0·69 all through the decennial period.

The *individual range* varied between 0·50 to 0·00 in No. 11*, and 1·00 to 0·45 in No. 16*, which in this, as in all other respects, comes out the best. The *aggregate range* in the three trees measured throughout lay between 1·75 in 1878 and 0·65 in 1880; for the five trees measured for the last eight years it was between 2·20 in 1885 and 0·85 in 1880.

The native oak throughout the south of Scotland suffered more than any other forest tree from the severe winter of 1880. Many specimens suffered great losses in twigs and branches, and not a few were killed outright. To the Craigiehall oaks no such visible damage was done, but the severity of the season was well impressed upon the girth-increase, which amounted to little more than one-third of that in 1878. Moreover, the results were not confined to that year. It was not till 1885 that the increase recovered to anything like the standard of 1878, and as that recovery was mainly due to the complete rally of No. 16*, the conclusion seems warranted that a lasting, if not permanent, injury has been experienced by Nos. 11* and 12*, and in all probability by 10* and 17*, although in their case the data are not so sufficient.

In the depression of 1887 the species may also have had a share, but it is possible that the small yield of that year may have been due to a progressive decline in vigour.

No. on List.	Girth when first measured.	Annual Increments.										Girth, Nov. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
						Quercus conferta.								
40	23·60	1·80	1·70	1·40	1·85	1·85	1·85	1·55	1·35	1·70	1·50	40·15	16·55	1·65
54	16·45	...	...	1·10	1·60	1·90	1·75	1·70	1·75	1·75	2·05	30·05	13·60	1·70
55	13·50	...	...	1·10	1·70	1·50	1·80	1·80	1·75	1·20	1·75	26·10	12·60	1·57
Total of three,		...	...	3·60	5·15	5·25	5·40	5·05	4·85	4·65	5·30	...	...	4·92
Average of three,		...	...	1·20	1·71	1·75	1·80	1·68	1·61	1·55	1·76	...	...	1·64
						Quercus Cerris.								
43	41·90	·60	·65	·35	·60	·65	·55	·60	·55	·65	·50	47·70	5·70	·57
10*	73·00	...	...	·70	1·25	·90	·85	·95	·95	·80	·95	80·35	7·35	·92
Total,		...	...	1·05	1·85	1·55	1·45	1·55	1·50	1·45	1·45	...	...	...
						Quercus rubra.								
44	30·80	·50	·40	·30	·50	·40	·40	·45	·55	·45	·55	35·30	4·50	·45

Three species of oak, besides the native one, were tested, but, as the number of trees was small, I have grouped them together in one table.

Quercus conferta.—Three specimens were observed, but only one for the whole decennial period. They are all favourably situated in the lower ground of the Botanic Garden, standing quite free from neighbours. They are among the earliest trees in the Garden to put forth their leaves. In 1880 No. 40 was in full foliage on the 15th May, and in 1882 the buds were bursting on the 27th March. All three have had a perfectly healthy appearance during the whole period except one, whose leaves on the west side were dried up and withered looking in the dry summer of 1887, without, however, in the least prejudicing the girth-increase.

The *annual rate of increase*, 1·60, is considerably greater than in any other of the tested deciduous species. Moreover, No. 54, alone of all the trees under observation, deciduous or evergreen, at the Botanic Garden or Craigiehall, attained the distinction of increasing as much as 2 inches in one year.

The *rate of upward growth* in No. 40 was ascertained to be a little above 7 inches annually for nine years, the height having been 23 feet 5·5 inches in spring 1879, and 28 feet 9·5 inches in autumn 1887.

The *range of the individual increase* has been moderate. It was greatest in No. 54, the figures being 2·05 and 1·10. The *aggregate range* (5·40 to 3·60) during the eight years, when all the three trees were under observation, was also moderate.

So far as the data go, there is every reason to believe that 1880 was the only year in the first depression that had any marked effect on the increase. The falling off was comparatively slight, particularly in No. 40, and recovery was complete in 1881.* It is remarkable that in both the subsequent principal years of general depression, 1883 and 1887, the increase in this species was considerably above its average.

* Apparently this species is remarkably hardy—hardier even than our native oak ; and for this reason, as well as on account of its rapid growth, deserves patronage as an ornamental tree. The only objection to it is its bushy, uninteresting form, at least as a young tree.

Quercus Cerris.—Of two trees under observation, one is in the east shelter belt of the Botanic Garden, surrounded by shrubs, but not pressed on by neighbouring trees; the other stands quite freely on grass at Craigiehall. Both are handsome trees, and have always been quite healthy in appearance.

The *average annual rate of increase* is three-quarters of an inch, but No. 10*, the larger of the two, furnishes much the greater share of this, its average being nearly an inch, while that of No. 43 is only a little above half an inch. In favourable circumstances this seems to be a fast-growing species, even at a considerable age, No. 10* being close upon 7 feet in girth, and still maintaining a growth of nearly an inch a year. It appears also to be hardier than the native oak.

The *range in the trees* separately has not been great. The extremes in No. 43 were 0·65 and 0·35, and in No. 10*, which was only measured for eight years, 1·25 and 0·70. The *aggregate range* also was inconsiderable.

This species appears to have suffered little in the first period of depression. There was no visible bad effect. No. 43 fell off in its increase only in 1880, and not severely. No. 10* was not measured till that year, but as far as the data go appears to have followed much the same course as the other. Both completely and permanently rallied in 1881. They did not suffer at all in the subsequent depressions.

Quercus rubra.—The single specimen of the American oak under observation is a young tree, standing freely in the Botanic Garden. A good many of the twigs are dead, and it has rather a shabby look.

The *annual rate of increase* was 0·45, probably abnormally low, owing to the defective condition just described; its *annual range* has been slight, and during the three consecutive bad years the girth-increase suffered materially only in 1880, a complete rally taking place in the third of them. It was in 1880, however, that the damaged condition of the twigs was first noticed. Thus, although there were unmistakable visible signs of injury from the severe season of 1880, there was no corresponding effect on the girth-increase. In the other seasons of depression the yield of this tree was above its average.

Tilia europæa.

No. in List.	Girth when first measured.	Annual Increments.										Girth, Nov. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
2	76·10	·50	·15	·00	·65	·55	·20	·25	·30	·25	·20	78·80	3·05	·30
18	42·70	·70	·40	·15	·25	·40	·35	·45	·35	·25	·20	46·20	3·50	·35
21*	99·65	·20	·15	·10	·20	·45	·20	·20	·10	·05	·10	101·40	1·75	·17
Total,		1·40	·70	·25	1·10	1·40	·75	·90	·75	·55	·50			

No. 2 is the handsome spreading lime, which stands quite free from neighbours in the centre of the Botanic Garden; No. 18, a healthy-looking young tree at the north end of the west shelter belt; and 21*, a large, handsome, well-clothed tree, grouped with two or three others near the lawn at Craigiehall. The foliage in all three has always appeared quite healthy, except occasionally when insect-eaten, a misfortune to which this species seems peculiarly liable.

Average Annual Rate of Increase.—Notwithstanding the good appearance of these trees, their annual growth has been singularly slow, averaging only 0·27, the best of them averaging 0·35 and the worst 0·17. That this low rate is quite abnormal there can be no doubt, and in fact the average in 1878 was 0·47, or removing 21*, the increase of which was much depressed even in 1878, the remaining two averaged 0·60 in that year. In the case of No. 2 our information extends unusually far back, as Sir Robert Christison has preserved notes of its girth in 1860 and 1874. The following are the general results:—Girth at 3 feet up in March 1860 = 67·50; November 1874 = 75·50; November 1887 = 80·50. This gives an increase of 8 inches in the first fifteen years and of 5 inches in the last thirteen years, or an annual rate of 0·53 for the first period, and of 0·38 for the second. But if we take the last five years of the latter period, the rate was only 0·24. This shows a rapidly diminishing rate from 0·53 to 0·24, the average for the whole twenty-eight years being 0·46. It is pretty clear, then, that this tree, notwithstanding its flourishing appearance, has passed its prime, and this would appear to indicate that even healthy limes, with every advantage of position, cannot be expected to increase materially after attaining a girth of $6\frac{1}{2}$ feet, in soil similar to that of the Botanic Garden.

The healthy-looking young lime, No. 18, has also a poor record. In 1878, indeed, it increased 0·70, but never since has its increase amounted to much more than half of that, This tree is a good deal encumbered by neighbours, but this seems an insufficient cause for so sudden and marked a decrease.

No. 21* comes out worst of all, with the miserable average of 0·17, although it is a fine tree, and has always had dense healthy foliage. Unlike the others, its increase was very poor even in 1878.

The *individual range* has been very great, particularly in No. 2, the extremes being 0·65 and 0·00. Even in No. 18, which suffered least, they were 0·70 and 0·15. The *aggregate range* was also very great.

The maximum growth of the three trees was 1·40 in 1878 and 1882, the minimum 0·25 in 1880; but 1883, 1885, 1886, and 1887 were all years of great depression, and on the whole progressively so.

There was no appreciable destruction of branches or twigs during the first depression, but the results upon girth-increase were very marked indeed. From 1·40 in 1878 the amount fell to 0·70 in 1879, and to 0·25 in 1880. Next year, however, a rally began, which was complete in the following year. It seems that some new calamity overtook the species in 1883, causing a fresh and progressive depression in the increase. The most remarkable fact is that along with this there is no deterioration in the apparent healthiness of the trees.

Acer Pseudo-Platanus.

No. in List.	Girth when first measured.	Annual Increments.										Girth, Nov. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
28	58·60	·50	·20	·15	·30	·40	·45	·55	·40	·35	·20	62·10	3·50	·35
7*	125·95	·40	·55	·30	·55	·45	·55	·55	·50	·40	·20	130·40	4·45	·44
Total,		·90	·75	·45	·85	·85	100	1·10	·90	·75	·40			

Four of this species were under observation, but two proved ineligible. One of these is the largest sycamore in the Arboretum, measuring 11 feet in girth. It is past its prime, having put on a scraggy appearance, although the foliage seems healthy enough. It grew at the rate of 0·32 through the decennial period, but owing to the extreme roughness of its bark and its tendency to scale off, the details are not trustworthy. The other rejected tree is a young one in the Botanic Garden measured in 1882, because it was the most forward tree in the garden, its leaves being half expanded on the 27th March. But this early effort cost it dear; the leaves were destroyed for the season by frost, many twigs at the top of the tree died; and in six years the girth-increase only averaged 0·15. Of the two trees in the table, No. 28 is a young one at the north end of the west shelter belt of the garden, somewhat crowded by other trees, and No. 7* is a fine old tree, nearly 11 feet in girth, standing quite clear of others in Craigiehall Park. Both of them have always produced dense and healthy-looking foliage.

The *annual rate of increase* has averaged only 0·40, a small amount for a species which makes as fair a show as any other in the Edinburgh district. 0·44 may be a fair average for No. 7*, a tree 11 feet in girth; but 0·35 must surely be too low for the healthy-looking and young No. 28.

From the similarity in the history of the two trees, it would seem that this species, after rallying from the first period of depression and escaping the second, had been subjected to some fresh evil influence, which, beginning in 1885, produced a progressive deterioration till 1887.

Remaining Deciduous Species.

As in the remaining deciduous species only one tree was tested, I have put them in one table, arranging them in the order of their vigour of growth.

Castanea vesca.—This fine tree has grown at the rate of nearly an inch a year. The annual variation was slight, between 1·10 and 0·75; the girth-increase was little affected in the first two of the three bad seasons, and rallied in the third; its greatest depression was in 1887.

Liriodendron tulipifera.—A fine handsome specimen, nearly 7 feet in girth. As Sir Robert took measurements of it in November 1874, we find that at 4 feet 2 inches from the ground

No. on List.	Girth, Mar. 1878.	Annual Increments.										Girth, Nov. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
Castanea vesca.														
4	70·80	1·10	·90	·85	1·10	·90	1·00	1·00	·85	1·00	·75	80·25	9·45	·94
Liriodendron tulipifera.														
6	75·70	1·00	·40	·30	·65	·60	·45	·65	·55	·75	·65	81·70	6·00	·60
Cratægus oxyacantha.														
16	38·00	·80	·10	·75	·35	·65	·65	·45	·55	·60	·60	43·50	5·50	·55
Ornus europæus.														
3	75·30	·60	·40	·30	·75	·50	·45	·35	·25	·20	·35	79·45	4·15	·41
Carpinus Betulus.														
33	44·50	·40	·35	·10	·55	·50	·45	·55	·40	·30	·50	48·60	41·10	·41
Fraxinus excelsior.*														
6*	139·75	·70	·25	·30	·40	·35	·35	·35	·35	·30	·40	143·50	3·75	·37
Æsculus hippocastanum.														
9	48·75	·75	·50	·35	·70	·10	·30	·20	·05	·20	·20	52·10	3·35	·33
Juglans regia.														
12	61·00	·50	·40	·00	– ·25	·10	·10	·15	·00	·15	·15	62·30	1·30	·13

it grew at the rate of 1·20 for the following three years; that it increased 1 inch in the succeeding year, 1878; but that for the last nine years the rate was reduced to 0·55, or little above half an inch; this depression was probably mainly due to the first two severe seasons, which produced an immediate and apparently prolonged effect; but as the tree continues perfectly healthy in appearance, and as the increase rallied to 0·75 in 1886, it is to be hoped that it has entered on a new career of prosperity.

This tree was also measured in 1874 at the ground, where the girth was 91 inches, 19 more than at 4 feet 2 inches up. In November 1887 it had increased at the ground to 111·50 inches, or 30 inches more than at 4 feet 2 inches up. The annual rate for thirteen years has been 1·57 at the ground and 0·75 at 4 feet 2 inches up. Thus it grew twice as fast below as above.

Cratægus oxyacantha.—This handsome weeping hawthorn averaged 0·55 in its increase; the annual variation was great, ranging between 0·80 and 0·10, the one following immediately after the other in 1878 and 1879. The effect of the three severe seasons was unique, as it was the only deciduous tree which suffered mainly in the first, and the only one which rallied in the second, the rally, moreover, being complete. In the third it again fell off, but rallied thereafter to an average of 0·60. It is probable, however, that the tree has either passed its prime, or that the effects of 1879 have been prolonged, as the rate of increase for three years previous to 1878 was as much as 1 inch. The rate for the thirteen years has been 0·65; and at the ground, where it was also measured, it was 0·70. In appearance the tree never suffered. In 1883 and 1887 the yield was above average.

Ornus europæus.—This graft on a two-foot stool of the common ash stands clear in the middle of the Garden. Its annual rate of increase for the decennial period has been 0·41, but its growth has been very unsteady, and the range, 0·70 to 0·20, considerable. During the three consecutive bad seasons it suffered some diminution of girth-increase in 1879, and more in 1880, but rallied in 1881; subsequently, however, for some unknown reason, as it has always looked healthy, the increase has been very slow. In the last thirteen years the stool, measured in the neck, has increased 9 inches and the graft only about 4.

Carpinus Betulus.—Rather a handsome tree, standing free among "the grasses," but not in every season well clothed with foliage. In 1887 foliage broke out all over its straight and rather lofty stem. Its average rate of increase has been 0·41, not under that of 1878, and the range was 0·55 to 0·10, the latter happening in 1880, the second of the three bad seasons; in the first there was merely a trifling fall, and in the third a rally to the maximum. In the depressions of 1883 and 1887 the yield was above average.

*Fraxinus excelsior**.—This aged ash, nearly 12 feet in girth, stands free in the park at Craigiehall. It seemed in fair condition in 1878, but since then has greatly degenerated, many branches having died, and the foliage getting thinner every year. This seems to have been brought about by the severe seasons 1879 and 1880, as the girth-increase fell in these years to 0·25 and 0·30 from the substantial yield of 0·70 in 1878; a partial recovery took place in 1881 to 0·40, an amount which has never since been exceeded. There was no evidence of depression in 1883 or 1887. Its average rate has been 0·37.

Æsculus hippocastanum.—This horse chestnut stands at the south-east angle of the original Botanic Garden, in a belt of trees and shrubbery, and is considerably crowded and overshadowed by neighbours. In 1878 it increased 0·70, but suffered a considerable diminution in its increase in the two following bad seasons; in the third, however, it rallied completely. Next year, in common with all of its species that I saw in the Edinburgh district, it was the subject of some disease, which completely withered the leaves early in May. The increase that year fell to 0·10, and in the last six years has averaged only 0·17. The remarkable fact is, that during this period of profound depression in the girth-increase the foliage, with the exception of the first year, has been remarkably healthy and dense. So great and sudden a fall can scarcely be attributed to increasing pressure from other trees, and most probably depends on a prolonged effect of the disease in 1882.

Juglans regia.—The walnut is a tree not often seen in the Edinburgh district, yet this specimen has grown to a respectable size in a position where it must have been openly exposed, for many years at least, to the strong west winds.

The very short trunk at its narrowest part, about a foot from the ground, measured 11 feet 3 inches in girth in 1878, but as it was difficult of observation there, the annual measurements were made afterwards on one of the two main limbs. Apparently a slight growth still goes on, averaging 0·13 annually in the decennial period; but if the measurements over its rough bark are reliable, this low amount is due to the severe winters of 1880 and 1881, as the limb appears to have increased by about half an inch in each of the two preceding years. The foliage, in general shabby of late years, was unusually fine in 1887, a dry warm season, and the tree produced a great quantity of half-sized, pretty well-filled nuts.

GENERAL HISTORY OF THE SPECIES.

B. Evergreen Trees.

Sequoia gigantea.

No. in List.	Girth, March 1878.	Annual Increments.										Girth, Nov. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
25	23·95	1·15	·80	1·00	·55	·70	·65	·65	1·00	·65	·95	32·05	8·10	·81
27	23·95	1·75	1·65	1·80	1·50	1·40	·95	1·20	1·80	1·10	1·00	38·10	14·15	1·41
1	18·95	1·85	1·50	1·50	1·30	1·75	1·05	1·15	1·45	1·10	1·05	32·65	13·70	1·37
2	23·85	1·25	1·70	1·55	1·35	1·65	1·00	1·10	1·25	1·00	·95	36·65	12·80	1·28
Total, .		6·00	5·65	5·85	4·70	5·50	3·65	4·10	5·50	3·85	3·95	...	...	1·22

Of these Sequoias Nos. 25 and 27 stand clear of other trees on the terrace, and the others are in the small grove of Sequoias in the Botanic Garden. All were noted in 1878 as being "crowded with branches to the ground." No. 25 is now, however, very inferior in appearance to the others, having many withered branches and its stem bare below. No. 27 is still clothed to the ground, but has lost its crowded, branched aspect, and like all the Sequoias in the garden which have passed their early youth, its stem has acquired an unnatural thickness below and a thin sinuous character at the top. The two in the grove are equal in height, but the branches in No. 1 are fewer than and not so long as in No. 2, and the same changes are beginning to appear in it as in No. 25.

The *average annual increase* of the four, 1·22, is probably abnormally low, as No. 25 has evidently not been thriving; withdrawing it, the average becomes 1·35. No. 25 was measured in 1878 at 1 foot from the ground. Its increase there in ten years is 13 inches, or 4 inches more than at 5 feet from the ground.

The inferiority of No. 25 to the others in the upward as well as the outward growth of the stem is shown in the following statement:—

Sequoia gigantea.	Height.						Averages.		
	Spring 1879.	Spring 1881.	Incr.	Autumn 1887.	Incr.	Total	Two years, 1879–80.	Seven years, 1881–87.	Nine years, 1879–87.
	Ft. in.	Ft. in.	in.	Ft. in.	in.	in.			
No. 25	21 11	22 11	12	26 3	40	52	6 in.	5·7 in.	5·8 in.
,, 27	22 11	24 7	20	31 2	79	99	10 ,,	11·2 ,,	·11 ,,
,, 1	19 5	...	...	30 0	...	127	...	...	·14 ,,
,, 2	21 10	...	...	31 8	...	118	...	...	·13 ,,

The three healthier trees grew at the rate of about a foot yearly, while the rate of No. 25 was only half as much. There was no sign of diminished vigour in upward growth with increasing age, as the rate was about the same in the first two and in the last seven years, in the two trees in which it was ascertained.

The *individual range* was slight, the highest being from 1·15 to 0·55, and the lowest, from 1·85 to 1·05. The *aggregate range* was considerable—from 6·00 in 1878 to 3·65 in 1883.

The species withstood the first two years of the first depression with little or no loss of girth-increase; and in the third, although all suffered, it was only the weakest, No. 25, which showed a heavy decline. All of them rallied in the subsequent year, but only to fall again in 1883 to the absolute minimum. From this depression there was a progressive recovery in 1884 and 1885; but in 1886 and 1887 they were again the victims of a heavy decline.

Cedrus Deodara.

No. in List.	Girth when first measured.	Annual Increments.										Girth, Nov. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
29	26·10	1·10	·70	·45	·35	·95	·45	1·05	1·20	1·20	1·05	34·60	8·50	·88
30	64·00	1·20	·60	·40	·25	·70	·20	·55	·60	·80	·70	70·00	6·00	·60
1	19·35	...	...	...	...	...	·60	1·30	1·00	1·35	·85	24·45	5·10	1·02
2	20·85	...	...	...	...	...	·70	1·15	1·10	1·40	·95	26·15	5·30	1·06
Total of 29, 30,		2·30	1·30	·85	·60	1·60	·65	1·60	1·80	2·00	1·80	...	...	·88
Total of the four,		...	...	...	...	...	1·95	4·05	3·90	4·75	3·60	...	...	...

Cedrus africana.

39	27·35	1·65	1·40	1·75	1·60	1·60	1·30	1·55	1·45	1·55	1·30	42·50	15·15	1·51

Of the two Deodars measured throughout the decennial period, No. 30, now nearly 6 feet in girth, is the largest of its species in the garden. It was still a fine and rapidly growing tree in 1878, but, like all of its kind which have passed their early youth, it had lost much of its original handsome form. Although healthy enough in appearance now, the foliage is thin at the top, and the form of the tree is somewhat stunted. These faults are visible also in the much younger No. 29, which in 1878 still retained its handsome shape. The yet younger Nos. 1 and 2 in the small Deodar grove have always hitherto had a perfectly healthy and handsome appearance.

The *annual increase* of the two older trees, which alone were measured for the decennial period, averaged only 0·72, but this was mainly owing to the depressing effect of the three bad seasons, which was great at the time, and, in the case of the oldest of all, apparently permanent. Excluding this one, and taking the last five years only, the average of the three healthier trees was a little above 1 inch.

The *individual and aggregate ranges* were very high in both the trees tested for the whole period.

In the first depression the two older trees, which alone were tested at that time, suffered a great and progressive fall from 2·30 in 1878 to 0·60 in 1881. A rally to 1·60 took place in 1882, but the species was severely affected in the depression of 1883. All four were then available, and their total increase was only 1·95, while next year it was 4·05. In the depression of 1887 only one of the Deodars participated.

Cedrus africana.—The single measured specimen of this species was in 1878 branched to the ground. In spring 1885 it was cleared of surrounding high shrubs, but without perceptible effect on the girth-increase. The stem has now been pruned for the lower 5 feet, and the long curved branches are rather sparse; the bark has also become covered with small shallow cracks, which however exude little turpentine. It has proved the quickest grower of the evergreens measured in the Botanic Garden, its annual average being 1·51. It has also grown remarkably steadily, the annual range varying only between 1·75 and 1·30. The effects of the three bad seasons on the girth-increase were only noticeable in 1879, and that to but a slight degree. 1883 and 1887 were also years of depression, but not to a marked extent.

Araucaria imbricata.

No. in List.	Girth when first measured.	Annual Increments.										Girth, Nov. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
34	18·10	·60	·50	·55	·50	·45	·30	·30	·30	·30	·35	22·25	4·15	·41
35	20·20	·50	·90	·75	·60	·85	·80	·75	·65	·60	·60	27·20	7·00	·70
4*	17·90	...	·85	·65	·45	·70	·70	·75	·80	·80	·60	24·20	6·30	·70
Total of the three,		...	2·25	1·95	1·55	2·00	1·80	1·80	1·75	1·70	1·55	...	...	·60
Total of Nos. 35 and 4*,		...	1·75	1·40	1·05	1·55	1·50	1·50	1·45	1·40	1·20	...	...	...

The great frost of 1860, which killed the older Araucarias in the Botanic Garden, did not leave Nos. 34 and 35, then quite young, unscathed. They lost their lower branches; and if we may judge from the appearance of the Craigiehall tree, it had suffered in the same manner. Otherwise they all appeared healthy enough at the beginning of the decennial period; but No. 34 gradually degenerated afterwards, and both trees having become unsightly were cut down in 1887.

The *average annual increase* was 0·70 in each of the healthier trees.

The *individual range* was comparatively small in all three, the highest, as might be expected, being in No. 34—0·60 to 0·30. The *aggregate range* of the two healthiest was between 1·75 in 1878 and 1·05 in 1881.

In the first depression the girth-increase of No. 34 was lowered year by year, and went on decreasing to the end of the period. In Nos. 35 and 4*, on the other hand, the maxima actually occurred in the first year of the first depression, and although the increase fell off in the second and third years of that depression, it was not to a serious extent, and they both rallied in 1882. They also escaped the depression of 1883, but No. 35 progressively declined thereafter.

Abies Douglasii.

No. in List.	Girth, Mar. 1878.	Annual Increments.										Girth, Nov. 1887.	Total In-crease.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
5	56·10	·60	·45	·45	·60	·55	·35	·15	·40	·15	·20	60·00	3·90	·39
10	64·30	·80	·30	·35	·25	·40	·15	·20	·05	·25	·05	67·10	2·80	·28
Total,		1·40	·75	·80	·85	·95	·50	·35	·45	·40	·25	...	...	·33

Trustworthy average results cannot be derived from these trees, as their history has been on the whole one of gradual decline from an average increase in girth of 1·40 in 1878 to 0·25 in 1887. A severe depression took place in the first of the three severe seasons, from which there was a gradual but only partial rally up till 1882. In 1883 a fresh severe fall took place, since which the increase has been trifling. Both were handsome and vigorous-looking in 1878, No. 10 in particular, the older of the two, being described as "crowded with small long branches to the ground." Of this tree we possess unusually full information. It must have been planted soon after the introduction of the species in 1827 by Drummond, naturalist to the second Franklin expedition (1825–27), as Loudon, in his *Review of the Botanic Garden*, ten years thereafter, gives its height as 8 feet, and its girth, probably at or near the ground, as 9 inches. The next recorded measurements were by Sir Robert Christison in November 1874 and March 1878, since when it was measured annually till October 1887, when it was cut down. The results are here given :—

	Girth.				Average annual Increase in		
	1837.	1874.	1878.	1887.	37 years, 1837–74.	4 years, 1875–78.	9 years, 1879–87.
At the ground, .	9 in.	82 in.	...	...	1·97	...	...
At 4 ft. 4 in. up, .	4 ,, ?	62 ,,	65·10 in.	67·10 in.	1·56	0·77	0·22

Thus the tree prospered exceedingly for about forty-five years, its average annual increase in girth, at 4 feet 4 inches from the ground, having been more than an inch and a half for the last thirty-seven years of that period. In the next four years the rate had fallen to three-quarters of an inch, but the tree was still handsome and apparently in perfect health.

This brings it to 1878, but in the autumn of that year many large branches were blown down; it then passed through the three severe seasons, when its increase fell to 0·30, 0·35, and 0·20; there was a rally to 0·40 in 1882, but in 1883, a year of disaster to evergreen growth, there was a fresh fall to 0·15, from which there was no substantial recovery. By this time a further loss of branches had reduced it to a perfect wreck; only about a fourth of its proper amount remained, distributed at the top and bottom, but still beautifully fresh and healthy looking. When cut down the tree was found to be 54 feet long, representing an annual upward growth of fully a foot, if we deduct the last nine years of its life, when the increase must have been little or nothing. The wood was quite healthy, and a section close to the ground showed 53 rings, a number corresponding closely with its probable age, if we add for its start in life two or three rings, which would not come into the section.

The younger tree, No. 5, was growing vigorously, at the rate of nearly an inch and a half annually, for three years before 1878, but in that year the rate fell to little more than half an inch. The tree suffered but little further diminution in girth-increase from the first two of the three bad seasons, and rallied to the standard of 1878 in the third, but fell off again in 1883, since which its increase has been small, averaging only a quarter of an inch a year. At the ground its increase has been 15 inches in thirteen years, nearly twice as much as at 5 feet up. In appearance also the tree has much fallen off; it has not more than half its proper proportion of branches, but it still looks healthy above.

Pinus sylvestris.

No. in List.	Girth when first measured.	Annual Increments.										Girth, Nov. 1887.	Result.	Average annual Result.
		1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.			
19	49·20	·00	− ·10	− ·05	...	...	...	...	...	...	...	...	...	...
36	52·55	+ ·25	+ ·30	− ·05	+ ·05	+ ·10	+ ·10	− ·05	·00	+ ·05	·00	53·30	+0·75	+ ·07
37	52·95	+ ·25	− ·25	·00	− ·15	·00	·00	·00	− ·05	·00	− ·45	52·30	−0·65	− ·06
11	93·80	...	...	...	...	− ·10	− ·10	− ·25	− ·05	+ ·05	− ·15	93·20	−0·60	− ·10

The Scots fir does not thrive generally in the Edinburgh district. Certainly the record of my measured specimens is a miserable one. No. 19, almost the only Scots fir in the Botanic Garden proper, had begun to decay in 1878, although but 4 feet in girth. It did not increase at all in that year or in 1879; actually decreased in 1880 and 1881; and was then cut down.

Nos. 36 and 37, among the best of a considerable number of poor specimens in the easterly groves of the Arboretum, had small heads of foliage, although they looked healthy enough, in 1878, but they have degenerated ever since. The girth of No. 36 diminished in several seasons, and the nett result of ten years was an increase of three-fourths of an inch. No. 37 grew a quarter of an inch in 1878, but never increased again, and suffered a decrease of very nearly an inch in nine years. Though evidently dying, both these trees are only about 4½ feet in girth. Occasionally the Scots fir does better than this in our neighbourhood. No. 11, in the low ground of the Arboretum, for example, has a tall straight stem, 7 feet 10 inches in girth. But it too has degenerated since 1878, when an increase of 0·30 was registered, as the nett result of the decennial period has been a *decrease* of nearly an inch; and during the last six years, when it was measured with peculiar care, its average loss was a tenth of an inch. In appearance this tree also grows shabbier year by year.

In 1878 a really fine Scots fir stood on the lawn of Cammo, 5 miles west of Edinburgh. It measured upwards of 10 feet in girth, and had a large healthy head of foliage, accommodating a rookery of some thirty nests. It was increasing very slowly, however, at the rate of only 0·20, in 1878 and 1879; in 1880 there was no increase, and since then the foliage has progressively decayed.

It is remarkable that in 1878 four of these five trees were still growing, although slowly, but that in the next year or two growth ceased, and decay of the foliage set in. It seems fair to conclude that in 1878 they were in a feeble state, and that the succeeding severe season gave them the *coup de grace.*

Pinus excelsa.

No. in List.	Girth, Mar. 1878.	Annual Increments.										Girth, Nov. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
24	30·90	·35	·20	·05	·30	·15	·25	·20	·40	·30	·20	33·30	2·40	·24
26	32·70	·40	·20	·35	·35	·40	·35	·70	·80	·65	·60	37·50	4·80	·48
Total, .		·75	·40	·40	·65	·55	·60	·90	1·20	·95	·80			

No. 24 was noted in 1878 as having "numerous branches from the ground," but grew only 0·35 in that year. After the second severe winter, when 18 inches of the top shoot died, the increase was only 0·05. Since then its increase has been low, though not much less than in 1878. It is now short and stunted, well clothed below but poor above, and without a top shoot. No. 26 has done better. It is upright and handsome, although rather scraggy. Perhaps it has got a new lease of life, as its average increase for the first six years was only 0·34, and for the last four amounted to 0·67. The inferiority of No. 24 is shown also by the upward growth, which was only from 22 feet 9 inches in 1879 to 23 feet 1 inch in 1887, or at the rate of under half an inch a year; while No. 26 grew as follows:—

Height, 3rd June 1879, 25 feet 1 inch.
30th April 1881, 26 „ 7 „ aver., 1879–80, 9 in.
January 1888, 29 „ 1 „ „ 1881–87, 4·3 in.
Average, 1879–87, 5·3 inches.

It would not be safe to make any general deductions from the results in these trees, as their growth has been so erratic. The weakest of them, however, No. 24, suffered a much more severe fall in girth-increase from the first depression than No. 26; both evidently escaped in 1883, and were not appreciably affected in 1887.

Pinus Laricio.—This Corsican pine [Table, p. 269] was severely affected in its girth-increase by the trying season of 1879, when the amount fell from 0·40 to 0·10, but it recovered in the following year, and has grown very steadily since at an average of nearly half an inch, with the exception of 1883, when the rate fell to 0·30. It is now 5 feet 8 inches in girth, and is one of the largest pines in the garden. In spring 1878 it was 55 feet high, and it is now 58 feet 10 inches, giving an average annual growth upwards of 4·7 inches for ten years. The foliage is rather thin.

Girth when first measured.	Annual Increments.										Girth, Nov. 1887.	Total Increase.	Average An. Increase.
	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
Pinus Laricio.													
64·30	·40	·10	·50	·50	·45	·30	·45	·50	·45	·45	68·50	4·10	·41
**Pinus austriaca.*													
16·75	...	1·60	1·55	1·65	1·55	1·75	1·80	1·65	1·40	1·45	31·15	14·40	1·60
Abies Lowiana, No. 31.													
15·00	1·40	1·25	1·40	·90	1·05	·80	1·00	1·10	1·15	1·05	26·10	11·10	1·11
Do. No. 32.													
16·10	·60	·10	·15	cut	dow	n							
**Cupressus Lawsoniana.*													
14·20	...	·80	1·15	·85	·85	·85	1·05	·85	·70	·60	21·90	7·70	·85

**Pinus austriaca.*—First measured in 1879, but evidently the girth-increase did not suffer material if any reduction in the three bad seasons, although in 1880 two years' growth of the top shoot died. Notwithstanding this loss, the tree has grown very steadily, the annual range being only between 1·80 and 1·40, and its average, 1·60, being higher than that of any other evergreen.

Abies Lowiana.—The history of these two trees is better known than usual. They stood side by side in 1887, and were of nearly the same girth, No. 31 being 15·0, and No. 32 16·10 inches. No. 31 was labelled "planted in 1868." Both seemed perfectly healthy, and were crowded with branches to the ground, nevertheless No. 32 had probably begun to suffer from debility, as its growth in 1878 was only 0·60, less than half that of its comrade. In June and July of the following year it assumed a distinctly unhealthy aspect, the upper foliage being thin, the top shoot not a third of the length of its neighbour's, and many blisters, some exuding turpentine, having formed on the bark. Increase in girth almost ceased, and in 1881 it was cut down.

No. 31 has not been so unfortunate, although it has lost much of its early vigour and beauty, the foliage having thinned considerably, the stem being much blistered, without however exuding turpentine, the top shoot having been lost in 1880, and the girth-increase being materially diminished. In 1878 this was very nearly an inch and a half; it suffered no material diminution in 1879, and in 1880 rose again to an inch and a half, but in 1881 it fell to 0·90, in 1883 to 0·80, its lowest point, and in the last four years has averaged only a little above an inch. The annual range has varied between 1·40 and 0·80, considerably under the average. In spring 1879 this tree was 18 feet 10 inches high, and it is now 26 feet 8 inches, representing an annual rate of about 10½ inches.

An *Abies nobilis* was measured in 1878, and noted as the oldest of its species in the garden. It was 3 feet 2 inches in girth and 45 feet high. But it had become unhealthy-looking the previous year. In 1878 its girth increased only 0·15, and in 1879 it was cut down.

**Cupressus Lawsoniana.*—This Craigiehall cypress has grown pretty steadily at the average of 0·85, the annual range being small—between 1·15 and 0·70. It has always looked healthy, and its girth-increase probably did not decline in the bad years, the maximum indeed happening in one of these, 1880. But as it was not measured in 1878, we do not know the rate before the bad seasons set in.

Taxus baccata.

No. in List.	Girth when first measured.	Annual Increments.										Girth, Nov. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
41	67·60	·60	·60	·35	·50	·50	·35	·65	·35	·55	·25	72·30	4·70	·47
42	34·10	·50	·15	·20	·30	·25	·25	·25	·30	·35	·05	36·70	2·60	·26
48	37·50	...	·60	·40	·40	·55	·50	·60	·45	·50	·30	41·80	4·30	·48
49	23·50	...	30	·35	·45	·55	·50	·45	·45	·55	·45	27·55	4·05	·45
50	33·30	...	·45	·40	·35	·45	·35	·40	·40	·35	·20	36·65	3·35	·37
47	33·20	...	·15	·05	·00	·10	·10	·10	·10	·15	·05	34·00	8·00	·09
53	32·20	...	..	·15	·15	·40	·25	·45	·25	·25	·10	34·20	2·00	·25
Total without No. 53,			2·25	1·75	2·00	2·40	2·05	2·45	2·05	2·45	1·30		...	·34
Total of the seven,			...	1·90	2·15	2·80	2·30	2·90	2·30	2·70	1·40	excluding No. 47,		·38

The history and conduct of the seven measured yews is so diverse and complex that it is essential to give in the first place a complete history of each.

No. 41, a beautiful spreading yew, by far the largest in the garden, standing clear of other trees upon grass, is traditionally believed to have been transplanted in 1767 from the old Physic Garden to the Botanic Garden in Leith Walk, and is known to have been transplanted thence in 1821–22 to its present site. Writing of its age in 1878, Sir Robert Christison says, "by its traditional history it must be 193, and may be 240." This yields an annual rate of 0·35 in the first case and of 0·28 in the second. Even the highest of these rates seems low for a tree of such a healthy and vigorous look as this, and it is probable that the traditional history is at fault, unless we accept as a sufficient explanation of so slow a rate, retardation caused by transplanting; and Sir Robert was assured by the former head-gardener, Mr Macnab, that the tree took many years to recover its power of growth after the transplantation in 1821–22. At all events, the rate for the last ten years has been much higher, amounting to 0·47, and this in spite of five of the ten years having proved very trying to evergreens, three of the five actually causing a marked fall in the girth-increase of this tree. If No. 41 be really entering its third century of life, or possibly be already half-way through it, its present annual rate of nearly half an inch is considerably greater than that which Sir Robert, from all the information he could gather, assigns to a yew of its supposed age in favourable circumstances.

The stem of this fine tree has now a nearly uniform girth of 6 feet for 3 feet from the ground, to the spring of the branches. The height of the tree on 23rd June 1879 was 27 feet 9 inches, and is now 27 feet 11·5 inches, representing an annual increase of only about a quarter of an inch. The spread of the branches at the same date was 51 feet, and is now 55 feet 4 inches, representing an annual rate of about half a foot in diameter, or 3 inches outwards all round.

No. 42 was transplanted from the former garden to the present one in 1821–22, but its age is unknown. Being situated in a border of trees and shrubs, it has not the spreading form of No. 41. Its annual rate of girth-increase for the decennial period has been only 0·28, and this low rate is probably due to a lasting effect of the first of the three severe seasons, when the amount fell from 0·50 to 0·15, from which no effectual rally has been made since. Its upward growth has been likewise slow, averaging only two-thirds of an inch annually for nine years. There was another great depression in 1887, when the girth-increase was only 0·05.

Nos. 47, 48, 49, and 50 were all planted when six years old, in 1821–22.

No. 47 was noted in 1878 as having a clear smooth trunk of about 5 feet, unpruned, and as being overshadowed by a forest tree on one side and choked on the other, so as in form to be only half a tree. These conditions still continue, and probably account for its exceedingly low annual average growth of only 0·09 in the last nine years, its rate for the previous sixty-four years of its life having been 0·53. Its present height is 21 feet 1 inch, representing an annual rate of upward growth of about 4 inches a year.

No. 48 stands in a shrubbery, but has lately been well cleared of neighbours, which somewhat pressed upon it; its form has not been injured, and it has a very healthy vigorous look. The lowest branch is at 4 feet up, and the stem is unpruned. Its annual increase in girth for sixty-four years down to 1878 was 0·59, and since then has been 0·48, the largest proportion of any of the measured yews. Girth-increase was somewhat depressed in the two last of the three severe seasons, and more seriously in 1887. The annual average upward growth for the first sixty-four years was a little over 4 inches, but for the last nine was barely 1 inch.

No. 49 stands free upon grass, but has an upright form, the result perhaps of pruning, the stem having been cleared to a height of 5 feet 3 inches. Its annual increase for the sixty-four years down to 1878 was only 0·37, but it has done better since, having averaged 0·45 in the last nine years. Its girth-increase was depressed, but only slightly, in the first and second of the two severe seasons. Its height on June 23, 1879, was 19 feet 7 inches, and on November

1887 was 21 feet 9½ inches, giving an increase of a little over 3 inches a year, the rate for the previous sixty-five years having been a little over 3½ inches.

No. 50, in a border of trees and shrubs, but not much incommoded, was transplanted once, and in October 1878 the stem was pruned up to 10 feet, many branches being lopped. Its annual increase for sixty-four years down to 1878 averaged 0·52, but in the last nine years has fallen to 0·37. Its girth-increase does not seem to have fallen in the two first of the severe seasons, and not to any great degree in the third, but was decidedly low in 1887. Its height, June 26, 1879, was 24 feet 1 inch, and is now 27 feet. This represents an annual increase of a little over 4 inches, the rate for the previous sixty-four years having been a little under 4½ inches.

No. 53 also stands among other trees and shrubs, and is somewhat overshadowed. Its trunk has been partially pruned for 4 feet. Its age is unknown. Its rate of increase for the last eight years has been only 0·25. This low rate has probably been caused partly by the three severe seasons. We have no measurement for the first of them, but in the second and third the increase was only 0·15, while in 1882 it sprung up to 0·40; 1883, and particularly 1887, were also seasons of depression. All the time the tree has had a healthy and vigorous appearance.

Taking a general view of the species, we find that the annual average girth-increase of the seven trees has been 0·34, or removing the only tree to which serious objection can be taken, on account of its appearance and surroundings, the average of six is 0·38. Removing two others, whose girth-increase has apparently received a prolonged, though, judging from their healthy appearance, not probably a permanent depression from the severe frosts of 1879–80–81, the average of the remaining four rises to 0·44.

Two of the trees, the largest and smallest, increased in girth at a considerably greater rate in the decennial period than in their previous career, but the reverse was the case with the three others whose total age was known.

The upward growth of five of the yews was also ascertained for the decennial period by measuring with a rod in the summer of 1879, and again in autumn of 1887, and as the age of these trees is known, we are enabled to compare their rate of increase in that period with the rate for the earlier part of their career.

Taxus baccata.	Height.		Average Increase.	
	June 26, 1879.	January 1888.	64 Years, 1815–78.	$8\frac{1}{2}$ Years, 1879–87.
	Ft. in.	Ft. in.	Inches.	Inches.
41	27 9 .	27 11·5	...	0·3
42	29 7	30 2·5	...	0·64
48	22 5	23 3	4·14	0·94
49	19 7	21 9·5	3·61	3·06
50	24 1	27 0	4·41	4·10

The great differences in the rate of upward growth shown in the Table admit of some explanation. Thus No. 41 has made no appreciable gain in height in the last eight years, and is no higher now than two others not half its own age; but then the perfect freedom allowed to it all round has caused the branches to spread outwards rapidly, as we have ascertained by actual measurement, and thus the deficiency of growth in one direction is compensated by a rapid increase in another. Again, the slow upward growth of No. 42 in the last eight years corresponds with a marked decrease in the girth-increase, and both are no doubt due to the effects of the hard winter of 1879. The slow upward growth of No. 48, evidently a very healthy tree, and which made the largest girth-increase of all, was probably due to overshadowing and overcrowding. It was cleared of neighbours in spring 1886, and it will be interesting to note the effect.

The *individual range* was highest in No. 42, 0·50 to 0·05, and lowest in No. 49, 0·55 to 0·30. The *aggregate range* lay between 2·90 in 1884 and 1·40 in 1887. From the depressing effect of 1879 three of the six yews, measured in that year, escaped. Five in seven suffered in 1880, and three in seven in 1881. The species participated only slightly in the depression of 1883, so disastrous to some of the evergreen species; but in 1887 it suffered most severely, five of the seven trees reaching their absolute minimum of increase.

Quercus Ilex.

No. in List.	Girth when first measured.	Annual Increments.										Girth, Nov. 1887.	Total Increase.	Average annual Increase.
		1878	1879	1880	1881	1882	1883	1884	1885	1886	1887			
45	41·50	...	·30	·15	·15	·35	·15	·40	·25	·55	·25	44·05	2·55	0·28
46	29·05	...	·40	·10	·10	·25	·20	·15	·15	·45	·25	31·10	2·05	0·23
Total, .		...	·70	·25	·25	·60	·35	·55	·40	1·00	·50	...	...	·25

No species in the Botanic Garden suffered such manifest injury from the three severe seasons as the evergreen oak. The largest specimen, not one of my observed trees, now 74·50 inches in girth, lost its whole foliage in 1880, two years' growth of the twigs having apparently perished. It has gradually recovered its clothing, but has never regained its former handsome thriving appearance.

The measured trees did not suffer so much, but it was noted in June 1879 that the winter leaves turned brown with the long frost, and dropped off before the spring buds appeared. The girth-increase probably fell considerably in this the first year of measurement, but in the next two severe seasons was reduced almost to nothing, and it was not till 1886 that any substantial increase was made. In 1880 No. 45 was the only tree of its species in the garden which retained its leaves green and vigorous till they dropped, according to the usual rule, with the development of new foliage in summer; nevertheless, it has not done much better than No. 46 on the whole, the annual average being only 0·28, that of No. 46 being 0·23. A slight rally which both made in 1882 was followed by a serious depression in 1883, from which there was no recovery till 1886, when both trees did so well that it seemed as if they were beginning a new career of prosperity. In 1887, however, a fresh and serious fall took place.

The Colouring Matters of Leaves and Flowers.

By PHILIP SEWELL.

(Read 8th March, 12th April, and 10th May 1888.)

[The following paper was, for convenience, divided into three parts, the first dealing with the physical and chemical properties of this class of colours; the second with colour changes; the third with the various hypotheses which, more or less recently, have been put forward to account for colour phenomena.

The paper is an expansion of one on Floral Colour, read in December of last year to the Botanical Society.]

PART I.

A. *Physical Properties.*

Their different physical characters were, naturally enough, those that first attracted the attention of botanists who wished to classify the various colours of plants. Many workers, since the time of De Candolle, who divided plant-colours into solid and fluid (xanthic and cyanic), have pointed out the necessary imperfection of a purely physical classification of them, and at the present time solubility, the appearance of particular spectra, and, so far as can be ascertained, chemical composition, all enter into account in any attempt at a natural grouping together of colouring matters of plants.

If we inquire as to what is the nature of the difference between so-called solid and fluid colours, we find that the solid are associated with a protoplasmic corpuscle of varying size and shape, and may, therefore, be called by the better name, used by Vines, "fixed" colours. Pringsheim states that some of these protoplasmic corpuscles have in their surface small pits, in which is mechanically retained the oily or viscid coloured fluid—the chlorophyll or the etiolin, as the case may be. The fluid colours are commonly dissolved in the cell-sap, although at times, as we shall see, they pass into the cell-wall or into the solid cell-contents, or, and this not uncommonly, occur crystallised within the cell.

The fault of De Candolle's classification, which of course was a purely arbitrary one, is clearly seen in this, that he regarded yellow colours as solid colours distinctively, blue and red as fluid distinctively. Hence, when it was recognised that yellow commonly exists as a fluid colour, and that red, and even blue, are at times attached to solid bodies, some other more natural arrangement was required. The real relationship of the colours is brought out in the assertion of Schimper (in 1885) that, in the different stages of developing colour-corpuscles, there may be found all shades from pale yellow, or green, to brilliant carmine; whilst at the same time there is transition of form of the retaining corpuscle. "The colouring matters of leaf and flower affect a series of states connected with and passing into each other," says Bonnier. We have to think of evolution among coloured products in the cell; of the yellow of etiolin, as indicated fully in Vines' *Lectures on Physiology*, becoming transformed into the green of chlorophyll; or, on decomposition, passing into yellow or red, either retained by the corpuscle of protoplasm; or, most commonly passing (the yellow as xanthophyll) into the cell-sap. We come, indeed, to regard the fixation of colouring matters as a sign of specialisation—that is, of a division of labour by the protoplasm of the cell. Amongst the lowest Cryptogams it is present as a viscid fluid distributed throughout the whole of the homogeneous protoplasm of the cell; amongst the Diatomaceæ, or as in *Spirogyra* amongst filamentous Algæ, it is present as bands in the protoplasm lining the interior of the cell-wall. Its association in the higher plants with the numerous distinct corpuscles, capable of being moved in the cell by the investing layer of protoplasm, is a clear case of differentiation; the corpuscles are isolated as the special portions of the protoplasm which effect the synthetic formation of carbohydrates.

The development of the chlorophyll and of its corpuscle (the chloroplast) has of late years, mainly through the observations of Schimper and Meyer, been very distinctly followed. The chloroplasts arise from colourless plastids, which have been traced in all young meristem, and even in the embryo-sac of various plants; they divide directly, and, at maturity, a yellow colouring matter, etiolin, appears as the result of the reduction of part of the protoplasm of the corpuscle. It is this etiolin which on exposure to light may become green.

It is interesting to notice, that a starch-grain in the corpuscle, obtained by it by the reduction of proteids in the cell, disappears as the etiolin is formed, being in part used in building up the protoplasm of the corpuscle, which protoplasm in turn goes to the production of the colour-substance.

As to stages subsequent to the production of the chlorophyll, Schimper and Baccarini have recorded that, from the round chloroplast may be formed a body of crystalline character, and of red or yellow colour, invested by a layer of protoplasm.

Evident conditions of degradation are commonly seen in fading leaves, where the chlorophyll-corpuscles either undergo disintegration, the whole leaf becoming brown, or collect together into amorphous masses; these, although at times differently coloured, are most commonly rendered yellow by the presence of xanthophyll. This xanthophyll is the substance into which the chlorophyll has chiefly altered.

Messrs Martin and Thomas have recorded several interesting observations as to the condition of the cells in leaves which, as in autumn, are undergoing colour-change. When red, the denser cell-contents have mainly disappeared, the colour being free in the cell-sap; when yellow, the colour is chiefly in the amorphous masses, the change evidently not having proceeded so far. The subsequent brown stage is one of complete decomposition, without any signs of vitality such as are exhibited with the other colours.

Colours occur most commonly as follows:—

White.—Either as plastids of an almost transparent or a very pale yellow colour, when the whiteness is not of a pure kind. Whiteness, however, is generally due to the presence of air in the tissue of which the part consists, and this allows of nearly total reflection; the cause being exactly similar to the cause of the whiteness of snow. Rose-coloured geraniums example the combination of cells containing air with others underneath containing red colouring matter.

Yellow is fixed as etiolin, in leaves or in certain flowers (it has an evident similarity with Krukenberg's "lippochromes"); or as fluid xanthophyll in leaves or many (? most) flowers.

Red appears at times attached to ordinary chromoplasts, at times in the form of crystals or globules, either with or without an investing layer of protoplasm; more generally it occurs in the cell-sap produced immediately, or mediately from chlorophyll or etiolin. In many cases red, especially where tannin is present, is known to result from the decomposition of glucosides, for example, in certain roots.

Blue is very rarely fixed. It is probably a derivative of red in all cases.

Violet, like orange and scarlet, is produced by the mixing of certain of the colours already mentioned in the same tissue, for instance, where cells containing fixed yellow have fluid red in the superposed cells.

Black is a result of the concentration of violet pigment.

Brown is due to amorphous decomposition-products, or to the presence of red and yellow pigments in the cells.

Variegated colours are often due, according to Engelmann, to localised colours in the walls of the cells.

A physical property of chlorophyll as of allied colours is its fluorescence. This property is not shared by etiolin, from which, as we have seen, all the chlorophyll-colours are produced. It is a property of many vegetable colours, and may be artificially produced by the addition of alcohol to the colourless fluid of the pellucid spots of *Hypericum,* which become brilliantly red as well as fluorescent.

At the present time a large amount of information regarding colours, as observed through the spectroscope, has been collected. Etiolin, chlorophyll, and xanthophyll have each a characteristic spectrum. The position of the absorption-bands in chlorophyll is materially changed when there is the least trace of acid present; similarly they are distinctively changed with an alkali.

More or less suggestive facts, such as the following, have been obtained—that the spectrum of fresh leaves submitted to sunlight changes in appearance, and ends by giving the spectrum of chlorophyll that has been acted upon by acids; that the spectrum of the yellow matter of dead leaves and of certain flowers is the same as that of xanthophyll; that the processes of assimilation and transpiration are variously modified according as they are effected in rays from one or another part of the spectrum.

It must be borne in mind, however, as was pointed out by M. Chaubard, in 1873, that the spectrum of chlorophyll may vary in the same plant, according to age, climate, temperature, exposure of soil, and also according to the nature of the solvent in which it is held. Although corrections are now carefully made, mistakes are only too common, from errors in observation with the spectroscope, but it appears that a similar spectrum is not a certain indication of an identically similar substance, inasmuch as Sachsse has observed allied colours differing in the amount of carbon they contained, yet exactly alike in their spectra. The analysis, therefore, which alone will be conclusive as to the true relationship of these colours, lies with the chemist.

B. *Chemical Properties.*

Owing to the large mass of literature relating to chlorophyll, and in view of the certain relationship which has been detected by Schimper between it and the variously coloured chromoplasts, it is necessary for us to refer in some detail to the chemical properties of this the most important of all the colouring-matters.

The first difficulty met with as to its composition is that about which so considerable a conflict has been waged—whether it should be regarded as a definite chemical substance or a mixture of several substances.

According to Vines, Pringsheim, and others the probabilities are in favour of its being a definite substance. Etiolin, however, is always present with it in the cell, and there is most commonly more or less of xanthophyll. Etiolin, as we have seen, is chlorophyll in the process of formation—xanthophyll is generally regarded as a product of its decomposition. Etiolin, as asserted by Hansen, exists in wheat-leaves in the proportion of 1 to 100 of the chlorophyll; xanthophyll, at times, as in autumn leaves, or as among the Diatomaceae, may take the place of, or quite obscure, the chlorophyll.

Many observers, notably Sorby and Sachsse, have, on the separation of the chlorophyll from the leaf, found several other colouring matters in the solution which are distinct from it. These are generally regarded as products of the decomposition of chlorophyll, due to its removal from the cell. Sorby distinguished seven, three of which he called xanthophylls; Sachsse distinguished nine, five of which were green and four yellow. The green contained nitrogen and a variable amount of carbon, from 66 to 72 per cent.; the yellow were destitute of nitrogen, containing from 66 to 71 per cent. of carbon, and the colours of the yellow series varied from pale yellow to yellowish-brown. The fact of the existence of such a definite series of colours so closely related, which, as Sachsse shows, differ from one another chemically, without having distinct spectra, may point to an alteration continually taking place in the constitution of the chlorophyll. It is not necessary to suppose that these substances were all produced as a result of the dissolving out of the chlorophyll.

Is it not a feasible supposition, that just as we now recognise etiolin as a step in the formation of chlorophyll, and xanthophyll as a step in its decomposition, so we may regard the individuals of these series determined by Sachsse as other steps still more close to one another? We may thus perhaps come to regard the condition of the chlorophyll in the plant as really analagous to the condition of the protoplasm from which it is derived; for just as there is now recognised in protoplasm a continually ascending and descending series of albuminoids, so we may recognise in the green colouring matter, with its distinct spectrum, a series of more or less stable compounds ever increasing and decreasing in complexity. These, under varying conditions, may be expected to alter in their relative proportion to one another in the cells of the plant, and may account for the varying composition of chlorophyll according to the many different analysts who have given us the results of their researches.

Pure chlorophyll has never been obtained, although many have supposed for a time that they had extracted it for analysis. Gautier and Hoppe-Seyler obtained by evaporation green crystals of a substance which they termed chlorophyllan, because of the ash present; for this Gautier suggests the formula $C_{19}H_{22}N_2O_3$.

Wollheim in 1887 deduced a formula for pure chlorophyll, agreeing with Tschirsch's formula for phyllocyanin, $C_{28}H_{47}N_3O_6$.

The following is a comparison of percentage compositions as given by them :—

	Gautier,	Hoppe-Seyler,	and Hansen.
C =	73·97	73·4	68·3
H =	9·8	9·7	10·5
N =	4·15	5·62	5·1
O =	10·33	9·57	16·9
Ash (Phosphates)	1·75	P 1·37	...
	...	Mg 0·34	...

In reference to the percentages of carbon and nitrogen, it is of interest to note that Sachsse, who showed that the members of his green series contained nitrogen while the others had none, is supported by Professor Gilbert, in a communication made at the last British Association meeting in Aberdeen. He pointed out that an increase in the depth of green colour is not associated with a relatively high carbon percentage, but depends directly on the amount of nitrogen present in the plant.

All chemists are agreed that iron cannot be detected in the composition of chlorophyll, though Timiriazeff has again suggested that all the conditions of chlorophyll and its various reactions would be explained by the assumption that iron in the form of an $FeOFe_2O_3$ compound is present. All that is yet certain is, the necessity of iron for its production.

Certain of the allied or derived colours of the leaf, as for instance carotin ($C_{18}H_{24}O$ of Arnaud), have been selected for observation with more or less satisfactory results; but of the blue, red, and fluid yellow colours of flowers, Flahault says "the most prominent character of the many they share in common is the exceptional readiness with which they are changed and broken down under the greater number of reagents."

A connection between red in leaf and flower is evidenced, according to Professor Schnetzler, by the fact that tannin occurs more plentifully where such colour is present, either in flowers or in young leaves.

Although many botanists regard the fluid colours—red, blue, or yellow—as derivatives of chlorophyll, Vines states that "as yet there is no direct proof that they are derivatives." From the researches of Schimper, mentioned above, it is evident that, in the words of Professor Marshall Ward, we have a "genetic and therefore real relationship" between green and red solid colours, that is between the chloroplasts and the chromoplasts; as yet, however, we are not certain of a like relationship on the part of the fluid colours.

Hansen assumes that there are four distinct pigments in plants:—Lippochrome-yellow (etiolin), soluble yellow, flower-red, and chlorophyll-green, and that chlorophyll is not the source of the other pigments.

The passage of brightly coloured pigments from corpuscles to the condition of that of cell fluid has been clearly demonstrated. The transitions and gradations in colour observable between green leaves and red bracts or flowers point to a common origin of the pigments, if not in the chlorophyll, possibly in the etiolin; but it is possible, nevertheless, to imagine that a red pigment may be directly produced instead of arising as a transition form out of etiolin.

It is necessary to remember that, as asserted by Vines, the fluid colours, allied to the aromatic group of substances, are physiologically waste products.

We shall regard them as definitely related to the chlorophyll colours—chlorophyll itself being produced when the metabolism is constructive; red or other colours when it is destructive. Instances of this we shall deal with when considering colour-changes.

Part II.

Colour-Changes.

Colour-changes may be, perhaps, most suitably considered under the following heads:—

1. Those induced artificially by various reagents; and those induced naturally, by the presence of substances of a like nature in the cells of the living plant.
2. Those associated with particular environments; which environments are either directly or indirectly the cause of change.
3. Those characteristic of definite conditions of growth. (These conditions may or may not be evidently referable to the influence of special environment.)

1. The colours produced from chlorophyll by means of various reagents, either in the cells of the plant or in solutions, have been numerous enough to lead to the assertion that, "given a solution of chlorophyll, it is possible by means of acids and alkalies to produce all the colours exhibited by flowers and fruits."

It does not concern us to know whether such colours are produced by decomposition or (as is probable at times) whether they exist mixed with the chlorophyll in the plant (a question which was alluded to in the first part of this paper), but we may notice in detail various of the ways in which such changes may be brought about.

(A) They may result from mere mechanical separation—for instance, by solvents such as fresh water, borax-water, and alcohol, by which means, among the Florideæ, Fucaceæ, &c., brown and red colours, normally obscuring the chlorophyll present, may be quickly dissolved out. Among the Diatomaceæ, the normal yellow colour due to the presence of phycoxanthine gives place under such agents to green, as this substance is affected more quickly than is the chlorophyll.

(B) That oxidation or reduction may also produce colour-change, we have evidence alike in nature and by experiment. Sorby some time ago asserted that by oxidation yellow changed to red, and red became brown, and if the process be carried further, the coloured substance may totally disappear. Timiriazeff has shown that chlorophyll may be rendered red, and finally colourless, by reduction (with nascent hydrogen), and regain its colour on oxidation. Another example of such induced change to and from green is that afforded by the experiments of Wiesner and Lindt upon *Neottia nidus-avis*. In this plant the transformation of the brown corpuscles to green may be brought about by an increase of temperature by addition of alcohol, or, most rapidly of all, by the action of an aldehyde as a reducing agent.

(C) Very many reagents (iodine-water and chloride of zinc, HCl, &c.) will re-convert yellow corpuscles to green, the colour at times being permanent, at times transitory.

As similar colours appear with widely different reagents, and as the variety of these changes is so great, Russel and

Lapraik were led to judge that the change was of a molecular, not of a chemical nature. Such changes may be observed by any one with the simplest experimenting. I may instance a few of such changes observed last summer by Mr Terras—the isolated instances elsewhere recorded being in no way more instructive.

The commonest transitions were those in accordance with the ordinary litmus-reactions of acid or alkalies; a seeming exception (doubtless due, however, to the action of the acid on the protoplasm of the corpuscle) being where a fixed red changed to a dirty blue with H_2SO_4 and HNO_3. Fluid-yellows of *Œnothera*, *Alyssum*, *Cheiranthus*, were changed to blue by H_2SO_4, by HNO_3, by solution of I and KI. The yellow of *Verbascum* failed to give any reactions, whilst many fixed yellows gave those of chlororufin. The yellow of *Linaria* changed to bright red with H_2SO_4. The red of *Dianthus deltoides* changed to yellow with H_2SO_4, and as with KHO, this yellow changed back to a transitory red with acids.

From some experiments which I made with a strong solution of KHO, I was able to detect some method among the number of such changes observed by myself and corroborated by many of the instances given by others.

It is known that chlorophyll becomes yellow by the action of alkalies; similarly I found that any other colour might be reduced to the same kind of yellow by the same means. Reds of *Linum*, *Monarda*, and *Dianthus;* blues of *Myosotis*, *Campanula*, and *Salvia;* whites of *Viola*, *Vaccinium*, and *Campanula*, were finally all rendered yellow. The yellow appeared after a longer or a shorter time; but it was remarkable that whilst the whites passed directly to yellow, the blues passed through a transitory emerald-green stage, due of course to the mixing of these colours; the reds became blue, then green, but in the end yellow as the others.

It is apparent that such easily-induced changes need more careful observation and more definiteness of experiment, before even such a transition to yellow as this above noticed can indicate anything to us with certainty. It is essential in all such cases to know as to the strength of the reagent—varying results being given with solutions of different strength in the same space of time.

We may, however, reasonably connect certain well-defined changes which occur naturally, and which are accompanied by the presence of definite substances among the cell-contents, with the naturally present acids or alkalies. The blue, common among the Boragineæ, may thus be explained by the well-known alkaline character of the plant. Similarly, the acid property of vine leaves may have something to do with their rich colouring.

Again, it has been shown that the proportion of various of the substances in the plant may vary at different times—sometimes during a single day. For instance, De Lange has asserted that plants contain a smaller proportion of acids when dead than when alive; that there is an increase of acidity during the morning, and a decrease at night. Similarly, the proportion of tannin (which often is known to produce a red colour in the cells where it is present) varies in different parts and at different times. It is present in many red flowers, and is in greater quantity in young than in old leaves.

Such associated substances may commonly be only produced as results of the same metabolic changes which produce colour; it cannot be denied that they must also influence the colour more or less conspicuously.

2. Passing on to consider those transitions which are due to the direct or indirect effects of environment, it is necessary to notice that this part of the subject has, especially in recent years, received a considerable amount of attention from Continental and English observers, various researches having been made as to the influence of light, heat, moisture, soils, or (comprising all these), as to effects of climatal conditions on vegetation generally, or on colour particularly.

(A) To confine our attention to the first of these, we will consider the effects of light as they are (α) direct, or (β) indirect.

(α) We have before alluded to the importance of light in effecting the change from etiolin to chlorophyll; it is necessary to add that a difference in colour of foliage may be noticed according to the amount of exposure, within certain limits, for instance, where leaves have been less or more shaded; but it is worthy of attention that this change is not in one direction only. Shaded parts may at times be more green, at times less green, than are parts exposed to more light. Thus strong light has been shown by Pringsheim to be injurious, as it quickly destroys the xanthophyll and the chlorophyll when very intense. Batalin showed in this connection that by very strong light the green colour might be made to disappear from branches of Coniferæ (this without modification of the protoplasmic corpuscle), and that after a few days yellow again appeared in the corpuscles; he was able, indeed, to induce this change in the same branch several times in the course of a summer.

Light appears to affect the production of the fluid colours which Flahault regards as the less stable compounds, such as reds and many yellows. Askenasy and later Flahault point out that this is in opposition to the observation of Sachs, who had doubtless experimented on a very limited number of flowers, and who held that, provided a sufficient supply of nutriment were accessible to the plant, it would colour its flowers as well in complete darkness as in daylight.

As before noticed, the less stable yellow phycoxanthine will disappear in strong light somewhat rapidly; whilst the red, according to Vines, and the yellow, according to Flahault, are found in less proportion in relatively weak light. These colours seem to alter most readily, as indeed we should expect from their suspension in the cell-sap, and they indicate clearly to us that a mean amount of light is most advantageous to their production.

Light appears to effect colour-change in certain green parts of various plants by acting upon the protoplasm which surrounds the chloroplasts, as Sachs has shown, producing a deeper shade when the chloroplasts are aggregated, as they are by day, on cell-walls at right angles to the direction of incidence.

(β) Of indirect effects we have from a longer exposure to light an increase in the reserve material assimilated; this allows of the production of brighter flowers, more material being at the disposal of those processes of metabolism which produce colour. We have also such indirect influences as may be exerted by the production of alkaloids, organic acids, and ferments mentioned by Vines as resulting in different amount from varying degrees of exposure to light.

Perhaps the clearest example of the chief indirect effect of light, in which a greater amount of assimilated material increases the brilliance of colour, is afforded by the experiment of Flahault upon plants grown at Paris and Upsala; the increase of colour in plants of the same species grown in the latter place is accountable for by the 170 hours more direct sunlight there in the course of the summer.

Cut flowers, which contained chlorophyll, were also shown by Flahault to colour very noticeably when placed in water and exposed to light. He corroborated Sachs' statement for a large number of plants, though not for all, that "flowers" will colour to their normal brilliance in complete darkness, provided they have a sufficient supply of nutritive material, which may be converted into colouring matter. Certain plants depend for much of their brilliancy on assimilation which takes place in leaves of the same year, and therefore they do not colour so brightly if their leaves are withheld from light, or injured so as to prevent perfect assimilation.

(B) The effects of heat in nature are all indirect in a similar way. It affects colour only as it quickens or retards the metabolic processes of growth, as it increases or diminishes the supply of reserve nutritive material in the plant. From this cause may be explained the failure of many flowers to colour brilliantly, or at all, during exceptional or ordinary winters, as has been noticed of the single stock. This will also afford a partial explanation of the asserted prevalence of white and yellow flowers during winter, if such is proved to be really the case. Certainly it is to an impoverished nutrition, largely brought about by change in temperature, that is due the fact of a cold damp winter producing white varieties, or of a droughty summer red varieties. The brilliant red assumed by many Algæ, as, for instance, *Palmella*, *Oscillatoria*, and *Protococcus*, according to Brun, in the shallow waters of alpine lakes, is mainly a consequence of a higher temperature, which prevents further vegetation, and breaks down or changes the green material in the cells into other brightly coloured products.

The more complex condition of heat with considerable moisture may produce other results than brilliancy of colour, indeed the direct opposite—paleness. This is often shown in the characteristic appearance of "forced" plants, which have, it may be supposed, a rapid extension from quick elaboration of cell-wall, but lack substance, or such stores of reserve material as we have already seen are necessary for colour-production.

(C) M. Sargot, in a paper on "The Influence of Moisture on Vegetation," tabulates briefly the following results:— "Plants belonging to drier regions when planted in those with warm and humid atmosphere, show a certain amount of blanching; their leaves are pale and thin, with elongated petioles. Their fruits do not become coloured with such lively tints." The tomato is instanced as colouring in such regions with much less brilliancy than is common in Europe.

(D) Certain of the influences of soils may be better considered when dealing with the effects of increased or diminished nutrition. They have little direct effect, though certain colour-changes are noticeable when some plants are grown in one position or another; as, for instance, is the case with *Raphanus Raphanistrum*, which, commonly having a lilac flower, is invariably yellow when grown by the sea-shore. Or again, Darwin mentions that it was pointed out by a famous grower of chrysanthemums, shortly after they were imported from Japan, that such plants, having a tendency to vary in colour, had, until of more stable character, to be carefully tested in different soils for fear of colour-change resulting.

Although it is probable that an increase in nitrates will deepen the colour of the leaves, yet excess of one material rather than another in the soil, unless absolutely injurious to the plant, will have no effect, because of the selective power of the plant, which takes in general only those substances which are needed.

Where, however, the soil is particularly dry or particularly damp, so as to affect the amount of nutrition, there we have to notice various induced effects upon colouring of leaves and flowers. This is seen in the leaf-colours of *Ranunculus Ficaria*, or of *Arum maculatum*, or in the flower-colours of plants growing near watery places.

(E) Climatal influences resolve themselves mainly into those of light, heat, moisture, and soils, and accordingly we have to notice differences of colour brought about by these influences in different latitudes and altitudes, or in different habitats of one country or another.

Many papers have been written especially regarding the colour of Arctic plants. Among the more recent of these the researches of Bonnier, agreeing with those of Flahault already mentioned, support the generalisation made by De Candolle, Fries, Schubeler, and others, that as flowers are met with growing nearer the north, the colour of leaves and of the petals may be seen to be more intense. M. Pellas has recorded, from careful observation, that the colour of the same species, grown in the same locality, but at different altitudes, is also increased as higher regions are reached. The colour-change is not, however, nearly so evident as in different latitudes. He mentions that certain plants, as *Silene rupestris*, *Silene inflata*, *Bellidiastrum*, have more rose colour in their petals in higher regions than in lower regions; at the same time, several plants are especially referred to as showing most markedly the colour-change. His facts are all in accordance with the experience of growers of alpine plants, who bewail the lessened brightness of their especial favourites when transplanted to their gardens.

3. Lastly, among the transitions that we may partly account for, must be mentioned those which we may associate characteristically with definite conditions of growth, dependent on the possibilities of nutrition. We have seen, in all the instances of indirectly produced colour-change which have been already mentioned, that the amount of nutrition or the amount of assimilation have been the direct cause of such variation.

Plants, when grown healthily, if exposed to light and heat, take on either green or other colour, and they are not able to produce their normal tint if the assimilation is not normal.

A vigorously vegetating condition is invariably associated with the production of chlorophyll; on the other hand, when plants are grown under unfavourable circumstances, their leaves may show variation in the amount of chlorophyll in proportion to the amount of etiolin, xanthophyll, and other coloured products; whilst, provided there is reserve material in the tissues of the plant, flower-colouring will proceed normally under such conditions.

It is within the experience of every gardener that coloured foliage plants, such as species of *Coleus*, *Croton*, *Arum*, can be grown most effectively when their roots are "pot bound," or on dry places, that is, with restricted nutrition, not where moisture and a plentiful supply of rich soil will favour vegetation. Many algæ show exactly the same phenomenon. A *Chroolepus*, cultivated by Mr Terras, was invariably green when grown in the more nutritive environment of water, but yellow when out of water. Similarly, van Tieghem mentions that *Bacillus viridis*, though green when in its home of stagnant water, becomes pale in fresh water.

The colour-changes of autumn and of spring occur also when assimilation is at a minimum, when material already in the plant undergoes further elaboration, active vegetation having ceased in the one case and not commenced in the other.

We may recognise a definite order in which colour-changes occur, and Mr Grant Allen has also made us acquainted with a similar order indicating increased specialisation, his arguments being based on distinct morphological specialisations in the plants accompanying the colour.

It is only when we have fully recognised the possible effects of such environments as we have been considering, and the different colour-changes which may be definitely associated with certain conditions, that we are in a position to recognise the possibilities of selection and of heredity in perpetuating such colours as are useful, and in taking advantage possibly of the less, certainly of the most, rapid variations resulting from one or another of the causes that we have enumerated.

Without at present giving any attention to the influence of selection, we may conclude this portion of the subject by enumerating, without special reference to the cause, other natural groups of clearly-defined colour-changes which have been observed in flowers. These have been noticed in individual plants. When they may be distinguished according to the time when they occur, the cause is probably the same in each case.

(*a*) There are the quick or slow changes as the flowers expand, *e.g.*, in *Pulmonaria*, *Myosotis*, *Orobus*, &c.

(*b*) There is the (usually slow) change during the life of the plant, completed in one day in certain species, especially those of tropical regions. In such cases the elaboration of coloured product is undoubtedly accelerated by heat or climatal conditions, which may, however, have given a character to the protoplasm which is inherited. In summer too, in temperate regions, when it is not uncommon for flowers to last more than a single day, it is not surprising if colour-change is rapid. Thus, we have such flowers as *Convolvulus minor* and *Hibiscus mutabilis*, which change from white through rose to red in less than twelve hours; so also *Œnothera* and *Gladiolus versicolor*. In two or three days *Lantana, Cheiranthus, Cobæa*, change similarly—others again still more slowly. Or this change may be partial, as in the spots on the petals of *Arnebia echioides*.

(*c*) Then we may distinguish the slow or the more quick change just preceding the death of the flower, as in *Weigelia* and *Cratægus*. This, which is perhaps the most marked colour-change to exhibit itself, is not the change of decay, which is one to brown amorphous masses; it illustrates the regular series of coloured products which under definite conditions are produced from the proteids of the cells. Such a change as that from white to red in *Weigelia* or *Cratægus* well accounts for the origin of the red varieties of these plants.

These colour-changes in single plants show us in the most extreme manner the possibilities of variation when there is but slight difference in the influences at work upon, and the conditions of, the cell-contents. Colour-change, less evidently from the same causes, yet essentially of the same nature, is also seen amongst the different individuals produced from seed in certain species, *e.g.*, species of *Anemone, Polygala, Anagallis*, &c., especially perhaps among annuals. It is evident that wherever mere conditions of environment do not produce these changes we have to look for a deeper cause in inherited character. It may be that some more subtle character than any we can yet distinguish is imparted to the different ovules of the same parent with its ever-varying protoplasm; and it is essential to remember how great this variation is, for it is shown, not less by flowers changing colour in a single day, than by the occasional production (as in *Centaurea Cyanus*, for instance) of two or three distinct colours on different branches from the same root-stock.

In any case, whatever may be the exact difference between the nature imparted to one or another ovule in the same capsule, we have seen sufficient to warrant the assertion that a more or less vigorous assimilation, a stronger or weaker constitution, and even environment directly, do much to influence colour, and this at times to a very marked extent.

When once we may reasonably account for colour-variation in individual seedlings, it is easy to see how, from the continuance of a particular environment, and also by the influence of the important factor selection, particular colours, or colours related to one another in a series, may become prevalent in natural groups, either among the species of a genus, the genera of a natural order, or, further still, among the natural orders of any alliance.

Part III.

Hypotheses accounting for Colour.

Having recognised the various colour-changes that commonly occur under conditions, the general effect of which upon the life-processes of the plant is more or less known, we must now acquaint ourselves with the various hypotheses which have been put forward to account for such phenomena. It is not necessary that we should know as to the exact manner in which vibrations of certain wave-lengths are returned to the eye from the various coloured fluids; this essentially is a question for the physicist.

A colour-change in certain inorganic bodies (therefore called "metachromes"), from red to violet as they contract, and from violet to red as they expand, or as they become more charged electrically with the negative element, was instanced in *Nature* some years ago by a physicist, as possibly throwing light on the phenomena of flower-colour. This was in connection with a paper on "The Seasonal Order of Colours in Flowers," also contributed to *Nature* by Dr Buchan, at that time president of this Society. Dr Buchan observed that of the British plants which flowered between

April and July the average order of the first appearance of the various colours was from blue, yellow, and white to red —the order of the spectrum colours. As at the time attention was called to the fact that light has little or no direct effect upon colour, it was thought that there was only a somewhat remarkable coincidence in these facts; but it may be possible that such data, being corroborated, on comparison with other floras, may indicate to us some indirect effect, following perhaps from the increased or diminished assimilation at one or another time of the year.

A couple of years after the date of publication of Dr Buchan's paper, there appeared, also in *Nature*, an article on "The Origin and Distribution of Organic Colour in Nature," in which, after opening with the statement that "colour throughout the realms of organic nature is a factor hitherto held to be the most capricious in its distribution, and the least amenable to any fixed law," the writer proceeds to show that it occurs in harmony with the "law of polarisation." He points out the prevalence of complementary colours, as in the red eye-speck with the green of *Volvox*, or in *Phæronema*, which is coloured orange, whilst above is the cærulean blue characteristic of the ocean in the abyssal depths which this organism inhabits. It is doubtful whether an explanation in such terms is any more satisfactory to us, than was the old truly metaphysical one which would have us see in colour and form harmony with "the law of beauty and design," framed to delight mankind.

Thanks to Charles Darwin (who, in this particular revivified the work of Sprengel), and thanks to Hermann Müller, we now know that flower-colour has its largest use in gratifying the bee, and that it cannot be spoken of as "wasting its sweetness" when there are around it countless insects to benefit by its attractiveness.

Thus a more real use for colour became evident, and natural selection was called in to explain its presence.

Now, allowing what we wish for natural selection, we have yet to ask ourselves, What is the origin of the variations in colour? how have earlier or later variations arisen which might be selected?

Most of those who have definitely dealt with the question of colour,—treating it professedly in a popular manner, as do

Mr Grant Allen and Dr J. E. Taylor in *Colour Sense*, in *Colours of Flowers*, and in *The Origin of Colour in Flowers*,—have too exclusively drawn attention to natural selection, referring only very inadequately to any physiological reasons for its appearance.

Now it is particularly necessary at the present time for us to refer to these physiological causes, but before treating the subject with some detail from this standpoint, it will perhaps be as well to quote from the writings of those who call our attention mainly to the influence of selection, so that we may see what is the effect of this great natural force, to the universal working of which Darwin has pre-eminently drawn our attention.

We have not to consider from the *Origin of Species*, nor from *Animals and Plants under Domestication*, that Darwin held natural selection as accountable alone for most observed variations; indeed, in one passage he speaks of evidence existing as to the presence of internal causes of variation which were not clearly enough evident to him for formulation; but often he uses expressions indicating that he believed variation to be indefinite, produced seemingly spontaneously, occurring as it were by chance. Indeed, it is evident that he often so spoke of chance or unaccountable variation, where nowadays with greater physiological knowledge we see at once the result of definite and easily recognisable life-processes.

That we are thus in a better position than ever before to deal with such variations as those of colour, is due also to the fact that, just as immediately after the publication of the *Origin of Species* biologists gave an almost disproportionate amount of attention to the action of natural selection, so with an opposite swing, as it were, of the pendulum, we are now ready to criticise natural selection and pay more attention to environment and the nature of the organism.

As a witness to the truth of this fact, we have Mr Herbert Spencer's two articles on "Factors in Organic Evolution," recently published.

That attention was disproportionately given to natural selection in the question of flower-colour is not wonderful, when Darwin was able to state in his great work (to what extent correctly we are now more able to judge), that "if insects had never existed on the face of the earth, our plants would never have been decked with beautiful colours," and "the beauty of fruits serves merely as a guide to birds and beasts, in order that the fruit may be devoured and the manured seeds dispersed." Also, Mr Herbert Spencer, whilst recognising the fact that "incipient floral colour is found among the Cryptogams, and in all young shoots of spring," adds that this "incipient floral colour would tend to fade away were it not intensified by the action of natural selection."

That such a colour would pass away, and that the intensifying is solely the work of selection, is pretty nearly the opinion of most, I believe; but we may fairly ask, Why should such colour tend to fade away? is it not, *à priori*, just as likely, nay probable, that once having originated, it will of itself tend to increase?

But leaving this consideration for the moment, let us try to explain what is the nature of selection in the case of colour.

It is at the present day more than ever demonstrable that certain plants are now so dependent on insects that they cannot live where such are absent, certain individualised flowers having become so adapted to companion insects, that without them they fail to set seed, and in consequence are limited absolutely in their distribution. This being so does not, however, imply that colour in flowers or fruits did not exist in considerable development before insects and fruit-eating animals existed; whilst also it is very evident that many flowers and fruits at present existing have attractive colours which no insect nor animal makes use of, or is able to make use of, as a result following from the selection or altered form of the inflorescence or of the flower, or the greater profusion of nectar, or the like.

In this connection Mr Russel Wallace says, "in flowers colour enables the insect to recognise the species, but no one has ever asserted that insects improve and alter the colour of flowers by their preference for certain varieties of colour irrespective of the honey and pollen produced." We are glad to find so definite a statement as this of Mr Wallace, for it is certain that the conception of a natural selection, as similar exactly, though not the same in degree, as the artificial selecting of the gardener, is more common than Mr Wallace supposes.

The following extract from Mr Grant Allen's *Colour Sense* illustrates the popular and, to the thoughtless, really misleading manner of treating the subject:—"Insects produce flowers; flowers produce insects. The colour-sense produces a taste for colour; the taste for colour produces brilliant butterflies and brilliant beetles. Birds and mammals produce fruits; fruits produce a taste for colour in birds and mammals. The taste for colour produces the external hues of humming birds, parrots, and monkeys; man's frugivorous ancestry produces in him a similar taste, and that taste produces in him the final result of human chromatic arts."

From this passage there is little information other than that there exists a remarkable interaction between plants and animals. With a similar attitude and manner, Dr J. E. Taylor speaks of "various colours held in reserve, to be brought out at a moment's notice." He instances the three-coloured varieties of *Anemone patens*, regarding the separation of the colours as a clear case in which nature has provided the plant with "three kinds of bait," just as a novice in the art of angling will be advised to provide himself with differently coloured flies.

Mr Wallace says, regarding sexual selection (and the passage is as applicable to the selection of flowers as of mates), "there is not one particle of evidence to show that minute differences in the colour of the same species are observed by insects, still less that such differences are so important to them as to lead to the rejection of a healthy and well-organised mate" (or individual).

Thus selection of flowers is dependent, not on minute variation in colour, but on such changes as we may expect would be appreciable in the size of the flower; in the grouping of several flowers together by shortening of the axis; and on sudden or conspicuous changes in colour, such as might be brought about by several of the factors of the plant's environment to which we have alluded. So in that part of the plant where characteristically there is evidenced a shortening of the axis, where reproduction prevails in contradistinction to vegetation, where also natural selection acts towards the production of the most individualised flowers, there we may expect the colour to be more intense, but we cannot say that the intensification is entirely the result of natural selection.

But as giving us the first hint of a cause of colour-change, we may refer again to the passage, written twenty-five years ago, by Mr Spencer in his *Principles of Biology*:—"Incipient floral colour existed among the Cryptogams and among all young shoots of spring. . . . . Failure of nutrition may be expected in parts the most remote from the roots, the ends of lateral axes are therefore the most probable points of fructification. . . . . But if these points at which nutrition is failing are also the points at which the colours inherited from lower types are likely to recur, then we may infer that the organs of fructification will not unfrequently coexist with such colours at the ends of such axes."

Here it will be seen that Mr Spencer accounts for the coexistence of colour and of flowers, but he fails to see the real physiological significance of their correlation. He attributes the appearance of colour at the ends of axes to heredity, not to lack of nutrition. We meet with various re-statements of this assertion of Spencer's by other writers, as, for example, in *Colour Sense*, where this passage occurs:—"We can hardly resist the inference that coloured whorls represent an intensification of the natural tint, such as is to be seen in spring shoots and in autumn leaves." Elsewhere, Mr Grant Allen notices more clearly than did Mr Spencer, as judged by the above extract, that the physiological condition of such highly coloured parts is that "they are expenders, not accumulators, of energy." We may take this statement, or we may take the statement by Vines, "that colouring matters are physiologically waste products," as roughly indicating the position we wish to emphasise, viz., that, in contrast to the green of chlorophyll, "colour" is to be regarded essentially as a product of a destructive metabolism (katabolism) in the cells in which it occurs.

Microscopic examination as to the actual conditions of the colour-containing cells has revealed to us, in the hands of Schimper, that not only does the colouring matter result as a product from the destruction of the protoplasm of the corpuscles, but that "its development, in what are to become chromoplasts, is frequently attended by a disappearance of the starch grains on, or in, the colourless corpuscle (leukoplasts) or chromoplasts from which the chloroplast arises."

But, in the vast majority of cases, although we may not, as here, have direct evidence of the destructive metabolism of the cell-contents, yet we are fairly entitled to judge from the circumstances of the cell's growth, whether the conditions are those favouring a destructive or a constructive metabolism (anabolism).

If we consider, in the first place, the conditions accompanying the most universal of all vegetable colour-changes, that of autumn; if we associate this colour-change with that of spring (in both these cases the colour appearing not only in trees, but in the smallest herbs, in flowering or flowerless plants); and, finally, if we associate with these two colour phenomena, that of reproduction, we may see at once an identity in the conditions which enable us to bring them all under a homologous explanation.

Colour "among young shoots of spring" is where carbon-assimilation has not yet commenced, but where the growth is at the expense of stores obtained in the previous season; colour in autumn—in the brilliant rosettes of *Sedum* or *Vaccinium*, in *Azalea* or *Acer* (which are as attractive to insects as any flower)—is where assimilation has ceased, and further elaboration or alteration of the cell-contents takes place; colour in the cells specialised for reproduction is also essentially produced where assimilation has given place to an opposite function, by which the young ova grow at the expense of materials elsewhere assimilated by the parent.

To give two excellent examples of this, we may notice the colour of the flowers of *Cupressus Lawsoniana* (seen at our last meeting), or the change of colour in mosses and many algæ when reproduction commences.

In regard to the formation of flowers among Phanerogams —if the nutrition be very abundant under conditions favouring carbon-assimilation—green and healthy leaves will be produced, as is in the experience of every gardener, often to the exclusion of flowers.

Professor A. Sachs (who was conducting a series of experiments with the view of determining the cause of flower-production) noticed that when plants were grown in yellow light there resulted a remarkable predominance of leaves, and a scarcity of flowers; whilst in white light the vegetation was less vigorous, and flowers very abundant. He was led to believe that the production of flowers was therefore favoured by the ultra-violet or invisible rays, which excited some unorganised ferment to take effect at the growing points. We may regard this conception of Professor Sachs as showing that when assimilation or the vegetative power is (practically) *nil*, then, as in the ultra-violet rays, elaboration of flowers or of colouring matters may take place. Whether or not the destruction of the protoplasm necessary to colour is aided by a "principle acting like a ferment," in however small quantities, remains to be seen—it would not alter the conditions, which would be indeed the more characteristically katabolic.

The gradations in form and colour from the assimilating leaves of the stem to the coloured non-assimilating and, at the same time, smaller bracts or leaves of the flower, is remarkably well seen in widely different plants—very clearly in the brilliant inflorescence of *Canna* and in *Epilobium*. Although all will agree that the small size of coloured bracts of the inflorescence is evidence of a checking of vegetation, and of the absence of assimilation in such parts, yet it is perhaps necessary to refer to the comparatively large size of most petals. It is found, however, that though petals are often large, they are formed of the most transitory substance, they are, in fact, so produced that they make a display at as little expense as possible. Undoubtedly if a flower normally $1\frac{1}{4}$ inch become $1\frac{1}{2}$ inch in diameter, we might suppose that such an exuberant growth would be liable to be influenced by the selective power of an insect's discerning eye. But we may call to mind the very large flower of the night-flowering *Cactus*, which is produced when assimilation, and what van Tieghem calls chloro-vaporisation, have ceased, and when the plant is therefore in a condition to pour its surplus elaborated material into its flower-bud. This growth, too, of the most elementary tissue is particularly evanescent, being suited only to last the night.

But not to confine our attention to these three chief conditions of colouring, nor to the correlation between flower-production and colour-production, we may notice that all the cases of colour-transition to which (in Part II.) I drew attention are capable of an homologous explanation in agreement with the explanation so far given of autumn and spring-colour and that of reproductive axes.

Thus colour appears, or undergoes change, in

(1) Parts farthest from the supply of nutrition, where there is either less material for elaboration, or where more elaboration has been undergone by the coloured substances.

Ex.—This increase in colouring may be seen in single inflorescences even, tips or whole rays of *Compositæ*, in *Silene*, &c. (Pellat); exterior of fruits, as apples; this especially on—

(2) The sunny sides, where the cells are exposed to influences which will quicken or increase the metabolic changes in the cell-contents; also indirectly seen in effects of light, heat, and soils.

Ex.—Exteriors of roots and seeds (turnip root).

(3) Where growth is evidently effected at the expense of stores of material, as in tubers and shoots from perennial root-stocks—*Asparagus, Lapageria.*

(4) Lower colours of these series of colour-products are produced in place of higher products, as in albinism, and blanching from weakened constitution, implying a less vigorous vitality, and less material assimilated which will give brilliantly coloured products.

(5) Colour in flowers during their growth when opening, or before death, occurs with greater or less brilliancy as the metabolism is hastened or not.

(6) Colour results directly from various chemical actions artificially or naturally observed, of which cases, that where it is a result of oxidation (reds from yellows, and deeper colours from the reds) affords the clearest evidence of destructive metabolism.

We must, of course, leave it to the chemist or the physicist to decide as to whether the later coloured products are in themselves more complex, or due to a splitting up into simpler substances; or whether, as suggested by Russel and Lapraik, the colour-changes observable in most cases with such different reagents are due to molecular rather than chemical alteration of the substance.

Certain striking correlations also afford us definite hints as to the cause of colour. Of these we may notice those cases in which a change of colour in the flower or fruit (due to some constitutional alteration) is indicated in an altered or similar shade in the colour of the ordinary leaves. This has been seen in black, red, or white fruited vines; in *Pernettya*, in *Erica*, *Cineraria*, *Chrysanthemum*, *Camellia*, and other plants. Darwin mentions several such correlations in *Variation of Animals and Plants under Domestication*; and it must be within the knowledge of all that skilled gardeners will, with remarkable precision, recognise different florists' varieties by the habit of growth, or by minute differences of leaf alone, and this among hundreds of the same genus.

Quite as striking is the correlation of secreting surfaces or honey glands, with more or less brilliancy of colour.

The secreting surface is essentially a more or less localised part of the plant, where not only is there no carbon-assimilation, but a surplus of somewhat altered nutritive material is being given out by the plant. The much coloured and viscid flower-stalk of *Lychnis viscaria* is also something more than the outcome of a happy variation with a deadly stickiness to repel insects, and a brilliant colour to attract them; the colour and the secretion are naturally linked together. So also the colour of honey guides, though perhaps as clearly subject to selection as any part of the plant, has a natural reason thus afforded for its presence, at any rate in its less specialised form.

Similarly, also, we see some reason for the presence of "spots of colour in the more highly modified parts," and for what has been called "compensation" in variation, as in the case of *Dianthus barbatus*, with its crowded, brilliantly coloured, transitory flowers mentioned by Dr Taylor.

It is not possible to mention this subject of the correlation of colour to other products of elaboration without referring to a most interesting passage from an article by Mr Russel Wallace, when offering objections to Mr Grant Allen's treatment of sexual selection. He says that, among certain groups of butterflies, Fritz Müller has discovered that there exists a sexual allurement of a peculiar odour given out by special patches of scales in individuals which are very brilliantly coloured. This fact, he remarks, "is a clear indication that colour is not a sexual allurement" (we might say, is not to be regarded only as a sexual allurement), "or we should find it most developed, not in conjunction with, but in the absence of, the attractive odour."

Other instances of the correlation of colour to size or vitality among animals as among plants, will suggest themselves to the biologist; for instance, in the male "stickleback" we recognise true and physiological significance in its indication of an exuberant vitality; for it has, no doubt, some purpose in indicating to the female the exceptional power of a would-be mate, just as in the spring "the freer crimson on the robin's breast" may be supposed to do likewise; but it was not because the female fish or bird liked colour *per se* that this was developed.

It is needless to refer in any detail to the evidence, which is overwhelming, in favour of a regular series of colours indicating progressive development, in such elaboration of further products. From the reactions of colouring matters. from the changes in the life-history of the individual and of the race, it is clear, as pointed out by Mr Grant Allen, that such a series from yellow to white, passing to red and blue, is a natural one. We do not need, however, to recognise that all the coloured whorls of flowers came from yellow stamens, for we have seen that green being the colour of vegetation, with its essential function of carbon-assimilation, yellow is but a stage to this, which may be given to any organ for a longer or shorter time as vegetation is checked; whilst white and red are also produced by its further or continuous checking; no considerations of morphological evolution affect the question.

We have thus a physiological meaning to give not alone for green, and for "colour" as opposed to green, but each colour, rightly considered, may have for each plant a special significance.

Darwin showed that the commonest variation of the Japanese *Chrysanthemum* was the production of yellow; in which doubtless the garden varieties reverted to a simpler colour more nearly like that of the chromoplast of their ancestors, than that resulting from the high art of the Japanese cultivator. Similarly, it would not be difficult to explain, in terms of increased or diminished possibilities of vegetation, the striking fact mentioned by Darwin of a double yellow hollyhock which, one year, suddenly turned into a pure single white kind, and in which subsequently a branch bearing the original double yellow flowers reappeared among the other branches.

Or, in conclusion, to take a yet more interesting case, it is recorded by Darwin in the same work,—*Variation under Domestication*,—that "white tubers of potato may be obtained from purple varieties by planting eyes which have so varied. A plant in Lancashire, of Kemp's potato, which is properly white, produced two tubers which were red. The red kind was propagated in the usual manner, and kept true to its new colour, and, being found a more productive variety, soon became known as "Taylor's Forty-fold."

Such examples as these last, and many of the preceding, should enable us to judge with increasing precision, although it may still be with indistinctness, as to the meaning of colour physiologically, not merely its meaning with relation to insects, the only part of the plant-environment to which it has so far been clearly shown to be related.

It will be seen that I have gathered together references to a considerable number of recent pamphlets, of which the main facts are incorporated in my paper; but as the list of papers includes all those which have been reviewed in English science reviews within the last ten years, it is probable that most if not all of importance, of later date than the papers mentioned in Professor Vines' *Lectures on Physiology*, will be included in the lists. They do not profess to be perfect reference lists to recent literature, they are essentially those from which this paper has been compiled.

In referring to some of this recent literature, it is very far indeed from my wish to undervalue any of those popular works mentioned, which have, in so excellent a manner, delighted a very large number of readers. I can only confess that, from the present standpoint, these works appear to me to have dealt very inadequately with causes of colour-variation, and to have given to the influence of selection by insects, the use of it, a somewhat undue prominence.

The fact that the present paper is an outcome of the one on "Floral Colour," written by me in conjunction with Mr Geddes, in which the influence of natural selection was depreciated, must be taken as an indication that the interest and criticism then aroused stimulated me to consider the question afresh and in more detail. This subsequent work has enabled me to see more clearly, in regard to colour, at once the immense power of selection, and the limits to its action. This I have attempted to bring out in this last part of my paper. It would not perhaps be incorrect to assert that next to the fact of evolution comes the fact of natural selection—more than any other realised within the century, to modify all our manners of learning, our thoughts, and our future. Yet, notwithstanding its importance, however we look at it, natural selection is only a selecting; having recognised its potency, we need to push back our inquiry, to find out as to the mystery of variation, as to those causes or tendencies which, when laid hold of by selection, and impressed by environment, have given to us progress and evolution of every advanced type, of even simpler organisms out of every organic structure.

Literature consulted on Plant-Colour.

1876. Ackroyd, "Metachromism," *Nature*, xiii. p. 298.
1886. Arnaud, "Leaf Colour," *Acad. de Sciences*, May 17, 1876; rev. *Eng. Mechanic*, xli. p. 508.
1885. Baccarini, "Flower Colours," *Ann. Inst. Bot. Roma*, ii., 1885; rev. *Jour. Roy. Mic. Soc. Lond.*, p. 268, 1886.
1872. Batalin, "Light," *Bot. Zeit.*, 1872.
Bennett, A. W., "Scent and Colour," *Pop. Sci. Rev.*, xiv. pp. 11 3125.
1879. Bonnier, "Flowers and Insects," *Bull. Soc. Bot. France*, xxvi. p. 68.
1880. Bonnier, "Arctic Flora," *Ann. Sc. Nat.*, t. x.; rev. *Bib. Bull. Soc. Bot. France*, xxix.
1880. Bonnier, "Green Flowers," *Bull. Soc. Bot. France*, xxvi. p. 249.
1880. Bonnier, "Distribution and Soil," *Bull. Soc. Bot. France*, xxvi. p. 20.
Bougler, G. S., "Scent and Colour," *Nature*, vol. xviii. p. 427; x. 620.
1876. Buchan, "Spring Flower Colours," *Trans. Bot. Soc. Edin.*, xii. p. 441.
1876. Buchan, "Spring Flower Colours," *Nature*, xiii. p. 249.
1880. Brown, "Vine Leaves, &c.," *Text-Book of Botany.*

Brun, "Colour in Algæ;" rev. *Bib. Bull. Soc. Bot. France*, xxvii.

1873. Chaubard, "Spectroscope," *Comptes Rendus*, lxxv. pp. 1836–9.

1886. Chmielewski, "Development of Chlorophyll," *Bot. Cent.* xxxi.; rev. *Jour. Roy. Mic. Soc. Lond.*, p. 982, 1887.

Comber, T., "Insects and Colour," *Nature*, vol. xi. p. 47, 1875.

1876. Costerus, "Seasonal Order," *Nature*, xiii. p. 427.

1886. Courchet, "Chromoleucites," *Bull. Soc. Bot. France*, xxxiii. p. 178; rev. *Jour. Roy. Mic. Soc. Lond.*, p. 256, 1887.

Darwin, *Variation in Animals and Plants under Domestication*, chap. x.

1880. Draper, "Spectroscopic," *Nature*, xxii. p. 29.

1880. D'Arbaumont, "Chlorophyll in Darkness," *Bull. Soc. Bot. France*, xxvii. p. 89.

1887. Engelmann, "Colours of Leaf;" rev. *Jour. Roy. Mic. Soc. Lond.*, p. 988, 1887.

1879. Flahault, "Light-Chlorophyll," *Bull. Soc. Bot. France*, xxvi. p. 249.

1879. Flahault, "Development," *Bull. Soc. Bot. France*, xxvi. p. 268.

1879. Flahault, "Arctic Flowers," *Bull. Soc. Bot. France*, xxvi. p. 346.

1879. Gautier, "Chemistry, Chlorophyll," *Comptes Rend.*, lxxxix. p. 861.

1884. Gardiner, "Tannins," *Camb. Philos. Proc.*, ix. p. 387.

1888. Geddes, "Variation and Selection," *Encyclop. Britannica.*

1885. Gilbert, "Chem. of Leaf Colours," *Brit. Assoc. Report*, 1885; rev. *Nature*, xxxiii.

1877. Godlewski, "Etiolation;" rev. *Jour. Roy. Mic. Soc. Lond.*, 1887.

1882. Grant Allen, *Colours of Flowers.*

1879. Grant Allen, *Colour Sense: its Origin and Development.*

1886. Hassack, "Colours of Leaves," *Bot. Central.*, xxvii.; rev. *Jour. Roy. Mic. Soc. Lond.*, p. 263, 1877.

1884. Hansen, "Chlorophyll in *Fucaceæ*," *Bot. Zeit.*, Number 41, October.

1884. Hansen, "Composition of Chlorophyll;" rev. *Nature*, xxx. p. 224.

1885. Hansen, "Colours of Flowers, &c.;" rev. *Eng. Mechanic*, vol. xli. p. 273.

1879. Hildebrandt, *Die Farber der Bluthen, &c.*, Leipzig, 1879.

1879. Hoppe-Seyler, "Chemistry," *Zeitsch. für Physiol. Chemie*, p. 336, 1879; *Nature*, xxii. p. 279.

1873. Kraus, "Chlorophyll Colours," *Sur Kenntniss der Chlorophyllfarbstoffe, &c.*; rev. *Nature*, viii. p. 202.
1886. Lange, "Acidity of Cell Sap;" rev. *Jour. Roy. Mic. Soc. Lond.*, p. 606, 1887.
1882. Lankester, "Chlorophyll Action," *Nature*, xxi. p. 587.
1885. Lindt, "*Neottia*, Pigments in;" rev. *Jour. Roy. Mic. Soc. Lond.*, p. 268, 1886.
1883. Marshall Ward, "Chloroplasts," &c., *Nature*, xxvii. p. 267.
1886. Martin and Thomas, "Autumn Colour;" rev. *Jour. Roy. Mic. Soc. Lond.*, p. 784, 1887.
Meehan, T., "Bees and Flowers," *Bull. Torrey Club*, vii. p. 66; *Gard. Chron.*, 1873, p. 949.
Meyer, "Chloroplasts," &c., *Biolog. Central.*, t. iv.
1882. Meyer, "Chloroplasts," &c., *Bot. Central.*, 1882; rev. *Nature*, xxxii. p. 343, and xxviii. p. 267.
1878. Mikosch, "Development," *Jour. Acad. Wiss. Wien*, lxxviii.; rev. *Jour. Roy. Mic. Soc. Lond.*, 1879, p. 592.
Mott, F. T., "Colour in Flowers not due to Insects," *Nature*, x. 503, and xi. p. 28, 1874.
1884. Müller, H., "Fertilisation of Flowers" (Eng. trans.), "Die Bedeuctung der Alpenblumen für die Blumentheorie," *Kosmos*, vii. pp. 276–287, 1880; *Nature*, xxi. p. 275, and xxii. p. 219.
1878. Pellat, "Environment, Climate," *Bull. Soc. Bot. France*, xxv.
1879. Petit, "Diatomine," *Bib. Bull. Soc. Bot. France*, xxvi. p. 225.
1887. Peyrout, "Spectroscopic;" rev. *Jour. Roy. Mic. Soc. Lond.*, 1887.
Phipson, "Palmella;" rev. *Bib. Bull. Soc. Bot. France*, xxvi. p. 138.
1885. Pringsheim, "Chlorophyll;" rev. *Jour. Roy. Mic. Soc. Lond.* 1880, p. 117.
1887. Pringsheim, "Chlorophyll," criticised by Vines in *Nature*, xxii. p. 85; also in *Annals of Botany*, Feb. 1888.
1881. Russel and Lapraik, "Spectroscopic," *Nature*, pp. 636–9.
1880. Sachsse, "Chemistry," *Bot. Central.*, 1880, p. 549; *Phytochem. Untersucht*, 1880; rev. *Jour. Roy. Mic. Soc. Loud.*, 1880, p. 825.
Sachs, Julius, "Colour of Flowers," *Text-Book of Botany*, Eng. edit., p. 675.
1886. Sachs, A., "Flower Production;" rev. *Jour. Roy. Mic. Soc. Lond.*, 1887, p. 616.

SARGNON, L., "Causes des vif colores que présentens les fleurs des hautes sommete alpines," *Comp. Rend. des Sciences*, pp. 297, 298, 1880; *Ann. Soc. Bot. Lyon*, viii., 1878; *Revue Internationale des Sciences*, pp. 450–65, May 1881.

1878. SAVILLE-KENT, "Colour in Nature," *Nature*, xviii. p. 523.

1882. SCHAARSCHMIDT, "Development;" rev. *Nature*, xxvi. p. 477.

1882. SCHIMPER, "Development," *Bot. Zeit.*; rev. *Nature*, xxviii.; rev. *Jour. Roy. Mic. Soc. Lond.*, 1886, p. 640.

1878. SCHNETZLER, "Colour of Flowers," *Bull. Soc. Vaud.*, xvii.; rev. *Jour. Roy. Mic. Soc. Lond.*, 1881, p. 270.

SCHNETZLER, "Borax Test;" rev. *Jour. Roy. Mic. Soc. Lond.*, 1878; *Les Mondes*, tom. liii. p. 158, 1880.

1884. SCHUNCK, "Chemistry," *Nature*, xxix. p. 277.

1885. SCHUNCK, "Chemistry," *Nature*, xxxii. p. 117.

1870. SORBY, "Foliage, Tints of," *Nature*, iv. p. 340.

SORBY, "Colours in Fungi," *Nature*, v. p. 298.

1876. SORBY, "Flowers in Dark," *Nature*, xiii.

1886. SVERINO, "*Aceras*, Purple of;" rev. *Jour. Roy. Mic. Soc. Lond.*, 1887.

1880. STAPF, "Environment," *Bib. Bull. Bot. Soc. France*, xxvi. p. 163.

1878. TAYLOR, J. E., *Flowers: Origin, Shapes, Colours, &c.*

1885. TIMIRIAZEFF, "Chlorophyll," *Nature*, xxxii. pp. 117, 342, and xxxiv. p. 52.

1885. TSCHIRCH, "Chlorophyll," *Bull. Deut. Bot. Gessel.*; rev. *Jour. Roy. Mic. Soc. Lond.*, 1887.

1886. VINES, *Lectures on Vegetable Physiology.*

1886. WOLHEIM, "Chemistry," *Biol. Central.*, 1886; rev. *Jour. Roy. Mic. Soc. Lond.*, 1886.

1879. WALLACE, A. RUSSEL, "Colour in Nature" (review of *Colour Sense*), *Nature*, xix. p. 501; "Colours of Animals and Plants," *Macmillan's Magazine.*

On the Leaves of Climbing Plants. By W. E. FOTHERGILL, M.A.

(Read 14th June 1888.)

Some time ago, while working at climbing plants in quite a different connection from the present, I noticed that the leaves of most of the plants I was handling were cordate, sagittate, hastate, and sometime peltate. After drawing up a few rough lists of orders where climbers occur, I became convinced that there must be some causal connection between the climbing habit and a large development of the basal portions of the leaves.

Accordingly, I went through the collections in the Edinburgh Herbarium, making, by aid of the "Genera Plantarum," lists of climbing plants in almost every order where they occur. In one column I placed those whose leaves were cordate, sagittate, or hastate, as I expected, and in another those not marked by this peculiarity. A glance down the column of exceptions in each order gave a clue to a rationale of the point, the apparently unfavourable cases as usual suggesting at the same time their own explanation and the basis for a general rule.

The salient feature of a climbing plant is, of course, the weakness of its stem. Whether this is the cause or the result of the climbing habit is, of course, beyond the present question.

External observation of the most typical plants in question showed that the stronger and stiffer the stem, the less marked was the basal development of the leaves. A series of sections confirmed the generalisation that *basal development varies inversely with the amount of strengthening tissue in the stem.* In some different specimens of ivy, for example, those with no large basal leaf-lobes had much more woody stems than those with markedly hastate leaves.

A large number of cases, however, contradicted the rule even as thus modified, and it was only on noticing that in all the cases where the stem was soft, and yet the leaves were not basally developed, they were sessile or on very short stalks. The *length of the petiole* then appeared as a second factor which is seen *to vary directly with the amount of basal development;* the longer the stalk, the more cordate or sagittate the leaf.

We can express these two modifications of the rule that climbing plants have basally developed leaves as follows:—Let b be the amount of basal development, s the amount of strengthening tissue in the supporting system, and p the length of the petiole, then $b \propto \frac{p}{s}$.

I must note here that, where leaves are compound or deeply divided, so many other complexities are introduced that it is almost impossible to use them for or against a theory of this kind; but in many cases, drawing a line round the points of leaflets gave an outline which fairly showed the distribution of the weight of the leaf, and this was usually affected by considerable development of the basal lobes.

Where the petiole is much used in climbing, the point of support of the leaf is raised so much as materially to alter the relations in question, so that I prefer to exclude such cases from the explanation I wish to suggest, which deals with the general aspect of the case as stated above.

Since the supporting system is one and the same throughout the plant, with the pliant and yielding stem of a climbing plant, we find also slight bending petioles which are unable to sustain much weight, especially if it is not favourably distributed. For optimum conditions of nutrition, a leaf must not hang down too much so as to catch the light, or bend its stalk so as to compress the conducting vascular system. Sessile or shortly stalked leaves will not suffer, nor will those of climbers, whose supporting system is stronger than usual; but where petioles are long, and share the weakness of a feeble supporting system, some compensation must be made by a favourable disposition of the weight to be borne. How then are the light petioles of weak climbing plants to stand erect and bear their leaves in an approximately horizontal position?

It is clear that great development of any one part of a lamina will alter the position of its centre of gravity. In an ovate leaf the centre of gravity is near the centre, in a cordate one it is near the insertion of the petiole.

Now, the moving of the centre of gravity of a lamina away from the apex towards the base lessens the bending strain on the petiole in two ways, or rather lessens the strain on the lower part where it springs from the stalk, and on the upper part where it passes into the lamina to become its midrib.

First, it brings the centre of gravity of the leaf nearer to the main axis, and so lessens the moment of the force exerted by the weight of the leaf about the point of insertion of the petiole in the axis. *Thus basal development of the leaves of* *climbing plants must greatly relieve the bending strain on the lower part of the petiole.*

Second, since basal development brings the centre of gravity of the lamina nearer the point of expansion of the petiole, there will be a much shorter distance between the point of support of the lamina and the point of action of its weight than otherwise would be the case. Thus a much slighter petiole will be able to keep the lamina approximately horizontal, if it be cordate, than if it be ovate. *Thus basal development of leaves must greatly relieve bending strain on the petiole at its point of expansion into the lamina.*

For these two reasons, then, I suppose the leaves of most climbing plants to be largely developed basally. Their petioles we may expect to be weak *a priori;* and we see that cordate and allied forms of leaves will exert less strain on these petioles than would other leaves, for the two purely physical reasons mentioned above.

Where the petiole is absent, there can be no strain on it, and this is simply the extreme case of a shortened petiole, so the shorter the petiole, the less marked is the basal development. Where the petiole is strong enough, it can also support a leaf of ordinary shape; but a long petiole, if not strong, must be helped by having the weight of the leaf brought —first, nearer the main axis, so reducing the strain at the insertion of the petiole in the axis; and, second, nearer the expansion of the petiole into the lamina, so lessening the strain at that point.

This little question appears to me deserving of the amount of trouble it has demanded. I have been unable, so far, to connect it with the question of cordation and peltation in general; for there are plenty of cordate and peltate leaves where neither *a priori* reasons nor actual examination shows weakness of supporting system, but I imagine that after eliminating the complexities of many basally developed leaves, other than those of climbing plants, the connection between the present point and the more general question may become visible.

Note.—A peculiarly pretty confirmation of the above view is given by the leaves of some Passifloræ, *e.g.*, *P. rubra* and *P. Vespertilio.* Here the centre of gravity is shifted towards the base of the leaf, not by largely developing the basal lobes, but by cutting off the apex, so that one gets a truncated or even depressed leaf apex.

Notes on New and Rare Marine Algæ, gathered in 1887.
By GEORGE WM. TRAILL.*

(Read 8th March 1888.)

1. *Chætomorpha cannabina*, Aresch. Identified by Professor Kjellman, of Upsala. New to Britain. July 1887.

Though *C. cannabina* is generally considered to be a fresh-water species (*vide* Crouan, *Florule du Finisterre*, p. 125, &c.), this habitat—the "Peerie Sea," Kirkwall—is salt water. It should be mentioned, however, that the "Peerie Sea" was formerly a fresh-water lake, separated from Kirkwall Bay by a narrow neck of land; and that, many years ago, in consequence of an attempt to drain it, the sea broke through, and has ever since regularly ebbed and flowed there.

2. *Rhodomela lycopodioides* (L.), Ag. Variety *β laxa*, Kjellman. This is identified by Professor Kjellman as his variety *β laxa*, which is new to Britain. I found it in pools at the Bay of Carness, due south from Hellyar Holm, Orkney, July 1887. It occurred sparingly.

3. *Vaucheria sphærospora*, Nordst.

Forma genuina, Nord., and
Forma dioica, Nord.

I forwarded these to Professor Nordstedt of Lund, who is the chief authority on this genus, and they were identified by him. He saw *antheridia* in connection with the *oögonium*; also single *oögonia*. Kirkwall and Scappa Bays, on mud covered by the sea at high tides only. July 1887.†

4. *Calliblepharis jubata* (Huds.). Extremely narrow form, *fide* Kjellman. Dredged in Kirkwall Bay, 6 fathoms. July 1887.

5. *Polysiphonia roseola* (Ag.), Aresch. Identified by Kjellman as young plants of *P. roseola*, and probably new to Britain. Crouan makes it a variety of *Polysiphonia urceo-*

* Mr Traill exhibited herbarium and microscopic specimens illustrative of his communication.

† [Since the above was written I have found this species at several places on the Dunbar coast in similar habitats. There were also *oögonia* and *antheridia* together. 16th August 1888.]

lata (Crouan, *Florule du Finisterre,* p. 156). Epiphytic on *Ulva latissima* in the "Peerie Sea," Kirkwall. July 1887.

6. *Lyngbya majuscula,* Harv. Associated with *Ulothrix flacca, Calothrix confervicola,* and *Sphacelaria cirrhosa.* Epiphytic on *Cladophora rupestris.* Corroborated by Holmes. Occurs at the General's Rocks near Granton, in pools near high-water mark. 26th August 1887. New to the Firth of Forth.

Note on Juncus alpinus, *Vill.* By F. Buchanan White, M.D., F.L.S., F.E.S.

(Read 9th February 1888.)

For some years past it has been suspected that *Juncus alpinus* was a member of the British Flora, on account of the existence of one or two herbarium specimens which probably (but *only* probably) belonged to that species. As one of these reputed examples came from Perthshire, the species had a special interest for me, and consequently I have been always keeping a lookout for it, and urging my friends to do the same. The search was all in vain, however, till one day in August last, when, wishing to see *Astragalus alpinus* growing in the Perthshire station where it was discovered by my friend Mr P. Neill Fraser, I came upon some rushes which, though immature, bore a suspicious resemblance to the long sought-for *Juncus alpinus.* Specimens of these I planted in the garden, where they ripened capsules, and proved my suspicions to be correct. (I may mention that I saw both the *Astragalus* and the *Oxytropis* in flower. The latter is *O. uralensis,* and not *O. campestris,** as suggested—from flowerless specimens—at a former meeting of the Society, but this has already been proved by Mr Brebner, who gave me specimens of each some years ago. It is very much to be hoped that the station for these rare plants will not become known to others than true botanists.)

* *O. campestris* is not uncommon near Loch Loch (7 or 8 miles distant from the *Astragalus alpinus* station), where it was discovered by Rev. J. Fergusson in 1887. In visiting its locality this season (1888) I found *Juncus alpinus* and *Kobresia caricina.*—F. B. W.

Shortly after finding these first specimens of *J. alpinus*, I got some rushes from my friend Mr J. Brebner, who was living in Glen Lochay, and with his usual kindness investigating the flora for me. Amongst these rushes were three stems of undoubted *J. alpinus*. Finally, on August 20, I found near Blair Athole a small bed of *J. alpinus* growing intermixed with *J. lamprocarpus*. Besides these three Perthshire stations, the plant was found—in September last—in a fourth locality, also near Blair Athole, by my friend the Rev. E. S. Marshall, whom I had told of the discovery. Mr Marshall, moreover, found the same species in Sutherlandshire, and it not improbably occurs, though perhaps locally, throughout the Scottish Highlands.

If thus, in one season, it has been found in comparatively so many places, how does it happen that *Juncus alpinus* has not been detected sooner? Probably because it requires a close examination to distinguish it from the nearly allied and very variable *J. lamprocarpus*.

This is pretty evident if, in the following record (from the *Report of the Botanical Record Club*, dated 1887, but just issued), the species is correctly determined: "87 Perth West. Croall. F. M. Webb. 'Moors near Gartur.' 'Near Ben Oss' (off Glen Falloch).—*Herb. Lees;* both sent as *lamprocarpus*, collected in 1875 and '79 respectively."

In the case of "critical" or obscure plants likely to occur in Britain, botanists would do well to familiarise themselves with the *facies* of the species to be looked for by the study of authentic foreign examples.

It is to be noted that this rush is not exclusively alpine, as the specific name would imply, but occurs also at low levels.

The specimens exhibited I have much pleasure in presenting to the Herbarium.

List of Plants which Flowered in the Rock Garden at the Royal Botanic Garden, Edinburgh, during 1887, *with Dates when First Flowers opened.* By R. LINDSAY, *Curator.*

January

3. Primula inflata.
18. Geum aureum.
    Helleborus abschasicus.
        niger, *var.* angustifolius.
        atrorubens.
26. Hepatica triloba, *var.* alba.
28. *var.* rubro-plena.
    Crocus Imperati.
    Dondia Epipactis.
    Primula acaulis.
        polyantha.
29. Hepatica angulosa.
    Aubrietia deltoides.
31. Hepatica triloba, *var.* rubra.
    Galanthus plicatus.
    Scilla præcox.
    Crocus suaveolens.
    Helleborus purpurascens.
        var. minor.

February

1. Galanthus Elwesii.
    Crocus annulatus.
    Primula acaulis, *var.* rubra.
4. Helleborus antiquorum.
        orientalis.
    Hepatica triloba, *var.* cærulea.
    Galanthus nivalis.
    Crocus Susianus.
5. Sieberi.
    Helleborus viridis.
        albicans, *var.* major.
14. Symplocarpus fœtidus.
    Saxifraga Burseriana.
19. Eranthis hyemalis.
    Leucoium carpaticum.
    Bulbocodium vernum.
    Scilla sibirica.

February

19. Cheiranthus Cheiri, *var.* "Golden Drop."
    Helleborus guttatus.
    Daphne Mezereum.
21. Cyclamen Coum, *var.* vernum.
    Colchicum crociflorum.
    Leucoium vernum.
24. Crocus sp.
    Galanthus Redoutei.
    Iris reticulata, *var.* Krelagei.
    Crocus biflorus.
    Aubrietia cœlestis.
    Crocus etruscus.
    Andromeda floribunda.
26. Crocus Olivieri.
    Saxifraga oppositifolia.
    Chionodoxa sardensis.
    Iris reticulata.
    Crocus vernus, *var.* albus.
    Rhododendron præcox.
    Saxifraga Rocheliana.
27. Arabis albida.
    Scilla bifolia, *var.* taurica.
28. Muscari lingulatum.
    Galanthus nivalis fl. pl.
    Saxifraga oppositifolia, *var.* alba.
    Doronicum caucasicum.
    Helleborus fœtidus.
    Draba Aizoon.

March

1. Saxifraga Burseriana, *var.* multiflora.
    Corydalis angustifolia.
    Saxifraga crassifolia.
    Primula Auricula.

March

2. Arabis procurrens.
   Primula denticulata.
   Mandragora vernalis.
   Corydalis cava.
   Saxifraga crassifolia, *var.*
3. Erica herbacea.
   var. alba.
4. Scilla bifolia, *var.* alba.
   Crocus tulipæflorus.
   Sisyrinchium grandiflorum.
   Veronica rupestris.
   Helleborus colchicus, *var.*
   Primula uralensis.
9. Saxifraga oppositifolia, *var.*
   Dentaria pentaphylla.
14. Narcissus minor.
16. Crocus vernus, *var.* niveus.
   Sisyrinchium grandiflorum, *var.* album.
   Narcissus Pseudo-Narcissus, *var.* Cambrica.
19. Chionodoxa Luciliæ.
   Saxifraga sancta.
   oppositifolia, *var.* pallida.
   Stracheyi.
   Anemone Pulsatilla.
   Primula marginata.
   Erythronium grandiflorum.
23. Saxifraga oppositifolia, *var.* aretioides.
   var. pyrenaica.
   var. grandiflora.
24. Puschkinia scilloides.
   Gagea lutea.
   Hepatica triloba, *var.* cæruleo-plena.
   Vinca minor, *var.* alba.
   Narcissus calathinus.
   Ribes sanguineum.
26. Muscari Szovitzianum.
   Corydalis solida.
   Erythronium Dens-canis.
   Primula denticulata pulcherrima.
   Saxifraga Burseriana, *var.* Boydii.

March

26. Pachystima Canbyi.
   Primula denticulata, *var.* purpurea.
   Orobus vernus.
   Crocus "Emperor."
28. Polygala Chamæbuxus.
   var. purpurea.
   Draba aizoides.
   Saxifraga biflora.
   Draba Mawii.
   Muscari botryoides.
29. Saxifraga retusa.
   var. bryoides.
   Erica mediterranea, *var.* minima.
31. Omphalodes verna.
   var. alba.
   Scilla bifolia.
   Muscari moschatum, *var.* majus.
   Aubrietia grandiflora.
   erubescens.
   Narcissus lobularis.
   Primula denticulata alba.

April

1. Draba altaica.
   Saxifraga cordifolia.
2. Dianthus "Marie Pere."
   Aubrietia Columnæ.
   Forsythia Fortunei.
4. Corbularia Graellsi.
   Adonis vernalis.
   Primula cashmiriana.
   Narcissus "Empress."
   Saxifraga sp. (Afghanistan).
   Soldanella montana, *var.* major.
5. Iberis petræa.
   Primula intermedia.
   Aubrietia Campbelli.
   Erica carnea.
7. Primula helvetica.
   Clusiana.
   Helleborus argutæfolius.
   Primula Peyritchii.
   Saxifraga hirta.

April

8. "Miss Hope's Daisy."
Omphalodes verna, *var.* marginata.
Carex Fraserii.
Anemone nemorosa.
Biota pyramidalis.
Narcissus Bulbocodium, *var.* minor.

9. Triteleia uniflora.
Narcissus "Emperor."
„ incomparabilis, *var.* giganteus, "Sir Watkin."
Lithospermum prostratum.
Rhododendron ciliatum.
Adoxa Moschatellina.

11. Soldanella montana.
Allium paradoxum.
Ornithogalum exscapum.
Potentilla alba.
Primula intermedia seedling.
Anemone nemorosa, *var.* Robinsoniana.
Pyrethrum Tchihatchewi.
Primula minima.
Vinca minor, *var.* fl. pl.
Aubrietia Columnæ, *var.* variegata.
Ornithogalum fimbriatum.
Hyoscyamus orientalis.

12. Primula decora.
Thomasini.
Thlaspi alpestre.
Pachysandra procumbens.
Narcissus rupicola.

13. Scilla lilio-hyacinthus.
Androsace filiformis.
Saxifraga Cymbalaria.
Corydalis nobilis.
Primula ciliata, *var.* purpurata.
Botryanthus atlanticus.

14. Orobus cyaneus.
Menziesia cærulea.
empetriformis.
Salix lanata.

April

15. Viola canina.
Muscari atlanticum.
Narcissus bicolor, *var.* Horsfieldi.
Erythronium giganteum, *var.* roseum.
Primula Wulfeniana.

16. frondosa.
Aubrietia Hendersonii.
tauricola.
Ranunculus Ficaria, *var.* fl. pl.
Salix repens.
Erica mediterranea, *var.* alba.
Vinca minor.
Saxifraga Wallacei.

18. Narcissus incomparabilis, *var.* plenus.
Saxifraga speciosa.
Draba ciliata.
Primula ciliata, *var.* Balfouri.
Podophyllum Emodi.
Erythronium giganteum.
Sanguinaria canadensis.
Primula Auricula, *var.* fl. pl.
Mahonia glumacea.
Androsace Laggeri.
Betula nana.
Rhododendron Chamæcistus.
Primula Reidii.
glabra.

19. Trillium grandiflorum.
Primula vulgaris calycantha.
Aubrietia conspicua.
Iberis superba.
Ranunculus auricomus.
Primula acaulis, *var.* platypetala.
Ranunculus Ficaria, *var.* alba.
Hutchinsia alpina.
Androsace carnea, *var.* eximea.
Narcissus bicolor, *var.* verus.
Hepatica americana.

20. Aubrietia purpurea, *var.* variegata.
Mooreana.

April

20. Pulmonaria saccharata.
    Andromeda tetragona.
    Phlox setacea.
    Cardamine trifolia.
    Phlox stellaris.
    Aubrietia Pinardi.
    Saxifraga tridentata.
22. Euphorbia myrsinites.
    Primula cortusoides.
23. Ulex europæus.
    Euphorbia Gmelini.
    Cardamine bellidifolia.
    Anemone nemorosa, *var.* plena.
    Epimedium violaceum.
    Muscari armeniacum.
    Arabis lucida.
    Ranunculus insignis.
    Saxifraga Lindsayana.
        pedatifida.
    Bryanthus erectus.
    Lamium maculatum, *var.* aureum.
    Cheiranthus Menziesii.
    Arabis lucida, *var.* variegata.
    Muscari botryoides, *var.* pallidum.
    Primula elatior "Bardfield Oxlip."
    Saxifraga flagellaris.
    Corbularia tenuifolia.
    Arum proboscideum.
    Mitella pentandra.
25. Euphorbia capitata.
    Myosotis dissitiflora, *var.* alba.
26. Tussilago alpina.
    Epimedium alpinum.
    Romanzoffia sitchensis.
    Doronicum Draytoniensis.
    Fritillaria montana.
    Prosartes Hookerii.
27. Narcissus pallidus, *var.* praecox.
    Saxifraga purpurascens.
28. Aristolochia pallida.
    Muscari Argæi.
    Arnebia echioides.

April

28. Hierochloe borealis.
    Bellis aucubæfolia.
    Petrocallis pyrenaica.
    Alyssum saxatile.
29. Ranunculus amplexicaulis.
    Primula involucrata.
    Orobus atropurpureus.
    Iberis corifolia.
30. Thlaspi prostrata.
    Hepatica acutiloba.
    Gentiana verna.
    Saxifraga tenella.
    Arenaria balearica.
    Pulmonaria auvernensis.
    Berberis Darwinii.
    Anemone alpina.
    Iberis sempervirens.

May

2. Ionopsidium acaule.
    Orobus flaccidus.
    Cortusa pubens.
    Saxifraga pulchella.
        Stansfieldii.
    Aubrietia Bougainvillea.
    Erysimum rupestre.
    Saxifraga nervosa.
    Loiseleuria procumbens.
    Veronica pectinata, *var.* rosea.
4. Trollius aconitifolius.
    Pyrus Maulei.
    Arctostaphylos Uva-Ursi.
    Oxalis corniculata, red *var.*
    Phlox nivalis.
    Silene acaulis exscapa.
    Saxifraga Rheii.
    Androsace villosa.
    Arabis procurrens, *var.* variegata.
5. Trichonema rosea.
    Schivereckia podolica.
    Phlox setacea, *var.* violacea.
        frondosa × P. Nelsonii.
    Lunaria biennis.
    Silene acaulis.
    Daphne Fioniana
    Arctostaphylos californica.

May

5. Aubrietia græca.
6. Ornithogalum sp.
Hutchinsia petræa.
Primula Muretiana.
Androsace coronopifolia.
Andromeda fastigiata.
Sedum canadense.
Scrophularia vernalis.
Paederota Zannichellii.
7. Salix reticulata.
Ranunculus pyrenæus.
Phlox aristata.
Tellima grandiflora.
Iberis alpina.
Scilla amœna.
Rhododendron Blandyanum. glaucum.
Saxifraga condensata.
Daphne Cneorum.
9. Camassia esculenta, *var.* alba.
Saxifraga corsicana.
Olearia Gunniana.
Rhodora canadensis.
Claytonia virginica.
Enkianthus himaliacus.
Andromeda polifolia, *var.* intermedia.
Corbularia nivalis.
Narcissus muticus.
Phlox Nelsonii.
Arabis Soyeri.
10. Anchusa sempervirens.
Actæa spicata, *var.* rubra.
Dielytra formosa.
Potentilla rupestris.
Draba gigas.
Primula Sieboldii.
Erythronium americanum.
Actæa spicata.
Claytonia perfoliata.
Cornus suecica.
Phlox frondosa.
Alchemilla vulgaris.
Globularia nudicaulis.
Skimmia japonica.
Erica australis, *var.* rosea.

May

10. Salix herbacea.
Dryas octopetala.
Salix sp.
Lychnis alpina.
Androsace Chamæjasme.
Saxifraga rotundifolia.
Erica hibernica.
11. Potentilla verna.
Camassia esculenta.
Vinca herbacea.
Primula Pedemontana.
12. Silene pusilla.
Valeriana montana.
Ajuga pyramidalis.
Anemone Popeana.
Dodecatheon Meadia, *var.* splendens.
Carex rupestris.
Polemonium Richardsonii.
Helonias bullata.
Saxifraga sp. (Switzerland).
affinis.
muscoides, *var.* purpurea.
cuspidata.
Asperula odorata.
Decaspora thymifolia.
Dielytra spectabilis.
Gentiana acaulis.
Polemonium cæruleum, *var.*
Gaultheria trichophylla.
Veronica repens.
13. Scilla parva.
Ulex europæus, *var.* flore pleno.
Iris ruthenica.
Valeriana saliunca.
Genista præcox.
Aubrietia croatica.
Cardamine pratensis.
Uvularia grandiflora.
Arabis petræa.
14. Saxifraga geranioides.
Leucoium æstivum.
Fritillaria montana, *var.* flore pleno.

May

14. Ranunculus gramineus.
Sieversia triflora.
Armeria maritima.
Androsace sarmentosa.
Saxifraga irrigua.
muscoides, *var.* atropurpurea.
repanda.
Delphinium nudicaule.
Coptis trifoliata.
Cytisus Ardoinii.
Tulipa pulchella.
15. Daphne collina.
16. Trollius caucasicus.
Gentiana pyrenaica.
Aquilegia vulgaris, *vars.*
Cytisus procumbens.
Vaccinium Vitis-Idæa.
Euphorbia amygdaloides, *var.* variegata.
Mertensia sibirica, *var.* alba.
Saxifraga hypnoides.
Vella Pseudo-cytisus.
Lamium Orvala.
Staphylea colchica.
Genista hispanica.
Ajuga orientalis.
Lychnis lapponica.
Phlox amœna.
Andromeda polifolia.
Stylophorum diphyllum.
Ranunculus radicans, *var.* flore pleno.
Saxifraga peltata.
Sturmiana.
Bucklandii.
umbrosa.
var. variegata.
Potentilla purpurea.
Trollius japonicus.
17. Viola tricolor.
Narcissus poeticus, *var.* major.
Ranunculus millefoliatus.
Vicia pyrenaica.
Cerinthe alpina.
Anemone alpina.

May

17. Erinus hispanicus.
Kernera saxatilis.
Oxalis corniculata.
Linaria alpina.
Fragaria vesca, *var.* muricata.
Saxifraga muscoides, *var.* pygmæa.
18. Erodium Reichardii.
Ranunculus uniflorus.
Phlox prostrata.
Alchemilla alpina.
Asarum canadense.
Potentilla alpestris.
repens.
Dodecatheon integrifolium.
Anemone alpina, *var.* sulphurea.
Ranunculus speciosus.
Saxifraga Stelleriana.
Geranium macrorhizum.
Phlox stolonifera.
Carex Vahlii.
Euphorbia sp.
Helianthemum amabile.
Saxifraga cuneifolia.
rupestris.
Silene maritima.
Saponaria ocymoides.
Viola odorata.
19. Potentilla reptans.
Polemonium reptans.
Uvularia sessilifolia.
Lysimachia nemorum.
Allium Pedemontanum.
Helianthemum polifolium.
Cercocarpus parvifolia.
Rubus arcticus.
Anthemis aizoon.
Mertensia sibirica.
Saxifraga Whitlavei.
21. Meconopsis cambrica.
Alyssum spinosum.
Alchemilla montana.
Primula Sieboldii, *var.* alba.
sikkimensis.
mollis.

May

21. Saxifraga pectinata.
    Aquilegia Stuartii.
    Reseda luteola.
    Primula obconica.
    Helicophyllum Albertii.
    Narcissus poeticus, *var.* longiflorus.
    Rhododendron lepidotum.
    Saxifraga serrata, *var.* hibernica.
        paradoxa.
    Iris cengialti.
    Sempervivum Reginæ-Amaliæ.
23. Pentstemon Menziesii.
    Saxifraga carinthiaca.
    Anemone narcissiflora.
    Arabis scopoliana.
    Potentilla lupinoides.
    Armeria canescens.
    Cardamine pratense, *var.* flore pleno.
    Hyacinthus amethystinus.
    Lychnis dioica.
        var. flore pleno.
    Papaver alpinum.
    Veronica Guthrieana.
    Sedum latifolium.
    Delphinium cashmirianum × D. cardinalis.
    Cheiranthus versicolor.
    Androsace lanuginosa, *var.* Leichtlinii.
    Scilla umbellata.
24. Sedum thymifolium.
    Convallaria majalis, *var.* plena.
    Smilacina racemosa.
    Valeriana pyrenaica.
    Saxifraga Geum.
        Aizoon, *var.* pectinatum.
    Polemonium humile.
    Geranium aconitifolium.
    Cardamine latifolia.
    Campanula alpina.
    Myosotis sylvatica.

May

25. Coronilla minima.
    Smilacina bifolia.
    Pentstemon procerum.
    Thalictrum formosum.
    Primula geraniifolia.
    Saxifraga notata.
        intacta, *var.* farinosa.
    Anthericum liliastrum.
    Anthemis montana.
    Bellis perennis, *var.* monstrosa.
    Linum acuminatum.
    Arenaria trinervia.
    Dianthus gelidus.
    Aster graminifolius.
    Ononis rotundifolia.
    Saxifraga lantoscana, *var.* superba.
    Androsace lanuginosa.
    Saxifraga M'Nabiana.
    Cheiranthus Marshallii.
    Armeria maritima, *var.* alba.
    Claytonia sibirica.
26. Saxifraga dentata.
        Koleutiana.
        cristata, *var.* hybrida.
    Chrysogonum virginianum.
    Anthyllis erinacea.
    Gnaphalium dioicum, *var.* roseum.
    Menziesia polifolia.
        var. alba.
    Saxifraga gracilis.
    Scilla verna.
    Erodium absinthifolium.
27. Arenaria stricta.
    Euphorbia spinosa.
    Genista pilosa.
    Saponaria ocymoides, *var.* splendens.
    Phlox verna.
    Achillea Clavennæ.
    Linum alpinum.
    Alyssum alpestre.
    Saxifraga capillaris.
        glacialis.

May

27. Dianthus deltoides.
    Arenaria purpurascens.
28. Fritillaria kamtschatica.
    Lychnis pyrenaica.
    Alchemilla alpina, *var.* conjuncta.
    Melittis melissophyllum.
    Convallaria majalis.
    Cornus canadensis.
    Berberis Jamesonii.
    Onosma taurica.
    Polemonium flavum.
30. Erinus alpinus.
    var. albus.
    Convallaria majalis, *var.* foliis-striatis.
    Geum minutum.
    Aquilegia glandulosa.
    Erodium Manescavii.
    Erigeron Roylei.
    Aquilegia Whitmanniana.
    Vella spinosa.
    Dianthus sp.
    Clintonia Andrewsiana.
    Dielytra speciosa.
    Iris tenax.
31. Fritillaria sp. (Sikkim).
    Gypsophila cerastioides.
    Scilla peruviana.
    Haberlea rhodopensis, *var.* robusta.
    Saxifraga Guthrieana.
    hieracifolia.
    longifolia.
    Tazetta.
    Anthericum Liliago.
    Carex vaginata.
    Helianthemum rosmarinifolium.
    Veronica pectinata.
    Pernettya angustifolia, *var.* speciosa.
    Rhodotypus kerrioides.
    Saxifraga Haworthii.
    Trollius asiaticus.
    Iris pumila, *var.*

May

31. Oxytropis uralensis.
    Saxifraga hederæfolia.
    Cotyledon.

June

1. Saxifraga hirsuta, *var.* minor.
    Melvillei.
    Geum, *var.* elegans.
    Prostii.
    Bucklandii.
    cristata.
    Tulipa cornuta.
    Helicophyllum Lehmanni.
    Trollius intermedius.
    Potentilla lanuginosa.
    Veronica prostrata, *var.* satureifolia.
    Thymus rotundifolius.
    Trollius europæus, *var.* albus.
    Primula capitata.
    Camassia tardiflora.
    Potentilla Tormentilla.
    Rhododendron ferrugineum.
    Sarothamnus Scoparius, *var.* pendulus.
    Globularia nana.
    Aquilegia californica, *var.* alba.
    Hippocrepis helvetica.
    Iris nudicaulis.
2. Aciphylla squarrosa.
    Hippocrepis comosa.
    Ranunculus monspeliensis.
    Achillea umbellata.
    Linaria Cymbalaria, *var.* maxima.
    hepaticæfolia.
    Saxifraga bronchialis.
    Calochortus cæruleus.
    Anemone coronaria.
    Arenaria montana.
    Achillea tomentosa.
    Helianthemum vulgare, *var.* "The Bride."
    Oxytropis cyanea.
    Erodium macrodenum.
    Buxus Handsworthensis.

June

2. Saxifraga islandica.
   ægilops.
   Pernettya mucronata, *var.* macrocarpa.
   Gypsophila prostrata.
3. Chelidonium majus.
   Centranthus ruber.
   Trifolium alpinum.
   Carex atrata.
   Rheum palmatum, *var.* Tanguticum.
   Helianthemum vulgare, *var.* "Royalty."
   Gnaphalium dioicum.
   Anthyllis montana.
   Saxifraga Portæ.
   Valeriana dioica.
   Saponaria ocymoides, *var.* Loderii.
   Horminum pyrenaicum.
   Ranunculus parnassifolius.
6. Veronica saxatilis.
   var. Grievei.
   Antennaria sericea.
   Achillea argentea.
   Geranium cinereum.
   Cerastium lanuginosum.
   Helianthemum vulgare, *var.* "Queen of Spring."
   Glechoma hederacea, *var.* variegata.
   Erigeron aurantiacum.
   Astragalus leontinus.
   Polemonium cæruleum.
   Veronica fruticulosa.
   Hieracium pilosellæforme.
   Orchis maculata.
   Pæonia tenuifolia, *var.* plena.
   Senecio pulcher.
   Trifolium repens.
   Baccharis patagonica.
   Cistus florentinus.
   Tolmiea Menziesii.
   Carex frigida.
   Delphinium Brunonianum.
   Aubrietia Leichtlini.

June

6. Heuchera sanguinea.
   Sedum olympicum.
   Hookerianum.
   oreganum.
   Potentilla fruticosa.
   Sieboldii.
   Anemone Polyanthes.
   Linaria anticaria.
   Festuca punctoria.
   Cortusa Mathiola.
   Cheiranthus alpinus.
   Phlox Nelsonii, *var.* "Vivid."
   Silene maritima, *var.* plena.
   Myosotis alpestris.
   Veronica prostrata.
   Ponæ.
   rupestris, *var.* nana.
7. Petrocoptis Lagascæ.
   Fragaria elatior, *var.* variegata.
   Chelidonium majus, *var.* laciniatum.
   Barbarea vulgaris, *var.* variegata.
   Lathyrus sp.
   Viscaria purpurea.
   Sedum buxifolium.
   Bupleurum Burserianum.
   Poa australis.
   Vaccinium Mortinia.
   Gaultheria carnea.
   Sempervivum Brauni.
   Helianthemum lavendulæfolium.
   Lychnis Viscaria.
   Sedum Rhodiola, *var.* ovatum.
   Ranunculus acris (straw-coloured var.).
8. Œnothera taraxacifolia.
   Pentstemon nitidum.
   Polemonium cæruleum, *var.* monstrosum.
   Dianthus fragrans.
   Edraianthus serpyllifolius.
   Robertia taraxacoides.

June

8. Hedysarum obscurum.
Sempervivum flagelliformis.
Sedum sp.
Vancouveria hexandra.
9. Potentilla "Wm. Bouilland."
Antennaria candida.
Veronica verbenacea.
Potentilla pedunculariș.
Dianthus cæsius.
Tofieldia americana.
Centaurea stricta.
Lithospermum purpureo-cæruleum.
Heuchera macrantha.
Erigeron alpinum.
Pentstemon confertum.
Achillea macrophylla.
Dianthus × Michael Foster.
Eurybia nitida.
10. Silene alpestris.
Anthyllis Vulneraria, *var.* rubra.
Wyethia mollis.
Eriophorum alpinum.
Saxifraga cæsia.
Phlox carolina.
Potentilla aurantiaca.
Aquilegia Chrysantha.
Helianthemum vulgare.
Papaver alpinum, *var.* album.
Veronica pinguifolia.
Cerastium grandiflorum.
Viscaria alba.
Pentstemon humilis.
Crucianella stylosa, *var.* coccinea.
Potentilla nivea.
Androsace foliosa.
Mimulus "Golden Beauty."
Alyssum Wiersbeckii.
Dianthus hybridus.
Plantago media.
11. Mimulus luteus.
Potentilla nevadensis.
Asphodelus ramosus.
Saxifraga Andrewsii.

June

11. Carex capillaris.
Homeria collina.
Libertia grandiflora.
Helianthemum vulgare, *var.* "Garibaldi."
Diphylleia cymosa.
Calceolaria Kellyana.
Silene Schafta.
Rhododendron ferrugineum, *var.* album.
Aquilegia canadensis.
Dactylis glomerata, *var.* aurea.
Potentilla "Dr André."
Antirrhinum Asarina.
Veronica urticifolia.
Polygonum sphærostachyum.
13. Potentilla purpurea, *var.* lutea fl. pl.
Silene ciliata.
Aster glabellus
Ramondia pyrenaica.
Arenaria laricifolia.
Astragalus hypoglottis, *var.* albus.
Dianthus alpinus.
Epilobium latifolium.
Geranium armenium.
Potentilla tridentata.
Cotoneaster thymifolia.
Saxifraga aspera.
Campanula collina.
Helianthemum vulgare, *var.* "Curiosity."
Discaria Toumatou.
Lupinus nootkatensis.
Ajuga genevensis.
Arum palæstinum.
Dalibardia repens.
Sedum asiaticum.
Dianthus alpinus × barbatus.
Helianthemum mutabile.
Saxifraga podophylla.
Iris chamæiris, *var.* purpurea.
14. Lindelofia spectabilis.
Scabiosa alpina.

June

14\. Plantago maritima.
Oxytropis diffusa.
Chrysobactron Hookerii.
Potentilla variabilis.
"Louis Van Houtte."
pyrenaica.
bifurca.
eriocarpa.
Helianthemum leptophyllum.
Veronica Colensoi.
Pyrethrum "Penelope."
Xanthoxylon fraxineum.
Teucrium longiflorum.
Dianthus Simsii.
Veronica Lyallii.
Cataractæ.
Rosa rugosa, *var.* alba.
Potentilla "Jane Salter."
Hemerocallis Dumortierii.

15\. Primula scotica.
Campanula carnica.
Orchis maculata, *var.* superba.
Dianthus caryophyllus.
Campanula turbinata.
Jasione montana.
Tofieldia carinthiaca.
Helianthemum vulgare, *var.* variegata.
Iberis jucunda.
Glossocomia clematidea.

16\. Calochortus albus.
Lotus corniculatus.
Actinella scaposa.
Dianthus neglectus.
Papaver alpinum, *var.* aurantiacum.
Saxifraga squarrosa.
Tradescantia virginica.
Genista sagittalis.
Oxytropis lactea.
Pyrethrum "Jupiter."
Dianthus superbus.
Mulgedium alpinum.
Astragalus vaginatus.
Alyssum repens.
Armeria setacea.

June

17\. Vicia villosa.
Linaria Cymbalaria.
Craspedia Richea.
Ajuga alpina.
Spiræa procumbens.
Potentilla "Alfred Salter."
Campanula Portenschlagiana.
Veronica taurica.
Colletia horrida.
Chamæbatia foliolosa.
Fettes Mount Pink.
Dianthus glacialis.
pungens.
Helianthemum aurantiacum, *var.* hyssopifolium.
Lonicera pyrenaica.

18\. Campanula gracilis.
Linaria sp.
Thalictrum orientale.
Bupleurum ranunculoides.
Epilobium longipes.
Hypoxis erecta.
Dianthus "Miss Paterson."
Aquilegia Trinityensis.
Polemonium cæruleum, *var.* variegatum.
Lychnis viscaria, *var.* splendens fl. pl.
Verbascum phœniceum.
Rhododendron ponticum, *var.* pumilum.
Helianthemum purpureum.
Digitalis purpurea.
Arnica montana.
Delphinium Belladonna.
Dianthus serotinus.
Armeria sp.
Dianthus campestris.
Lilium pyrenaicum, *var.* rubrum.
Spiræa Aruncus.
Sempervivum arachnoideum.
Helianthemum venustum.

20\. Asperula hirta.
Symphytum caucasicum.
Papaver orientale.

June

20. Anchusa sikkimensis.
Scutellaria alpina.
Silene muscipula.
Lilium Chaixii.
Iris cuprea.
Brodiæa congesta.
Geranium Endressii.
Aster alpina.
Anchusa incarnata.
Kalmia angustifolia.
Crambe cordifolia.
Campanula garganica.
Dianthus arboreus.
Fischeri.
Pentstemon speciosum.
Astragalus monspessulanus.
Rosa pyrenaica.

21. Lilium albanum.
Melissa grandiflora.
Allium MacNabianum.
Triteleia Murrayana.
Globularia Wilkommi.
Aster alpinus, *var.* albus.
Scutellaria altaica.
Lupinus polyphyllus.
Nardostachys Jatamansii.
Sisyrinchium mucronatum.
Veronica amplexicaulis.
Thymus serpyllum, *var.* hirsutum.
Campanula turbinata, *var.* alba.

22. Dianthus cruentus.
Erodium caruifolium.
Sedum spathulifolium.
Campanula abietina.
Pyrethrum "Acme."
Lilium carniolicum.
Sempervivum globiferum.
Eriogonum subumbellatum.
Campanula tenella.
Dianthus prostratus.
Campanula "G. F. Wilson."
Genista tinctoria.
Juncus effusus, *var.* spiralis.
Tropæolum polyphyllum.

June

22. Iris xiphioides.
Sempervivum Webbianum.
Dianthus pulchellus.
Acantholimon glumaceum.
Dianthus Atkinsonii.
Cistus formosus.
Sedum acre, *var.* elegans.
kamtschaticum.
Gaultheria Shallon.
Linum monogynum.
Stenactis speciosum.
Astragalus purpureus.
Asteriscus maritimus.
Helianthemum "Double Chocolate."
Phlomis fruticosa.
Agrostemma Flos-jovis.

23. Iris pallida.
Dianthus fimbriatus.
Sedum trifidum.
elegans.
acre.
Campanula pulla.
Antirrhinum majus.
Campanula pumila, *var.* alba.

24. Dioscorea villosa.
Aristolochia Clematitis.
Verbascum olympicum.
Senecio laxiflora.
Veronica anomala.
Delphinium "Cambridge."
Linnæa borealis.
Dianthus "Mrs Sinkins."
Campanula pulchella.
Rose "Paquerette."
"Paul's Single White."

25. Sempervivum hirtum.
Potentilla sericea.
marginata.
Veronica officinalis, *var.* rubra.
Erigeron purpureum.
Helianthemum Millerii.
Sedum oreganum.
Dianthus caucasicus.
liburnicus.

June

25. Sempervivum Boutignyanum.
Calceolaria plantaginea.
Dianthus Mussinii.
Campanula glomerata, *var.* dahurica.
azurea.

27. Potentilla "Vase d'Or."
Lotus corniculatus, *var.* flore pleno.
Morina Coulteriana.
Campanula grandis.
Sempervivum acuminatum.
Galium erectum.
Aconitum Napellus.
Spiræa discolor, *var.* dumosa.
Lepidium petræum.
Campanula persicifolia, *var.* coronata.
Sedum acre, *var.* aureum.
Campanula eximea.
Peliosanthes sp.
Lilium umbellatum, *var.* croceum punctatum.
colchicum.
Phyteuma Scheuchzerii.
Fragaria lucida.
Delphinium cashmirianum.

28. Potentilla "Chameleon."
Lithospermum graminifolium.
Scutellaria galericulata.
Hypericum empetrifolium.
Armeria alpina.
Thymus serpyllum, *var.* album.
Buddlea globosa.
Linum perenne, *var.* roseum.
Leontopodium alpinum.
Campanula barbata.
Sempervivum Pomellii.
Alyssum argenteum.
Helenium Bolanderi.
Cathcartia villosa.

30. Sempervivum fimbriatum.
calcareum.

June

30. Delphinium "Madame de Bihau."
Arenaria longifolia.
Dianthus "Little Gem."
Phlox ovata.
Anthyllis Vulneraria.
Buphthalmum salicifolium.
Erythræa aggregata.
Prunella Webbiana.
Teucrium sp.
Thymus Acinos.
Sidalcea candida.
Sempervivum auvernense.
Malva sylvestris.
Dianthus barbatus, *var.* pumilus.
Sempervivum Pittonii.
Campanula muralis, *var.* alba.
Epilobium sp.
Campanula Zoysii.
Lychnis vespertina, *var.* flore pleno.
Gaillardia maxima.

July

1. Genista aspathuloides.
Cacalia alpina.
Hypericum Burserii.
Acæna obovata.
Vicia onobrychioides.
Lathyrus latifolius, *var.* albus.
Centaurea montana.
Delphinium Menziesii.
Pyrethrum Willmottii.
Inula sp.
Helianthemum vulgare, *var.* "Yellow Standard."
var. "Double White."
Rheum officinale.
Dianthus tymphresteus.
Silene argoa.
Sedum Aizoon.
cruciatum.
grandiflorum.
virescens.

July

1. Sedum Andersonii, *var.* glaucum.
    hirsutum.
    pinnatum.
2. Asterocephalus caucasicus.
    Orobanche rubra.
    Thymus lanuginosus.
    Sempervivum Wulfenii.
    Lathyrus latifolius.
    Cocculus japonicus.
    Zigadenus elegans.
    Acæna adscendens.
    Geranium Wallichianum.
    Bupleurum Candollei.
    Acæna macrophylla.
    Sempervivum rupestre.
    atlanticum.
    Collomia coccinea.
    Campanula glomerata.
    Carduus nutans.
    Rosa polyantha "Mignonette."
    Veronica formosa.
    Silene purpurea, *var.* arborescens.
    Helianthemum Double Crimson.
3. Geranium Lamberti.
    Rumex sanguisorbæfolia.
    Narthecium americanum.
    Gaillardia grandiflora.
    Coronilla iberica.
    Rosa polyantha Jean Driver.
    Adenophora liliifolia.
4. Potentilla alchemilloides.
    Dianthus capitatus.
    Dracocephalum Ruprechtii.
    Dianthus cinnabarinus.
    Sedum neglectum.
    Dianthus "Napoleon III."
    Iberis gibraltarica.
5. Papaver somniferum.
    Erysimum latifolium.
    Baptisia australis.
    Eryngium asperifolium.
6. Spiræa palmata, *var.* purpurea.

July

6. Teucrium pyrenaicum.
    Convolvulus lineatus.
    Campanula nitida, *var.* alba.
    Prunella vulgaris.
    Gentiana Saponaria.
    Goodyera repens.
7. Erythræa diffusa.
    Thymus alpinus.
    Gentiana adscendens.
    Erigeron glabellum, *var.* molle.
    Erica cinerea, *var.* rubra.
    var. bicolor.
    var. longispica.
    var. purpurea.
    Veronica glauco-cærulea.
8. Sedum turgidum.
    Sempervivum triste.
    Veronica Traversii.
    Lilium Kramerii.
    Silene chloræfolia, *var.* swertifolia.
    Wulfenia Amherstiana.
    Lilium canadense.
    Agrostemma Coronaria.
    Tropæolum majus.
9. Santolina incana.
    Campanula Tymonsii.
    Onopordon Acanthium.
    Funkia albo-marginata.
    Calliprora flava.
    Milla laxa.
    Saponaria cæspitosa.
    Senecio speciosus.
    Lathyrus tuberosus.
    Orchis foliosa.
    Ononis arvensis.
    Campanula turbinata, *var* Grievei.
    Hypericum elegans.
    Helianthemum pictum plenum.
    Cyananthus lobatus.
    Sempervivum Delassiœi.
    Mentha Requienii.
    Geranium sanguineum.

July

11. Lychnis Haageana.
Sempervivum tectorum.
Spiræa palmata.
Erigeron eriocarpum.
Prunella pyrenaica.
Lysimachia verticillata.
Œnothera odorata.
Milla longipes.
Collomia grandiflora.
Linaria genistæfolia.
Anemone rivularis.
Sedum brevifolium, *var.* Pottsii.
Sempervivum californicum.
Campanula Waldsteiniana.
12. Malva moschata.
var. alba.
Micromeria piperella.
Spiræa bullata.
Œnothera riparia.
Rosa polyantha "Perle d'Or."
Aquilegia pyrenaica.
Erica stricta.
Dracocephalum stramineum.
Thymus serpyllum, *var.* borealis.
14. Chelone barbata, *var.* Torreyii.
Centaurea procumbens.
Astilbe japonica.
Teucrium aureum.
Bupleurum orbiculare.
Meconopsis Wallichii.
Erica ramulosa.
Mackiana.
Sedum spurium, *var.* album.
Gentiana septemfida.
15. Achillea Ptarmica.
Wulfenia carinthiaca.
Saxifraga fimbriata.
Dracocephalum arguinensis.
Plantago montana.
Veronica corymbosa.
var. variegata.
maritima, *var.* alba.

July

16. Epilobium Fleisheri.
Gentiana ornata.
Rose, Paul's Single Crimson.
Dianthus Seguieri.
Gentiana Fortunei.
Chrysanthemum tripteris.
Anthemis tinctoria, *var.* discoidea.
Lilium dalmaticum, *var.* Leichtlinii.
superbum, *var.* pardalinum.
18. Calendula officinalis.
Parietaria officinalis.
Stobæa purpurea.
Scabiosa Webbiana.
Lilium dalmaticum, *var.* dark purple.
Œnothera Youngii.
Hypericum pulchrum.
Veronica incisa.
Calandrinia umbellata.
Funkia japonica.
Polygonum affine.
Campanula macrantha, *var.* alba.
Linaria origanifolia.
Arum tenuifolium.
19. Scabiosa lucida.
Campanula glomerata, *var.* flore pleno.
Gentiana Burseri.
20. cruciata.
Campanula sarmatica.
Phlox glaberrima.
Gentiana tibetica.
Campanula Hostii, *var.* alba.
Thymus micans.
Dianthus sylvestris, *var.* albus.
Campanula carpatica, *var.* alba.
cervicaria.
macrantha.
pelviformis.

July

21. Gentiana septemfida, *var.* cordifolia.
Thymus striatus.
Statice minima.
Sempervivum pseudo-arachnoideum.
Lobelia Paxtonii.
Cassinia fulvida.

23. Coreopsis lanceolata.
Statice incana.
Saxifraga propaginea.
Betonica orientalis.
Inula ensifolia.
Thymus comosum.
Campanula isophylla, *var.* alba.
Helenium pumilum.
Onopordon horridum.
Sedum monregalense.
Dianthus deltoides, *var.* albus.
Leucanthemum arcticum.
Epilobium brachycarpum.
Linaria vulgaris, *var.* Peloria.
Helianthus multiflorus.
Veronica telephifolia.
Arnica Chamissonis.
Spiræa palmata, *var.* alba.

25. Pterocephalus Parnassi.
Gentiana Wallichii.
Polygonum vaccinifolium.
Ophelia sp.
Androsace commutata.
Cyclamen europæum.

26. Lilium auratum.
Umbilicus sempervivum.
Sedum cæruleum.
Sempervivum acuminatum, *var.* nigrum.
Coronilla varia, *var.* minor.

27. Lychnis Chalcedonica, *var.* plena.
Rosa polyantha Anna Marie De Montrave.
Campanula Hay-lodgensis.
isophylla.
fragilis.

July

28. Apargia autumnalis.
Mazus pumilio.
Lavandula spica.
Veronica spicata, *var.* laxa.

30. Campanula floribunda.
Astilbe rivularis.
Sempervivum Neildrechii.
Gypsophila repens.
Campanula nitida.
Olearia Haastii.
Michauxia campanuloides.
Scabiosa succisa, *var.* alba.

August

1. Calluna vulgaris, *var.* tomentosa.
Veratrum Maackii.
Veronica parviflora.
Calluna vulgaris, *var.* Serlii.
Erica Watsonii.
Echinops Ritro.
Rosa viridiflora.

2. Orobanche elatior.
Ligularia Hodgsonii.

3. Veronica spicata.
Platycodon grandiflorum.
Hypericum tomentosum.
Statice Dodartii.
Fuchsia magellanica.
Carnation "Souvenir de la Malmaison."
Alstrœmeria aurea.

5. Calluna vulgaris, *var.* Foxii.
Plantago abnormal, *var.*
Colchicum autumnale.
Statice Gangentiana.
Molinia cærulea, *var.* variegata.

8. Lythrum virgatum.
Gypsophila paniculata.
Spiræa Bumaldæ.

9. Clematis Jackmani.

10. Centaurea alpina.
Pyrethrum "Brutus."
Hypericum patulum.
Calluna vulgaris, *var.* pygmæa.

August
10. Sedum dasyphyllum, *var.* oblongifolium.
Monarda Kalmiana.
Montbretia Pottsii.
12. Symphiandra pendula.
13. Hydrangea paniculata, *var.* grandiflora.
Scabiosa gramuntia.
Polygonum cuspidatum.
Yucca filamentosa.
Allium glaucum.
15. Parnassia nubicola.
Hypericum pyramidatum.
Erica vagans, *var.* alba minor.
Digitalis ferruginea.
17. Colchicum autumnale, *var.* verum.
var. album.
Scabiosa agrestis.
Colchicum autumnale, *var.* pallidum.
var. striatum.
Anemone japonica, *var.* alba.
Lilium tigrinum.
Colchicum autumnale, *var.* variegatum.
Zauschneria californica.
23. Erica vagans.
Gentiana asclepiadea, *var.* alba.
Veronica longifolia, *var.* subsessilis.
Aster sikkimensis.
24. Funkia lanceolata.
Teucrium Scorodonia, *var.* crispum.
Galium rubrum.
26. Epilobium obcordatum.
Sedum populifolium.
Dianthus Knappei.
Potentilla formosa.
Cyclamen hederæfolium.
var. album.
29. Veronica incana.
Lobelia fulgens.

August
29. Calluna vulgaris, *var.* fl. pl.
var. Alportii.
Monarda didyma.
Aster spectabilis.
31. Coreopsis verticillata.
Micromeria Douglasii.
Pratia littoralis.

September
3. Gladiolus purpureo-auratus.
Oxalis lobata.
Geranium polyanthes.
Erica Tetralix, *var.* Lawsoniana.
Pentstemon Lobbii.
Gladiolus Saundersii.
Colchicum speciosum.
7. *var.* rubrum.
Hypericum nepalense.
Erica cinerea, *var.* spicata alba.
10. Kniphofia nobilis.
Crocus speciosus.
Campanula Rainerii.
Gypsophila Rokojecka.
13. Colchicum maximum.
14. Crocus nudiflorus.
Colchicum autumnale, *var.* plenum.
var. albo-plenum.
Erica ciliaris.
Crocus Shrundri.
24. Lepidium graminifolium.
Saponaria officinalis, *var.* plena.
Montbretia crocosmæflora.
28. Sedum cordifolium.
japonicum.
Braunii.
Crocus medius.
Sedum sp.
Crocus pulchellus.
29. Chelone Lyonii.
Anemone japonica

October
3. Crocus asturicus.
Vitis humulifolia.

October
6. Sedum spectabile.
12. Teucrium flavum.
    Kniphofia Uvaria.
    Ianthe bugulifolia.
18. Sedum maximum.
    latifolium.
    Tricyrtis australis.
    Helleborus niger.
22. Aster longifolius.
    Polygonum capitatum.
    Aconitum californicum.
26. Tricyrtis hirta.

October
26. Aster sp.
29. Helleborus altifolius.

November
9. Parochetus communis.
12. Sternbergia lutea.
15. Gynerium argenteum.
17. Plumbago Larpentæ.
    Schizostylis coccinea.
    Jasminum nudiflorum.

December
28. Tussilago fragrans.

Number which Flowered each Month during 1887.

January,	19	August,	73
February,	45	September,	31
March,	65	October,	16
April,	159	November,	6
May,	326	December,	1
June,	432		
July,	235	Total,	1408

Report on Temperatures and Open-Air Vegetation at the Royal Botanic Garden, Edinburgh, from July 1887 *to June* 1888. By ROBERT LINDSAY, *Curator of the Garden.*

July 1887.—All outdoor vegetation suffered severely from the excessive drought which prevailed during the month of July. There were frequent showers of rain during the month, but the ground had become so thoroughly parched that very little benefit was derived therefrom. The day temperature was frequently above 80°, the highest being 89°, on the 9th, and the lowest 66°, on the 31st. The highest night temperature was 62°, on the 3rd, and the lowest 35°, on the 6th. Many trees and shrubs had their growth arrested. Herbaceous plants were dwarf, but continued to flower freely. Annuals and bedding plants suffered least of all from the drought. On the Rock Garden 235 species and varieties came into flower during July, as against 282 during the corresponding month last year.

August.—During this month the heat and drought which characterised the previous months were continued well into the middle of the month, after which time the weather became cooler, and showers of rain more frequent. The greatest difficulty was experienced in keeping alpine and herbaceous plants alive through the long-continued drought. Leaves of trees were already turning yellow, and artificial watering appeared to do more harm than good. It was interesting to observe how well some plants were capable of resisting drought. A few which seemed to enjoy it were *Zauschneria californica*, *Epilobium obcordatum*, *Phygelius capensis*, *Escallonias*, and *Ceanothus*, all of which were finer flowered than usual. The highest day temperature was 83°, which occurred on the 28th, and the lowest was 62°, on the 17th. The lowest night temperature was 37°, which occurred on the 22nd, and the highest 56°, on the 6th. There were twenty-one dry days. On the Rock Garden seventy-three species came into flower during August, as against eighty-six during last August.

September.—This month was, on the whole, favourable, a good supply of rain fell during the first week ; all danger from drought was now at an end. Occasional heavy showers occurred at intervals during the remainder of the month, but at no time was the rainfall in excess. There were nineteen dry days. The first frost this season took place on the night of the 27th, when the thermometer registered 32°. On the 8th, 13th, and 18th, 36° were registered respectively. The highest day temperature was 73°, on the 1st, and the lowest 54°, on the 14th.

Deciduous trees and shrubs shed their leaves early ; Elm, Lime, and Lilac were among the first to become denuded. Autumn tints were less interesting than usual on most trees, an exception being *Pavia flava*, the foliage of which attained a rich golden hue, and continued for a considerable time without a leaf falling. Many plants made a second growth, and instances of abnormal flowering were pretty frequent. A fairly good crop of seeds of herbaceous plants was secured in excellent condition. On the Rock Garden thirty-one species of plants came into flower.

October.—The weather was on the average cold and dry The thermometer was at or below the freezing point on nine nights, indicating collectively 31° of frost (while in October last year the thermometer just reached the freezing point on one night). The lowest readings were—on the 12th, 24°; 15th, 28°; 22nd, 25°; 24th, 27°; 25th, 29°. The lowest day temperature was 42°, on the 24th, and the highest 65°, on the 3rd. There were twenty-one dry days during the month. Dahlias and other tender bedding plants were cut down by frost on the 12th; the flowers of *Anemone japonica* and its varieties were injured at the same date. *Kniphofia Uvaria* and *nobilis* flowered exceedingly well, and were very brilliant throughout the month, as were also the various species of Aster, or Michaelmas Daisies, Chrysanthemum, *Helianthus*, *Rudbeckia*, and other Compositæ. Fruit was most abundant on *Pyrus Aria* and *latifolia*, *Cotoneaster frigida* and *microphylla*, Walnut, and Holly; while Yew, Thorn, Elder, and Snowberry produced moderate crops. Hardy Rhododendrons, Azaleas, and other Ericaceous plants are finely set with flower-buds, as was to be expected from the thorough ripening the wood has undergone during an exceptionally dry and warm summer. Fine effects from autumnal tints were produced by the common Beech; *Azalea pontica*, *Ampelopsis*, and *Liquidambar* had also well coloured leaves. *Biota*, *Cryptomeria*, and other Conifers assumed their characteristic brown winter tinge early in the month. On the Rock Garden, although a considerable number of plants were still in blossom, only sixteen opened their first flowers during October.

The total number of species and varieties which have flowered on the Rock Garden since January 1 is 1401. At the same date last year 1165 had flowered.

November.—During the month the thermometer was at or below freezing point on twelve occasions, indicating collectively 49° of frost, as against 17° for the corresponding month last year. The lowest reading was registered on the 15th, viz., 23°, or 9° of frost; other low readings occurred—on the 16th, 24°, and on the 24th, 29th, and 30th, 25° was registered respectively. The highest morning readings were—on the 1st, 43°; 2nd, 44°; 7th, 44°; 8th, 45°; 26th, 49°. The lowest day temperature was 34°, on the 29th, and the highest 53°, on the 26th. The weather was very changeable and unsettled throughout the month. Rain or sleet fell more or less on sixteen days; no serious storms were experienced, and very little snow having fallen, outdoor work was not much interfered with. During the first week of the month the few remaining leaves of deciduous trees and shrubs were all cleared off. Outdoor vegetation is now, as nearly as possible, in a dormant condition. Few plants are in flower in good condition, with the exception of *Jasminum nudiflorum*, *Helleborus altifolius*, *Schizostylis coccinea*, *Sternbergia lutea*, and the winter flowering variety of *Daphne Mezereum.* Berry-bearing plants, particularly Yew and Holly, are fast becoming stripped of their berries by birds—much earlier in the season than usual, although the ground has been fairly open. The past season has probably rendered the berries more palatable as food to the birds than they usually are, at all events they are disappearing so rapidly that in a short time very few will be left.

The following plants came into flower on the Rock Garden, viz.:—*Parochætus communis*, *Gynerium argenteum*, *Sternbergia lutea*, *Plumbago Larpentæ.*

A good many stray blossoms are still to be seen on such plants as *Lithospermum prostratum*, *Veronica rupestris*, various Aubrietias, Heaths, and Wallflowers. In the absence of very severe frost, late flowers of these varieties are usually to be had at this season.

December.—The thermometer was at or below the freezing point on twenty-four occasions during the month, indicating collectively 132° of frost for the month, as against 174° for the corresponding month of 1886. The lowest readings occurred on the 10th, 22°; 11th, 21°; 25th, 20°; 27th, 22°; 31st, 22°. The lowest day temperature was 30°, on the 11th, and the highest 52°, on the 3rd. Rain, sleet, or snow fell more or less on thirteen days. Only one plant came into flower on the Rock Garden during December, viz., *Tussilago fragrans.* The total number of species and well marked varieties which have thus flowered during the past year, amounts to 1408 as against 1165 for the preceding year. A record has been kept showing the date when each plant was first observed in flower. The largest number came into flower during the months of May and June, viz., 326 and 432 respectively.

January.—The weather of January has again been unusually mild for the season. Vegetation is considerably in advance of what it was at the same date last year, early though it was. Frost was registered on fourteen mornings, indicating collectively 67° of frost for the month, as against 91° for the corresponding month last year. The lowest readings of the thermometer occurred on the 3rd, 27°; 19th, 20°; 20th, 24°; 28th, 24°; 29th, 20°. The lowest day temperature was 31°, which occurred on the 19th, and the highest 59°, on the 9th. On six days throughout the month the maximum temperature reached 50°. The rainfall was very light. Snow fell heavily on the 2nd, and slight falls took place during the last four days of the month. On the Rock Garden twenty-four species and varieties came into flower.

Of the forty plants whose dates of flowering are annually recorded to the Society, the following came into flower:—*Tussilago fragrans,* December 28 (1887); *Dondia Epipactis,* January 5; *Corylus Avellana,* January 25; *Galanthus nivalis* and *Crocus susianus,* January 26; *Galanthus plicatus* and *Scilla præcox,* January 26; *S. sibirica,* January 30.

February.—The past month has been exceedingly wintry. Frost was registered on twenty-three mornings, indicating collectively 121° for the month, as against 76° for the corresponding month last year. The lowest readings of the thermometer were on the mornings of the 12th, when the glass fell to 18°; 13th, 23°; 15th, 24°; 16th, 9°; 17th, 21°. The lowest day temperature was 34°, on the 24th, and the highest was 52°, on the 8th of the month. Snow began to fall on the 12th. On the 13th there was a fall of about 5 inches, and renewed falls more or less heavy occurred at intervals till the end of the month. Vegetation, which had started rather early in consequence of the mildness of the previous month, received a decided check. This has been beneficial rather than otherwise, in the present case, the amount of snow which had fallen having preserved plants from injury. Various half-hardy plants are, as yet, uninjured in the open ground. The following spring plants annually recorded came into flower, viz.:—

Rhododendron atrovirens,	Feb. 3	Nordmannia cordifolia,	Feb. 11
Leucoium vernum,	„ 4	Bulbocodium vernum,	„ 22
Arabis albida,	„ 6	Daphne Mezereum,	„ 22
Symplocarpus fœtidus,	„ 8	Crocus vernus,	„ 23
Tussilago alba,	„ 9	Iris reticulata,	„ 23

On the Rock Garden twenty-nine plants came into flower during the month, as against forty-five during February 1887. The finest in blossom were:—*Muscari lingulatum*, *Iris histrio*, *I. reticulata*, *Leucoium carpaticum*, *Galanthus Elwesii*, *G. plicatus*, and *G. Redoutei*, *Chionodoxa sardensis*, *Colchicum crociflorum*, *Crocus Imperati*, *C. annulatus*, and *C. Sieberi*, *Erica herbacea* and *E. herbacea alba*, *Hepatica triloba*, single and double varieties.

March.—This month was wintry in the extreme. Vegetation has made scarcely any progress. Outdoor work was seriously interrupted, much more so than during any month this winter. The thermometer was at or below the freezing point on twenty-three mornings, indicating 131° of frost collectively, as against 100° registered on eighteen mornings during the corresponding month last year. The lowest readings occurred on the 5th, 22°; 17th, 21°; 21st, 22°; 26th, 22°; 28th, 20°. The day temperature varied very much. On the 8th the thermometer reached 59°, while on the 15th it did not exceed 30°. On the Rock Garden sixty-four species came into bloom during March. Of the forty spring flowering plants, whose dates of flowering are annually recorded to the Society, the following eleven came into flower, viz.:—*Sisyrinchium grandiflorum*, *Scilla bifolia alba*, *Mandragora officinalis*, and *Scilla bifolia taurica*, on March 8; *Sisyrinchium grandiflorum album*, March 13; *Narcissus pumilus*, March 17; *Scilla bifolia*, March 19; *Omphalodes verna*, March 23; *Draba aizoides*, March 30; *Orobus vernus* and *Erythronium Dens-canis*, March 31.

April.—Vegetation made very slow progress throughout the month, frequent sharp frosts and cold easterly winds having prevented any rapid growth from taking place. Many deciduous trees and shrubs were still in their winter condition at the end of the month. Hardy herbaceous plants are also behind their usual time of flowering. No appreciable injury has been observed from these late spring frosts except this retardation of growth. The thermometer fell below the freezing point on eleven occasions; the lowest readings were registered on the 1st, 5th, 7th, 8th, and 9th of the month, when the glass fell to 25°, 26°, 26°, 25°, and 22° respectively. The lowest day temperature for April was 42°, which took place on the 23rd, and the highest day temperature was 64°, on the 17th of the month. The total amount of frost for the month is the same as for April last year, viz., 58°.

The collective amount of frost registered this season up to the end of April, is 589°, as against 520° for the same period last year. The following is the distribution for each month:—October, 31°; November, 49°; December, 132°; January, 67°; February, 121°; March, 131°; April, 58°. The lowest point reached this season was 9° Fahr., or 23° of frost, which occurred on February 16.

On the Rock Garden 137 species and varieties of plants came into flower during the month, being twenty-two less than for last April. Amongst the most conspicuous were:—

Androsace Laggerii.
Aubrietia Leichtlini, *var.*
,, Hendersoni.
Anemone fulgens.
,, Robinsoniana.
,, Pulsatilla.
Dentaria pentaphylla.
,, triphylla.
Daphne Blagayana.
Corbularia Graelsi.
Erythronium giganteum.
,, roseum.
,, Nuttallianum.
Gentiana verna æstiva.
Narcissus Bulbocodium.
,, bicolor and vars.
Narcissus Eystettensis.
,, incomparabilis and vars.
,, rupicola.
,, triandrus.
Petrocallis pyrenaica.
Polygala Chamæbuxus.
,, purpurea.
Primula ciliata purpurata.
,, decora.
,, mistassinica.
,, cashmiriana.
Soldanella montana.
Trillium grandiflorum.
Tulipa pulchella, &c.

Of the forty spring flowering plants annually recorded to show their periods of flowering, nine came into flower, thus completing the list for the thirty-eighth year.

No.	Name of Plants.	First Flowers opened.		
		1886.	1887.	1888.
1	Adonis vernalis, . .	April 3	March 29	April 16
2	Arabis albida, . . .	March 4	Feb. 27	Feb. 6
3	Aubrietia grandiflora, .	April 6	March 19	April 14
4	Bulbocodium vernum, .	Feb. 27	Feb. 19	Feb. 22
5	Corydalis solida, . .	April 6	March 26	April 6
6	Corylus Avellana, . .	Feb. 10	Jan. 26	Jan. 25
7	Crocus Susianus, . .	Feb. 12	Feb. 4	Jan. 26
8	,, vernus, . . .	March 17	Feb. 17	Feb. 23
9	Daphne Mezereum, . .	March 22	Feb. 5	Feb. 22
10	Dondia Epipactis, . .	Dec. 30 1885.	Jan. 13	Jan. 5
11	Draba aizoides, . . .	March 31	March 28	March 30
12	Eranthis hyemalis, . .	Feb. 10	Feb. 4	Feb. 8
13	Erythronium Dens-canis, .	March 26	March 19	March 31
14	Fritillaria imperialis, .	April 25	May 4	April 29
15	Galanthus nivalis, . .	Feb. 9	Jan. 27	Jan. 26
16	,, plicatus, . .	Feb. 9	Jan. 31	Jan. 26
17	Hyoscyamus Scopolia, .	April 3	March 23	April 13
18	Iris reticulata, . . .	March 20	Feb. 26	Feb. 23
19	Leucoium vernum, . .	Feb. 17	Feb. 14	Feb. 4
20	Mandragora officinalis, .	April 3	March 2	March 8
21	Narcissus Pseudo-Narcissus,	April 6	March 23	April 3
22	,, pumilus, . .	March 25	March 14	March 17
23	Nordmannia cordifolia, .	March 20	Feb. 18	Feb. 11
24	Omphalodes verna, . .	April 3	Feb. 28	March 23
25	Orobus vernus, . . .	March 28	March 6	March 31
26	Rhododendron atrovirens, .	March 23	Feb. 17	Feb. 3
27	,, Nobleanum,	April 4	Feb. 26	April 13
28	Ribes sanguineum, . .	April 8	March 23	April 10
29	Scilla bifolia, . . .	March 19	March 2	March 19
30	,, ,, alba, . .	March 21	March 4	March 8
31	,, præcox, . . .	Feb. 13	Feb. 16	Jan. 26
32	,, sibirica, . . .	Feb. 17	Feb. 19	Jan. 30
33	,, taurica, . . .	March 20	Feb. 27	March 8
34	Sisyrinchium grandiflorum,	March 21	March 4	March 8
35	,, album, .	March 21	March 8	March 13
36	Symphytum caucasicum, .	April 20	April 10	April 18
37	Symplocarpus fœtidus, .	March 23	Feb. 14	Feb. 8
38	Tussilago alba, . . .	Feb. 10	Feb. 3	Feb. 9
39	,, fragrans, . .	Feb. 6	Jan. 19	Dec. 28 1887.
40	,, nivea, . .	April 3	April 4	April 10

May.—The month was, generally, dry and cold, with easterly wind. The thermometer was six times at or below the freezing point during the month, indicating collectively 5° of frost, as against 12° during last May. The lowest readings were—on the 3rd, 32°; 9th, 31°; 10th, 32°; 11th, 29°; 12th, 31°; 29th, 32°. The lowest day temperature was 54°, on the 4th of the month, and the highest 70°, on the 17th. The foliage of most of the ordinary forest and ornamental trees and shrubs came rapidly forward, and notwithstanding the backward kind of weather experienced, fine luxuriant leaves have been developed. Those which have already flowered, such as Horse Chestnut, Lilac, Azaleas of sorts, Magnolias, and the various species of Pyrus and Prunus, have been considerably above the average in this respect. The profuse manner in which the many varieties of Holly have flowered is very remarkable. Herbaceous plants are generally late in flowering, but promise to be fine later on. The Rock Garden was very attractive during the month from the large number of plants in blossom; 367 species and varieties came into flower during May, while a large proportion of those which began to flower during the previous month were still in good condition. Among the best of those which opened in May were:—

Andromeda fastigiata, Androsace Hookeriana, A. villosa, Anemone alpina, A. a. sulphurea, A. narcissiflora, A. polyanthes, Anthemis Aizoon, Anthyllis erinacea, Arnebia echioides, Atragene alpina, Bryanthus erectus, Corbularia tenuifolia, Corydalis nobilis, Cytisus Ardoinii, C. decumbens, Daphne Cneorum, D. collinum, Dianthus glacialis, Dracocephalum grandiflorum, Enkianthus himalaicus, Erinus alpinus, Erythronium americanum, Gentiana verna, Iris cengialti, Pentstemon Menziesii, Primula farinosa, P. Olgæ, P. Reidi, P. sikkimensis, Ranunculus amplexicaulis, R. anemonoides, R. insignis, R. pyrenæus, Rhododendron lepidotum, Silene acaulis, S. pusillus, Trifolium uniflorum.

June.—The month was unusually cold and disagreeable, in marked contrast to that of last year. Easterly winds were almost of daily occurrence. No frost was registered during the month at the Garden, but in various districts of Scotland several degrees occurred, and much damage has been done thereby. The lowest night temperature recorded at the Garden was 35°, which took place on the 1st of the month; other low readings were registered—on the 3rd, 37°; 4th, 37°; 11th, 38°; 14th, 36°. The lowest day temperature was 42°, on the 2nd, and the highest 72°, on the 17th. Notwithstanding the cold backward nature of weather experienced, trees and shrubs generally have seldom been seen in finer condition; both foliage and flower have been decidedly above the average. Variegated forms of *Taxus, Biota, Retinospora,* and other Conifers have developed unusually bright and finely coloured foliage, affording a pleasant contrast to the dark green leaves produced by the typical species. This is not the least remarkable feature of this abnormally cold summer, seeing that variegated plants, as a rule, require abundance of heat and sunshine to enable them to colour well. The fine warm summer and autumn of last year has doubtless had much to do with their present satisfactory condition.

Annuals and other plants which depend entirely on the present season's growth for their wellbeing are in a backward condition, and unless a change of weather takes place soon, will be a total failure.

Alpine and herbaceous plants, though somewhat late, are flowering freely, and owing to their not having suffered from drought this season, their period of flowering has been prolonged. On the Rock Garden 430 species and varieties came into flower during June, making a total of 1052 since January 1, as against 1048 for the same period last year. Amongst the most conspicuous were:—*Achillea Clusiana, Aciphylla squarrosa, Allium M'Leani, Anemone palmata, Aster diplostephioides, Aquilegia glandulosa, Aubrietia Leichtlini, Campanula abietina, C. Allioni, Chamæbatia foliolosa, Clintonia Andrewsiana, Coronilla iberica, Cypripedium spectabile, Delphinium nudicaule, D. cashmirianum × cardinale, Dianthus alpinus, D. gelidus, D. superbus, Dryas Drummondi, Edraianthus pumilio, E. serpyllifolius, Epilobium latifolium, Gentiana pyrenaica, G. Weschniakowi, Heuchera sanguinea, Ianthe bugulifolia, Linaria origanifolia, Leontopodium alpinum, Lychnis viscaria splendens fl. pl., Lonicera pyrenaica, Myosotis alpestris, Nardostachys Jatamansi, Onosma taurica, Orchis maculata superba, Oxytropis uralensis, Patrinia nudicaulis, Pentstemon Lewisi, Polygonum sphærostachyum, Ranunculus parnassifolius, Saponaria cæspitosa, Saxifraga pyramidalis, Scilla peruviana, Vaccinium Mortinia, Vancouveria hexandra, Veronica amplexicaulis, V. anomala, V. Colensoi, V. Hulkeana, V. vernicosa.*

OBITUARY NOTICES OF DECEASED FELLOWS.

Sir WALTER ELLIOT of Wolfelee. By Hugh Cleghorn, M.D.

(Read 8th December 1887.)

We have to record with great regret the death of Sir W. Elliot, a former President of this Society, which occurred at Wolfelee on 1st March 1887, at the venerable age of 84 years. A notice would have appeared sooner, but considerable time was needed to collect the leading facts of his long and useful life, since any account of his career must tell of eminent public services and scientific work of a varied and remarkable kind. He was one of the few survivors of a group of distinguished Indian administrators and linguists who, in the first half of this century, laid the foundation of Oriental learning in British India. Such men were Sir W. Jones-Colebrook, H. H. Wilson-Prinsep, Max Müller, Sir Monier Williams, Reinhold Rost, and, I may add, Sir W. Muir, the honoured Principal of our University.

Sir Walter was so widely known for his acquaintance with ancient literature, coins, sculptures, and zoology, that his botanical work might easily escape attention. In fact, various notices of the subject of this memoir have appeared written by zoologists, antiquaries, and ethnologists, who have dilated upon his varied and extensive attainments.* Walter Elliot was born in Edinburgh in 1803, son of James Elliot of Wolfelee, a junior branch of the old Border family Elliot of Lariston. His early education was under a private tutor at home and in Cumberland. Afterwards he went to a school near Doncaster, and then to Haileybury College, which he left with distinction in 1821, to take up his appointment in the East India Company's Civil Service at Madras.

He served in the Southern Mahratta country from 1821 to 1833, when he returned to England by the Red Sea. In 1826 and 1828 he had personal meetings with Mountstuart Elphinstone and Sir John Malcolm, then Governor of Bombay. At the insurrection of Kittur his superintending officer, Thackeray, father of the novelist, was killed, and he was taken prisoner, and detained several weeks in peril of his life. During his long public career he kept a diary, and

* *Nature*, April 7 (W. T. Blandford); *Linn. Soc. Proc.* (P. Sladen); *Indian Antiquary; Roy. Asiatic Soc. Proc.* (Sir A. J. Arbuthnot).

one learns from it with how much eagerness he studied the natural history of the Province. His observations appeared in 1839 in the *Madras Journal of Science.* "The Catalogue of the Mammalia found in the South Mahratta Country" is often referred to by naturalists and sportsmen. The habits of the animals were described, and measurements of each were made by himself.

In 1836 he returned to India as private secretary to Lord Elphinstone, then Governor of Madras, and the remainder of his service was spent in that Presidency. At the same time he held the appointment of Translator to Government in the Canarese language. On Lord Elphinstone's retirement in 1842, he became member of the Board of Revenue till 1845, when he was sent on special duty to the Northern Circars, then in an unsettled state.

Sir Walter printed at Madras in 1859 the *Flora Andhrica,* or plants of the Northern Circars, a work of much value on the Telugu districts, containing the vernacular and botanical names in native and English characters.

After his return from India Sir Walter submitted a paper at the Edinburgh meeting of the British Association in 1871, on the advantage of systematic co-operation among provincial natural history societies, so as to make their observations available to naturalists. He stated that while the number of societies was considerable, their operations were limited, and hence that benefit which might be secured did not issue. He believed there was a general desire for co-operation between the members of different natural history societies, and while he was not prepared to suggest a means by which this might be secured, he would be glad to hear what members had to say (see in full *Trans. Bot. Soc. Edin.,* 1871). It was greatly owing to this paper and the discussion which followed that the union of local natural history societies was eventually effected.

In biology he took a keen interest, and was a frequent contributor to not a few journals which deal with his favourite researches. A chronological list of his scientific papers is appended to this notice. All these researches contain the results of accurate observations carefully recorded.

In 1885 an important work was published by him, being vol. iii. pt. 2, of the International *Numismata Orientalia,* Coins of Southern India. The most interesting fact is that, being quite blind, he revised the proofs, &c., by the ear, and described many of the coins by the touch.

Since this notice was read, it occurred to some friends that a memorial tablet should be erected within the Parish Church of Hobkirk, and the following epitaph was drawn up by Colonel Henry Yule, C.B. :—

THIS MONUMENT IS ERECTED BY FRIENDS.

To the Honoured Memory

OF

SIR WALTER ELLIOT OF WOLFELEE,

K.C.S.I., LL.D., F.R.S., ETC.,

Who was for forty Years a Member of the Civil Service at MADRAS,
and during the last five held a Seat in the Council of that Presidency.
Able, Trusted, and Distinguished in the Service of the State,
He was yet more Eminent for the immense Compass and Fruitfulness
of his Research
in Fields of Study so various and so rarely combined
as the Archæology and the Natural History
of the INDIAN PENINSULA.
His Work in the Collection, the Decipherment, and the Elucidation
of ancient Hindu Inscriptions in sundry Languages
Has formed a chief Element in the Recovery of the History of the
Territories in which he laboured;
His Rescue of the precious Marbles of AMRAVATI,
which now line the great Staircase of the BRITISH MUSEUM,
brought to Light one of the most wonderful Monuments
of ancient INDIAN Art and Religion;
His Treatise on the Coins of SOUTHERN INDIA,
based on the indefatigable Research of many Years,
but finally elaborated at the Age of Eighty-two, when he was
entirely bereaved of Sight,
presents a rare and memorable Example
of undismayed and successful Struggle with Difficulties
which might well have seemed overwhelming;
His numerous Contributions to Scientific Journals, bearing on the
Ethnology, the Zoology, the Ornithology, the Agriculture, and the
Vegetation of the same Regions, testify at once to the Width of his
intellectual Interests, and the Accuracy of his Observation.

For twenty-four years after his return from the East, he dwelt in his native county and on his paternal estate, honoured and beloved; efficiently fulfilling all the duties of a country gentleman; recognised by all as a devout Christian man, of singularly sweet and equable temper, of generous and kindly hospitality, and of unfailing patience under the blindness which tried so severely a man of his varied tastes and active mind; and furnishing to all an example of qualities which, if they were more common, would make this a better and a happier world.

BORN 16TH JANUARY 1803: DIED AT WOLFELEE 1ST MARCH 1887.

Scientific Papers contributed by Sir Walter Elliot to Transactions of Societies, Journals, &c.

1. Account of the *Poma sodomitica*, or Dead Sea Apples [1835], *Entom. Soc. Trans.*, ii. 1837–40, pp. 14–17.
2. A Catalogue of the Species of Mammalia found in the Southern Mahratta Country, with their synonyms in the native languages in use there, *Madras Jour.*, x., 1839, pp. 92–108, 207–233.
3. Description of a new Species of *Naja*, or Cobra di Capello, *Madras Jour.*, x., 1840, pp. 39–41.
4. Note on the Species of *Naja* (*N. vittata*), described, page 39, *Madras Jour.*, xi., 1840, pp. 390–393.
5. On *Bos Gaurus*, *Jour. Asiatic Soc.*, x., 1841, pp. 579–580.
6. Description of a new Species of Terrestrial *Planaria* (*P. lunata*), *Madras Jour.*, xv., 1848, pp. 162–167.
7. On the Farinaceous Grains and the various Kinds of Pulse used in Southern India, *Edin. New Phil. Jour.*, xvi., 1862, pp. 1–25 ; *Edin. Bot. Soc. Trans.*, vii., 1863, pp. 276–300.
8. On *Euphysetes simus*, *Ann. Mag. Nat. Hist.*, xix., 1867, pp. 372, 373.
9. On the Habits of the Indian Rock-Snake (*Python molurus*), *Brit. Assoc. Reports*, xl., 1870 (sect.), p. 115.
10. Address on the Progress of Botanical Science [1870], *Edin. Bot. Soc. Trans.*, xi., 1873, pp. 1–41.
11. On a Goshawk killed at Minto, and other Raptorial Birds, *Proc. Berwickshire Nat. Field Club*, vol. vi.
12. Rarer Birds of the Hawick District, *Proc. Ber. Nat. Field Club*, vol. vii.
13. Some Account of the Plague of Field Mice in the Border Farms in 1876–77, with Observations on the Genus *Arvicola* in general, *Proc. Ber. Nat. Field Club*, vol. viii.
14. Notes on the Indian Bustard (*Eupodotis Edwardsii*), *Proc. Zool. Soc.*, 1880.
15. On the Representation and Co-operation of Naturalists' Clubs, *Proc. Ber. Nat. Field Club*, vol. ix.

Besides the above, he contributed many articles on Ethnology and allied subjects to various scientific journals, chiefly Asiatic.

Professor Asa Gray. By Andrew Taylor.

(Read 10th May 1888.)

We are called again to remove from the list of our Foreign Honorary Fellows one who, like several of his European *confrères* previously deleted from our roll of honour, founded a great national botanic garden, with herbarium and library, and who, too, was known in both continents as an academic teacher, as well as the author of popular text-books. Asa Gray died on 30th January 1888, at the ripe age of 78, in Cambridge, Mass., after a lingering paralytic attack. As he had previously requested, a choir of boys sang, in the University chapel at his funeral, stanzas in meet accord with his long-known devout Christian practice. The closing verse may indicate their import:—

> "Thy light upon our evening pour,
> So may our souls no sunset see;
> But death to us an open door
> To an eternal morning be."

Dr Gray had, at recurrent intervals, visited European Botanic Gardens, our own included, in the prosecution of his life-work. His striking individuality,—a thin, wiry figure, brimming over even in old age with cheerful energy for work,—had impressed botanists of the Old World as much as those of America. So, when the telegraph flashed the news of his departure, a wave of profound sympathy spread amongst his brother scientists to her who had been a help-meet in his home and work for forty years.

Born in Paris, Oneida Co., N.Y., in 1810, Gray for a while assisted in his father's tannery. The perusal of the article "Botany," in Brewster's *Edinburgh Encyclopedia,* incited the youth to cease feeding the bark-mill in order to study medicine, which, like many a similar tyro desirous of an "open sesame" to the natural sciences, he never practised. At twenty he obtained the friendship of Professor John Torrey of New York, and became his assistant in 1833, thus early entering on his special botanical career. For a while curator of the Lyceum of Natural History, New York, he became Fisher Professor of Natural History at Harvard

College, Cambridge, in 1842, at the same time tenanting the official residence attached to the curatorship of the College Botanical Gardens, the only considerable addition to the establishment since its foundation in 1805. But Gray was to alter all this in the forty and more busy years spent in the grounds, or in the study subsequently added to the old house, the windows of which looked out on the beds of his favourite order Compositæ, and through which you were almost sure to see him working at botanical specimens at the central table, or bending over a microscope at the east window. A fire-proof building containing the library of 8000 volumes and pamphlets, as well as an herbarium, specially ranking beside the great European establishments of like character, as unique in its illustrations of the flora of America and Japan, were amongst the most prominent results of this wiry single-handed worker with no idle moments. Gray's investigations in systematic botany were chalked out for him by Professor John Torrey. The *Flora of North America*, vols. i., ii., published in 1838, was his first effort as an author. His herbarium studies embraced this flora from the Arctic islands to Mexico, as well as from ocean to ocean, with descriptions of from 10,000 to 12,000 species. The new Government surveys of the Far West, as well as other exploring expeditions, constantly brought in new treasures for description and comparison. Gray held the position of Naturalist to the Wilkes' Exploring Expedition, but he threw the post up when it started. Indeed, excepting journeys to the Alleghanies, California, and New Mexico, his *rôle* was that of the systematic botanist in the herbarium. His repeated journeys to Europe were made in this capacity. He married Jane L. Loring in 1848, a lady who materially assisted him in these special labours. The Harvard Herbarium and Gardens are the best monument of his arduous toils. He also issued in 1866 a single volume containing two parts, with supplements, completing the description of Gamopetalæ of North America, leaving the complete description of the flora of that continent, the ambition of his early years, an unfinished task. A quarto volume, with a superb atlas of plants, constitutes the fragmentary botany of the Wilkes' South Pacific Expedition. Further progress was stopped for lack of funds. The Memoir on the Flora of Japan U.S. North Pacific Exploring Expedition is perhaps the author's most important contribution to geographical botany. The flora of Japan is compared with those of Eastern and Western America, whilst analogies are derived from the fossil floras of the Cretaceous era and the geological horizons above it, in the same regions. Asa Gray was no dryasdust herbarium keeper. His removal has called forth spontaneous testimonies from many of his students of his tender personal interest in them, only deepening with the rolling years, and of the way in which he led them from simple facts up to the higher morphological problems. His early pupils recall how he might be seen, near the class hour, hurrying down Garden Street of Harvard, his head and body hardly visible because covered with flowers and branches. For many years he was a personal influence in North America. Indeed, the day before he was struck with paralysis his conversation was marked by the characteristic clearness and vivacity of younger days. The presentation of a silver vase and salver, by 180 of the botanists of North America, on 18th November 1885, was the fitting memorial of Asa Gray's seventy-fifth birthday. Letters poured in from all quarters of the land; and on a friend remarking that it must have been a great pleasure to read such friendly greetings, he replied, "I have not read them yet; I must work now. This evening I shall have time to read them."

Recreation was found by Gray in a change of work. He had no idle moments. The evenings of the days which had been given to hard work on the flora of North America would be devoted to dashing off reviews and notices, chiefly for *Silliman's American Journal of Science*, of which he was co-editor for many years, as well as for the general periodical press. He carefully prepared his remarks on papers read at scientific meetings. His great paper on the history of Sequoia and the relations of North American to North-Eastern Asian as well as to Tertiary Vegetation, delivered as retiring President of the North American Association for the Advancement of Science in August 1872, was written in the railway carriages from California to Derbuque. This was afterwards expanded into an octavo volume, and along with some reviews written under similar conditions, forms *Darwiniana*.

Dr Gray's name was connected with seventy different societies, either as an active foreign, honorary, or corresponding member. He was made M.D. in 1831 by the College of Medicine and Surgery at Fairfield, N.Y.; an M.A. in 1844, and an LL.D. in 1875, by Harvard University. During his last trip to Europe, in 1887, the University of Cambridge conferred on him the degree of D.Sc., that of Oxford D.C.L., and that of Edinburgh, LL.D. He became Fellow of the American Academy in 1841, and its president from 1863 to 1873. He was made a foreign member of the Linnæan Society in 1850. He was elected a corresponding member of the British Association for the Advancement of Science in 1852, and a corresponding member of the Academy of Science of the Institute of France in 1878.

The following is a list of Asa Gray's chief works:—

Mineralogy of Jefferson and St Lawrence Counties (N.Y.), in *Silliman's Journal* for 1834–36.

First Century of North American Gramineæ and Cyperaceæ; second century issued, but work not completed. 1833.

A Monograph of the North American Rhyncosporeæ; and, A Notice of some New, Rare, or otherwise Interesting Plants from the Northern and Western Portions of the State of New York, *New York Lyceum Nat. Hist.*, 1856.

Elements of Botany. 1836.

Synoptical Flora of North America, in conjunction with Dr Torrey, Vol. I., parts 1 and 2, 1838; parts 3 and 4, 1840. Vol. II., part 1, 1841; part 2, 1842; part 3, 1843,—after Dr Gray had gone to Cambridge.

The Botanical Text-Book, 1842. 2nd, 3rd, 4th, and 5th ed., 1845, '50, '53, '57. Vol. I. enlarged under the same title, but with the sub-heading *Structural Botany or Organography on the basis of Morphology, with Principles of Taxonomy and Phytography, and a Glossary*, 1879. Vol. II. Physiological Botany, by Prof. Geo. L. Goodale, 1883. (Vol. III., on Cryptogamic Botany, and Vol. IV., on Natural Orders, are yet to be completed.)

Chloris Boreali Americana, selected chiefly from those in cultivation at Botanical Garden, Harvard University, 1st Decade. 1846.

Genera Americæ Borealis Orientalis Illustrata. Two volumes issued, with 186 plates, but would have taken ten volumes to complete on the same scale.

Botany for Young People and Common Schools:—Part I. How Plants Grow. 1858. Part II. How Plants Behave. 1872.

Field, Forest, and Garden Botany in the United States east of the trans-Mississippi river, both wild and cultivated. 1868.

A Manual of the Botany of Northern United States. 1848. Five editions, last in 1867.

First Lessons in Botany and Vegetable Physiology, with Glossary of Botanical Terms. 1857.

Darwiniana: Essays and Reviews pertaining to Darwinism. Appleton, 1877.

Natural Science and Religion. Two Lectures delivered in Yale College. 1880.

Professor HEINRICH ANTON DE BARY. By Professor Bayley Balfour.

(Read 14th June 1888.)

Heinrich Anton de Bary was born on January 26, 1831, at Frankfort-on-the-Maine, where his father was a physician. As a boy at the Gymnasium of his native town, his taste for botanical pursuits was evidenced by the herbarium which he formed. His university life was spent at Heidelberg, Marburg, and Berlin, and at the last-named university he took the degree of M.D. in 1853. Of his botanical teachers, Alexander Braun and George Fresenius were those who exercised most influence upon him during his student career. After graduation he practised medicine for a short time at Frankfort-on-the-Maine, but soon he accepted a docentship in Botany at the University of Tübingen, where Hugo von Mohl was then professor. This early association with the founder of modern plant-anatomy had a profound effect upon De Bary, who in late years always spoke with affection of this early experience. De Bary did not long remain at Tübingen. In 1855 he became Professor Extraordinary, and in 1859 ordinary Professor of Botany at Freiburg a. Br. In 1867 he removed to Halle a. S., where he remained until 1872, when he moved to Strassburg. As Professor in this University he spent the remaining years of his life, which closed, all too soon, on the 19th January 1888. Only in 1887 did he pay a first visit to England, when at the meeting of the British Association in Manchester. There he charmed every one by his genial and kindly disposition. He was a Foreign Honorary Fellow of this Society.

The following is a list of De Bary's published works, for which we are indebted to a notice in the *Botanisches Centralblatt*, by Professor K. Wilhelm :—

The most important are marked with an asterisk (*).

I. *On Algæ.*

1. Ueber die Algengattungen Oedogonium und Bulbochaete, *Abhandl. der Senckenberg'schen Gesellsch.*, Bd. i., 1854.
3. Ueber die geschlechtliche Generation der Algen, *Berichte der naturf. Gesellschaft zu Freiburg*, i. Br., 1856.
3. Zu Gonatozygon monotaenium, *Hedwigia*, 1856.
4.*Untersuchungen über die Familie der Conjugaten. Leipzig (A. Felix), 1858.
5. Bericht über die Fortschritte der Algenkunde in den Jahren 1855–57, *Bot. Zeitg.*, 1858.
6. Beiträge zur Kenntniss der Nostocaceen, insbesondere der Rivularieen, *Flora*, 1863.
7. Ueber Cosmocladium, *Flora*, 1865.
8. Entwicklungsgeschichte der Acetabularia, *Abh. der naturf. Ges. zu Halle*, Bd. xi., 1859.
9. Ueber den Befruchtungsvorgang bei den Charen, *Monatsber. der k. Akad. der Wiss. zu Berlin*, 1871.
10. Aus den Sporen erzogene Chara crinita (*Vortrag, gehalten auf der* 45, *Versammlung deutscher Naturforscher und Aerzte zu Leipzig*, 1872).
11. Zur Keimungsgeschichte der Charen, *Bot. Zeitg.*, 1875.

II. *On Fungi.*

12. Beiträg zur Kenntniss der Achlya prolifera Nees, *Bot. Zeitg.*, 1852.
13. Ueber den Bau der Anthinen, besonders A. purpurea, *Hedwigia*, 1853.
14.*Untersuchungen über die Brandpilze und die durch sie verursachten Krankheiten der Pflanzen. Berlin (G. W. F. Müller), 1853.
15. Ueber die Entwicklung und den Zusammenhang von Aspergillus glaucus und Eurotium, *Bot. Zeitg.*, 1854.
16. Ueber die Myxomyceten, *loc. cit.*, 1858.
17. Zur Kenntniss einiger Agaricinen, *loc. cit.*, 1859.
18.*Die Mycetozoen, *Zeitschrift für wissenschaftliche Zoologie*, Bd. x., 1859.
19. Einige neue Saprolegnieen, Pringsheim's *Jahrb. f. wiss. Bot.*, ii., 1860.

20. Ueber Schwärmsporenbildung bei einigen Pilzen, *Berichte der naturf. Gesellschaft zu Freiburg*, i. B., 1860.
21.*Ueber die Geschlechtsorgane von Peronospora, *Bot. Zeitg.*, 1861.
22.*Die gegenwärtig herrschende Kartoffelkrankheit, ihre Ursache und Verhütung. Leipzig (A. Felix), 1861.
23. Die neuen Arbeiten über die Schleimpilze und ihre Stellung im System, *Flora*, 1862.
24. Die neuesten Arbeiten über Entstehung und Vegetation der niederen Pilze, insbesondere Pasteur's Untersuchungen, *Flora*, 1862 und 1863.
25. Untersuchungen über die Entwicklung einiger Schmarotzerpilze, *Flora*, 1863.
26.*Recherches sur le développement de quelques champignons parasites. Mémoire pour servir de réponse à une question proposée par l'Académie des Sciences en 1861, *Annales des Sc. Nat.*, 1863.
27. Ueber die Entwicklung der Sphaeria typhina und Bail's mykologische Studien, *Flora*, 1863.
28.*Caeoma pinitorquum, ein neuer der Kiefer verderblicher Pilz, *Monatsber. der Akad. der Wiss. Berlin*, 1863.
29. Beiträge zur Morphologie und Physiologie der Pilze, I. Reihe. *Abhandl. der Senckenberg'schen naturf. Gesellschaft zu Frankfurt a. M.*, 1864.
30. Beiträge zur Kenntniss der Chytridieen (in conjunction with Woronin), *Berichte der naturf. Gesellschaft zu Freiburg*, i. B. Bd. iii., 1864.
31.*Neue Untersuchungen über Brandpilze, *Monatsber. d. Akad. der Wiss. Berlin*, 1865 und 1866.
32. Ueber die Keimung grosssporiger Flechten, Pringsheim's *Jahrb. für Wiss. Botanik*, v., 1866.
33.*Morphologie und Physiologie der Pilze, Flechten und Myxomyceten, Hofmeister's *Handbuch der physiologischen Botanik*, ii. Leipzig (W. Engelmann), 1866.
34.*Beiträge zur Morphologie und Physiologie der Pilze, II. Reihe (in conjunction with Woronin), *Abhandl. der Senckenberg'schen naturf. Gesellschaft zu Frankfurt a. M.*, 1866.
35.*Zur Kenntniss insectentödtender Pilze, I., *Bot. Zeitg.*, 1867.
36. Bemerkungen über Arthrobotrys oligospora, *loc. cit.*
37.*Ueber den Krebs und den Hexenbesen der Weisstanne, *loc. cit.*
38. Die Traubenkrankheit (Oidium Tuckeri), *Hildb. Ergänzungsblätter*, ii., 1867.
39. Bericht über die in den Cholera-Entleerungen vorgefundenen Pilze, *Bot. Zeitg.*, 1868.

40. Anmerkung zu Hartig's Nachträgen zur Abhandlung über Pilzbildung im keimfreien Raum, *Bot. Zeitg.*, 1869.
41.*Zur Kenntniss insectentödtender Pilze, II., *Bot. Zeitg.*, 1869.
42.*Ueber Schimmel und Hefe, *Heft* 87 *und* 88 *der Sammlung gemeinverständlicher wissenschaftlicher Vorträge, herausgegeben von Virchow und Holtzendorff.* Berlin (C. G. Lüderitz), 1869.
43.*Beiträge zur Morphologie und Physiologie der Pilze. III. Reihe (in conjunction with Woronin), *Abhandl. der Senckenberg'schen naturf. Gesellschaft zu Frankfurt a. M.*, 1870.
44. Ueber den sonenannten Brenner (Pech) der Reben, *Annalen der Oenologie*, Bd. iv.; *Bot. Zeitg.*, 1874.
45. Protomyces microsporus und seine Verwandten, *Bot. Zeitg.*, 1874.
46. Notiz über Cronartium ribicola, *loc. cit.*
47.*Researches into the Nature of the Potato-Fungus (Phytophthora infestans), *The Journal of Botany, British and Foreign*, 1876.
48.*Ueber Aecidium abietinum, *Bot. Zeitg.*, 1879.
49. Ueber die von Fischer von Waldheim aufgeworfene Frage nach der Stellung der Ustilagineen, *Actes du Congrès International de Botanistes, d'Horticulteurs, &c., tenue à Amsterdam en* 1877. Leide, 1879.
50. Zur Kenntniss der Peronosporeae, *Bot. Zeitg.*, 1881.
51.*Untersuchungen über die Peronosporeen und Saprolegnieen und die Grundlagen eines natürlichen Systems der Pilze, *Abhandl. der Senckenberg'schen naturf. Gesellschaft zu Frankfurt a. M.*, 1881.
52. Zu Pringsheim's neuen Beobachtungen über den Befruchtungsact der Gattungen Achyla und Saprolegnia, *Bot. Zeitg.*, 1883.
53.*Vergleichende Morphologie und Biologie der Pilze, Mycetozoen und Bakterien. Leipzig (W. Engelmann), 1884. An English translation was published by the Oxford University Press in 1887.
54.*Vorlesungen über Bakterien. Leipzig (W. Engelmann), 1885. 2. Aufl. (ebenda), 1887. An English translation was published by the Oxford University Press in 1887.
55.*Ueber einige Sklerotinien und Sklerotienkrankheiten, *Bot. Zeitg.*, 1886.

III. *On Vascular Cryptogams.*

56. Ueber die Keimung der Lycopodiaceen, *Berichte der naturf. Gesellschaft zu Freiburg*, i. Br., 1858.
57. Notiz über die Elateren von Equisetum, *Bot. Zeitg.*, 1881.

IV. *On Anatomy of Higher Plants.*

58.*Ueber die Wachsüberzüge der Epidermis, *Bot. Zeitg.*, 1871.

59.*Vergleichende Anatomie der Vegetationsorgane der Phanerogamen und Farne, *Hofmeister's Handbuch der physiologischen Botanik*, iii. Leipzig (W. Engelmann), 1877. An English translation was published by the Oxford University Press in 1884.

V. *On Morphology and Taxonomy of Phanerogams.*

60. Prosopanche Burmeisteri, eine neue Hydnoree aus Südamerika, *Abhandl. der naturf. Gesellschaft zu Halle a. S.*, Bd. x., 1868.

61. Notiz über die Blüten einiger Cycadeen, *Bot. Zeitg.*, 1870.

62. Ueber eine bemerkenswerthe Umbelliferenform, *Polylophium hybridum*, *loc. cit.*, 1871.

VI. *On General Botany.*

63. De plantarum generatione sexuali. Inaugural Dissertation. Berlin (G. Schade), 1853.

64. Ueber die Copulationsprocesse im Pflanzenreich, *Berichte der naturf. Gesellschaft zu Freiburg*, i. Br., 1857.

65.*Ueber apogame Farne und die Erscheinung der Apogamie im Allgemeinen, *Bot. Zeitg.*, 1878.

66. Botanik. Siebentes Bändchen der "Naturwissenschaftlichen Elementarbücher." Strassburg (Trübner), 1878.

67.*Die Erscheinung der Symbiose, *Vortrag, gehalten auf der Versammlung deutscher Naturforscher und Aerze zu München*, 1877. Strassburg (Trübner), 1879.

68.*Zur Systematik der Thallophyten, *Bot. Zeitg.*, 1881.

VII. *Miscellaneous.*

69. Die Schrift des Hadrianus Junius über den Phallus und der Phallus Hadriani, *Bot. Zeitg.*, 1864.

70. G. Fresenius. Nachruf (*loc. cit.*, 1872).

71. Dem Andenken an D. F. L. von Schlechtendal (*loc. cit.*).

72. Zur Beurtheilung der Pilzschriften des Herrn Hallier (*loc. cit.*, 1868).

73. Hugo von Mohl. Nachruf (*loc. cit.*, 1872).

74. Zur Geschichte der Naturbeschreibung im Elsass, *Rede, gehalten beim Antritt des Rectorates in Strassburg*, 1872.

75. August Röse. Nekrolog, *Bot. Zeitg.*, 1873.

76. W. Ph. Schimper. Nachruf (*loc. cit.*, 1880).

PROCEEDINGS, MISCELLANEOUS CONTRIBUTIONS, AND EXHIBITIONS.

SESSION 1887–88.

November 10, 1887.

Replies received by the President were read in acknowledgment of the Address presented to Her Majesty on the occasion of Her Jubilee, which Her Majesty had graciously accepted.

Mr G. F. Scott Elliot contributed "Notes on the Flora of the Canary Islands," with illustrative specimens.

Specimens of Liquorice and a mixed inflorescence of Maize, grown in his garden, were sent for exhibition by Dr Paterson, Bridge of Allan.

Mr M'Andrew, New Galloway, contributed notes and specimens of new or rare plants found in his neighbourhood.

Valuable donations to the Herbarium, of Canary Island plants, collected and presented by Mr Scott Elliot and Mr Neill Fraser, were exhibited.

Specimens of interesting plants in blossom during November were sent from Mr John Campbell, Ledaig, and Dr Macfarlane explained how favourably their Associate was situated for the cultivation of plants, and mentioned some of the more striking features of his garden, observed during a recent summer visit.

Mr Taylor exhibited a growth, considered by Mr Scott Elliot to be *Spumaria alba* in an immature state. It was found by Mr W. S. Gresley, M.E., oozing out as a white viscid liquid from a seam of cannel coal about 400 feet from the surface, near Ashby-de-la-Zouch.

December 8, 1887.

A communication was made by Mr P. Sewell "On Flower Colour," which appears in an expanded form on p. 276 *et seq.*

Mr P. Geddes brought forward the question as to the "Origin of Spines and Prickles." Mr Geddes considered that spines and thorns were expressions of insufficient vegetation, however produced, and though at times evidently of advantage, and subject to selection, he held that a great deal too much stress had been laid on the importance of selection in regard to them. On the other hand, he looked upon prickles as the product of an overplus of vegetative growth.

Mr E. M. Holmes sent for exhibition fruits of species of *Eucalyptus*, *Cucumis*, and *Martynia*, kindly sent to him by Mr T. Hanbury of Palazzo Orengo, Italy, in whose garden they were ripened.

January 12, 1888.

Owing to the lamented death of Professor Alexander Dickson, ex-President, the Council resolved, at their meeting on January 3rd, that the General January Meeting be not held, and circulars announcing this were accordingly issued to members.

February 9, 1888.

Dr Craig, on taking the chair, referred to the great losses botanical science had recently sustained, and which affected the Society so much. He stated that, beside the severe loss felt by all the Fellows in the removal from their midst of his predecessor in the Presidential Chair, they were called to mourn the death of Professors Asa Gray and De Bary, Dr Boswell of Balmuto, and the Rev. Mr Colvin. After passing a high tribute of regard to Professor Dickson, ex-President, he called on Dr Cleghorn, who proposed the following:—

"It is with profound sorrow and regret that the Council have to record the loss which the Society has sustained by the death of our ex-President, Professor Dickson, who died suddenly at Hartree, on December 30.

"Professor Dickson was elected a member of the Society in 1857, and always manifested a deep interest in its welfare. After his election to the Chair of Botany in the University of Edinburgh, he took a leading part in the work of the Society and in the management of its affairs. He was elected President in 1865, and again in 1884.

"During his connection with the Society he enriched its *Proceedings* with many valuable contributions, especially in the department of Vegetable Morphology and Embryogeny, a domain in which he had few equals.

"He has been taken away from us in the midst of activity and usefulness, and not only has the Society by his death lost one of its most eminent Fellows, but the science of botany has lost one of its most accomplished and ardent votaries.

"As a Professor of Botany, his memory will be cherished by the students of the Universities who were privileged to listen to his instruction, to see his beautiful delineations, and to feel the living touch of his sympathy and kindness, which acted like a charm upon the hearts of all who came under his influence, and caused him to be regarded as the most approachable of teachers.

"To those of us who enjoyed the pleasure of his intimate acquaintance, his sudden death has come as a sad personal bereavement, but we shall ever cherish the memory of his warm-hearted genial friendship, his inflexible integrity, his wonderful unselfishness, and the unostentatious grace which characterised all the actions of his life."

The Fellows unanimously expressed approval of the motion, and agreed that it should be incorporated in the Minutes of the Society. The Secretary was also instructed to send an excerpt to the relatives of the deceased.

Mr P. Geddes gave his views "On the Origin of Evergreens."

Mr Lindsay exhibited a large truss of *Rhododendron argenteum*, Hook. f.; *Narcissus cyclamineus* from Portugal, presented to the Garden last year by the Rev. C. Wolley Dod, Edge Hall, Malpas; seedling plants of *Helleborus orientalis* from the open air, having different coloured flowers, and which had been raised from seeds ripened at Balmuto, and presented by the late Dr Boswell.

Mr Potts, Fettes Mount, exhibited *Chamæbatia foliolosa*, from California.

Mr J. R. Hill drew attention to examples of a spurious Ipecacuanha, recently offered for sale, and also an *Astragalus* from Cyprus resembling *A. mollissimus* in its action on animals.

The Secretary showed flower blossoms from Mr Campbell of Ledaig.

March 8, 1888.

A letter was read from Dr Archibald Dickson, thanking the Society, on behalf of himself and relatives, for the letter of condolence recently received.

Exhibits of plants were made by Mr Lindsay from the Royal Botanic Garden, and from Mr Campbell of Ledaig.

April 12, 1888.

The President, in name of the Society, congratulated Professor Bayley Balfour on his appointment to the Chair of Botany at the University.

Professor Balfour exhibited various cultivations of the Ginger Beer plant, and gave a short account of its probable introduction into this country, and of observations he had made on it.

May 10, 1888.

The Secretary reported that arrangements had been finally made for the establishment of a corps of observers to co-operate with Dr Christison in tree measurement, and that facilities had been given by the Society for carrying on the work by these gentlemen, who were Fellows or Associates of the Society, and experts in arboricultural matters. Dr Christison had agreed to act as convener of the Committee.

Mr Lindsay exhibited a large number of plants from the Botanic Garden, and drew attention to Primula and Orchid exhibits sent by Mr Sanderson, Talbot House.

June 14, 1888.

A paper was read by Mr P. Sewell on "Similar Modifications in the Characters of different Plants."

July 12, 1888.

It was resolved to empower the Council to petition against the New Universities (Scotland) Bill, now before the House of Commons, in so far as it enacted the transference of the Royal Botanic Garden from the Treasury to the Edinburgh University.

Mr John Wilson, B.Sc., read a paper on "The Leaf Glands of *Plumbagineæ*."

Mr R. Turnbull read a preliminary note on "The Distribution and Structure of Water Stomata in Cotyledonary leaves."

OFFICE-BEARERS.

At the General Meeting held on Thursday, 10th November 1887, the following Office-Bearers for 1887–88 were elected:—

PRESIDENT.

William Craig, M.D., C.M., F.R.S.E., F.R.C.S.E.

VICE-PRESIDENTS.

Robert Lindsay.
Rev. John Macmurtrie, M.A.
Symington Grieve.
Andrew Taylor, F.R.P.S.

COUNCILLORS.

Rev. J. M. Robertson, M.A.
William Watson, M.D.
William B. Boyd of Faldonside.
Thomas A. G. Balfour, M.D., F.R.S.E., F.R.C.P.E.
Malcolm Dunn, Dalkeith Palace Gardens.
Alexander Galletly.
David Christison, M.D.
Professor F. O. Bower, M.A., F.R.S.E., F.L.S.
Alexander Buchan, M.A., LL.D., F.R.S.E.
Hugh Cleghorn, M.D., LL.D., F.R.S.E.

Honorary Secretary—Professor Sir Douglas Maclagan, M.D., F.R.S.E.
Honorary Curator—The Professor of Botany.
Foreign Secretary—Andrew P. Aitken, M.A., D.Sc., F.R.S.E.
Treasurer—Patrick Neill Fraser.
Assistant-Secretary—John M. Macfarlane, D.Sc., F.R.S.E.

LOCAL SECRETARIES.

Aberdeen—Stephen A. Wilson of North Kinmundy.
Berwick—Philip W. Maclagan, M.D.
Birmingham—George A. Panton, F.L.S., 95 Colmore Row.
Calcutta—George King, M.D., Botanic Garden.
Cambridge—Charles C. Babington, M.A., F.R.S., Professor of Botany.
,, Arthur Evans, M.A.
Chirnside—Charles Stuart, M.D.
Croydon—A. Bennett, F.L.S.
Dublin—W. R. M'Nab, M.D., F.L.S., Professor of Botany, Royal College of Science.
Fife—J. T. Boswell, LL.D., F.L.S., of Balmuto, Kirkcaldy.
Greenock—Donald M'Raild, M.D.
Kelso—Rev. David Paul, M.A., Roxburgh Manse.
Kilbarchan—Rev. G. Alison.
London—William Carruthers, F.R.S., F.L.S., British Museum.
,, E. M. Holmes, F.L.S., F.R.H.S.
Manchester—Benjamin Carrington, M.D., Eccles.
Melbourne, Australia—Baron Ferdinand von Mueller, M.D.

Nairn—WILLIAM ALEX. STABLES.
Norfolk—JOHN LOWE, M.D., King's Lynn.
Nova Scotia—GEORGE LAWSON, LL.D., Dalhousie.
Ottawa, Ontario—W. R. RIDDELL, B.Sc., B.A., Prov. Normal School.
Oxford—Professor BAYLEY BALFOUR, F.R.S.
Perth—F. B. WHITE, M.D., F.L.S.
Saharunpore. India—J. F. DUTHIE, B.A., F.L.S., Botanic Garden.
Shrewsbury—Rev. W. A. LEIGHTON, B.A., F.L.S.
Silloth—JOHN LEITCH, M.B., C.M.
Wellington, New Zealand—JAMES HECTOR, M.D., F.R.SS. L. & E.
Wolverhampton—JOHN FRASER, M.A., M.D.

Fellows elected, Session 1887–88.

1887.
Nov. 10. JOHN G. KERR, Eskbank—*Res. Fellow.*
Dec. 8. GUSTAV MANN, Edinburgh—*Res. Fellow.*
J. S. SCOTT, L.S.A., Manchester—*Res. Fellow.*
JAMES A. TERRAS, Edinburgh—*Res. Fellow.*
JOHN M. FORSYTH, Woburn—*Non-Res. Fellow.*
Dr E. C. HANSEN, Copenhagen—*Foreign Fellow.*
H. WILDPRET, Orotava—*Foreign Fellow.*
1888.
Feb. 9. JAMES HUNTER, F.R.C.S.E., Edinburgh—*Res. Fellow.*
PHILIP SEWELL, Edinburgh—*Res. Fellow.*
WILLIAM LEARMONTH, Alloa—*Non-Res. Fellow.*
Mar. 8. Sir R. MURDOCH SMITH, R.E., Edinburgh—*Res. Fellow.*
A. B. STEELE, Edinburgh—*Res. Fellow.*
April 12. W. E. FOTHERGILL, M.A., Edinburgh—*Res. Fellow.*
May 10. Professor J. W. H. TRAIL, Aberdeen—*Res. Fellow.*
WILLIAM CARMICHAEL, Edinburgh—*Res. Fellow.*
June 14. WILLIAM J. MOFFAT, Edinburgh—*Res. Fellow.*

ADDITIONS

TO THE

LIBRARY, HERBARIUM, AND MUSEUM,

AT THE

ROYAL BOTANIC GARDEN, EDINBURGH,

FROM 1ST OCTOBER 1887 TO 1ST OCTOBER 1888.

LIBRARY.

BOOKS.

BABINGTON, C. C. Manual of British Botany. 7th Edition.—*From the Director, Kew Gardens.*

CURTIS and HOOKER. The Botanical Magazine. Vols. I.–CXIII.—*From Charles Jenner, Esq.*

DOWNING, A. J. (Editor). The Horticulturist. Vol. IV.—*From the Director, Kew Gardens.*

DUTHIE, J. F., B.A. The Fodder Grasses of Northern India.

——— Illustrations of Indigenous Fodder Grasses of Plains of North-Western India.—*From the Author.*

LANGE, Professor J. Conspectus Floræ Grœnlandicæ. Part 2. Copenhagen, 1887.—*From the Author.*

MIQUEL, F. A. G. Commentarii Phytographici.—*From the Director, Kew Gardens.*

MUELLER, BARON FERD. VON. Iconography of Australian Species of *Acacia* and cognate Genera. Decades 1–11.—*From the Author.*

PARNELL, Dr R. British Grasses. Two copies.

——— Grasses of Scotland. Two copies.

——— Grasses of Britain. One copy.—*From Dr Parnell's Trustees.*

STEWART and CORRY. Flora of North-East of Ireland.—*From the Belfast Naturalists' Field Club.*

VAHL, M. Eclogæ Americanæ. Fasc. 1, 2.—*From the Director, Kew Gardens.*

VOGEL, JULIUS. Official Record of the New Zealand Industrial Exhibition of 1885.—*From the Colonial Museum Director.*

PAMPHLETS, REPRINTS FROM SCIENTIFIC PUBLICATIONS, &c.

ALLAN, F. J. Council's Report, Public Health Medical Society.—*From the Society.*

CARRINGTON, Dr, and PEARSON, W. H. List of Hepaticæ collected by Mr Thomas Whitelegge in New South Wales.—*From the Authors.*

CESATI, V. Prospetti delle Felci raccolte dal Signor O. Beccari nella Polinesia. Two copies.—*From Kew.*

COHN, Dr F. Bericht über die Thätigkeit der Bot. Sect. der Schlesischen Gesellschaft. 1887.—*From the Author.*

CRAIG, Dr W. MSS. Index to Blytt's *Norges Flora.*

DE CANDOLLE, A. P. and A. Cinquième Notice sur les Plantes Rares cultivées dans le Jardin de Genève.—*From Kew.*

ENGELMANN, Dr G. List of Cacteæ (Botany of King's Expedition), pp. 127–274, 361–375.—*From Kew.*

FREMONT and EMERY'S Reports. TORREY on Rocky Mountain Plants and ENGELMANN on Cactaceæ.—*From Kew.*

GAMBLE, J. S. The Nilgiri "Strobilanthes."—*From Kew.*

GRAY, Dr ASA. Botanical Contributions. 1887.

——— Contributions to North American Botany. Studies of *Aster* and *Solidago* in Older Herbaria. 1882.—*From the Author.*

HANSEN, E. C. Recherches sur la physiolog. et la morpholog. des ferments alcooliques. Part 7.—*From the Author.*

JANCZEWSKI, Dr ED. Germination del' *Anemone apennina*, Lin.—*From the Author.*

KUHN, M. Reliquiæ Mettenianæ.—*From Kew.*

LAWSON, Dr G. Provincial Government Crop Report. July 1888. Halifax, N.S.—*From the Author.*

LOUDON, J. P. Specimen (Cryptogamia) of the Encyclopædia of Plants. —*From Kew.*

LUERSSEN, Dr CH. Die Einführung Japanischer Woldbäume in die deutschen Forsten.—*From the Author.*

MACDONALD, A. C. Transactions and Proceedings of the Royal Geographical Society of Australasia. Vol. V. Part 1.—*From Kew.*

MAIDEN, J. H. Report of Technological, Industrial, and Sanitary Museum Committee of New South Wales.—*From the Museum.*

MUELLER, BARON F. VON. Fragmenta Phytographiæ Australiæ. Fasc. 66, 67, 68, 69, 86, 87, and 94.

——— The Southern Science Record, No. 11.

——— Systematic Census of Australian Plants. 2nd Annual Supplement.—*From Kew.*

NYLANDER, W. Lichenes Fuegiæ et Patagoniæ.—*From the Author.*

OUDEMANS, C. A. Violaceæ (ex Annales Mus. Bot. Lugd. Bat., iii. pp. 67, 68). Two copies.—*From Kew.*

SCHOMBURGK, Dr R. Report of Adelaide Botanic Garden.—*From the Author.*

Sitzungsbericht des Gesellschaft naturforschender Freunde zu Berlin am 15 Januar 1867.—*From Kew.*

Suringar, W. F. R. Algarum Japonnicarum, &c., Index (ex Ann. Mus. Bot. Lugd. Bat., iii. p. 256).—*From Kew.*

Twining, Thomas. The Botanic Stand.—*From Kew.*

Warburg, O. Die Öffentlichen Gärten, &c., in Britisch Indien.—*From Kew.*

Warming, Professor E. Une Excursion aux Montagnes du Brésil. 1883.

——— Symbolæ ad Floram Brasiliæ centralis cognoscendum. Parts 27–30. 1883–84.

——— Om Gronlands Vegetation. 1886–87.

——— Neuere Beiträge zu Grönlands Flora. 1887.

——— Tabellarisk oversigt over Grönlands, Islands og Færoernes Flora. 1887.—*From the Author.*

Warren-Merrill, J. List of Ferns, &c., Boston.—*From Kew.*

Zanardini, G. Iconographia Phycologica Adriatica. Fasc. 2, 3, 4, and 5 of Vol. I.—*From Kew.*

TRANSACTIONS, &c., OF LEARNED SOCIETIES, AND KINDRED INSTITUTIONS.

Belfast.—Naturalists' Field Club.

Annual Report and Proceedings, Series II. Vol. II. Part 7.—*From the Club.*

Natural History and Philosophical Society.

Proceedings for Session 1886–87.—*From the Society.*

Boston.—Boston Society of Natural History.

Memoirs. Vol. IV. Parts 1–6.—*From the Society.*

Massachusetts Horticultural Society.

Transactions, 1887, Parts 1 and 2.—*From the Society.*

Bremen.—Naturwissenschaftlichen Verein.

Abhandlungen. Band X. Heft 1, 2.—*From the Society.*

Bristol.—Bristol Naturalists' Society. Vol. V. Part 3. List of Officers, &c.—*From the Society.*

Cherbourg.—Soc. Nation. des Sc. Nat. et Math.

Mémoires. Tome XXV.—*From the Society.*

Cincinnati.—Society of Natural History.

Vol. X. No. 4; Vol. XI. No. 1.—*From the Society.*

Copenhagen.—Botaniske Forening i Kobenhavn.

Botaniske Tidsskrift (Journal de Botanique). Series III. Vol. XVI. Liv. 4.—*From the Society.*

Crawfordsville, U.S.—The Botanical Gazette. Vol. XIII. Nos. 1–9.—*From the Editors.*

Dublin.—Royal Society.

Transactions. Vol. III. Part 14; Vol. IV. Part 1.

Proceedings. Vol. V. Parts 7 and 8; Vol. VI. Parts 1 and 2.—*From the Society.*

EDINBURGH.—Botanical Society.
Transactions and Proceedings. Vol. XVII. Part 1, 1887.—*From the Society.*
Royal Society.
Transactions. Vols. XXXI., XXXIII. Part 2.
Proceedings. Sessions 1885–88.—*From the Society.*
Royal Physical Society.
Proceedings. Session 1886–87.—*From the Society.*
Royal Scottish Society of Arts.
Transactions. Vol. XII. Part 1.—*From the Society.*

EPPING FOREST and County of Essex Naturalists' Field Club. Transactions and Proceedings. Vol. II. Nos. 1–8.—*From the Club.*

ERLANGEN.—Physikalisch Medicinischen Societät zu Erlangen. Heft 19. 1886–87.—*From the Society.*

GLASGOW.—Natural History Society.
Proceedings, Vol. II. Part 1.—*From the Society.*

HAARLEM.—Bevordering van Nijverheid.
Tijdschrift. 4e Reeks, Deel XII., 1888.—*From the Society.*
Musée Teyler.—Archives. Series II. Vol. III. Part 1.—*From the Corporation.*

HALLE.—Kais. Leop. Carol. Deutsche Akad. der Naturforscher.
Nova Acta. Band L. No. 1; Band LI. No. 5; Band LII. No. 2.
Leopoldina. Heft. XXII., XXIII., 1886–87.—*From the Academy.*

HERTFORDSHIRE Natural History Society.
Transactions. Vol. V. Part 1. Catalogue of the Library.—*From the Society.*

KONIGSBERG.—Physical. Ökonom. Gesell.
Schriften, XXVIII., 1887.—*From the Society.*

LONDON.—The Linnean Society.
Journal. Nos. 148, 149, 152 to 155, 158 to 163.
Transactions. 2nd Series. Vol. II. Part 15; Vol. III. Part 1.
The Pharmaceutical Society.
Journal. Nos. 906–948.
The Quekett Microscopical Club.
Journal. Ser. 2. Vol. I. No. 8; Vol. II. Nos. 14, 15; Vol. III. Nos. 21, 22.
India Office.
Annual Administration Report of Forest Department (S. and N. Circars), Madras Presidency, for 1886–87.

LUND.—Acta Universitatis Lundensis. Tom. XXIII.—*From the University.*

MANCHESTER.—The Botanical Record Club.
Phanerogamic and Cryptogamic Report for the Year 1887.—*From the Club.*

MOSCOW.—Société Imperiale des Naturalistes de Moscou.
Bulletin, 1888, No. 2.—*From the Society.*

NEWCASTLE-ON-TYNE.—Tyneside Naturalists' Field Club.
Transactions. Vol. IX. Part 2.—*From the Club.*

NEW YORK.—American Museum of Natural History.
Report of Trustees, 1887–88.—*From the Trustees.*

New York.—Academy of Sciences.
Transactions. Vol. VII. Nos. 1 and 2.—*From the Academy.*
Cooper Union for Advancement of Science and Art.
Twenty-Fifth Annual Report, 1888.—*From the Trustees.*
Torrey Botanical Club.
Bulletin. Nos. 1–9, 1888.—*From the Club.*
Paris.—Société Botanique de France.
Bulletin. Revue Bibliographique. Vol. XXXIV. A–D; Vol. XXXV. A–C.
Comptes rendus. Vol. XXXIV. Nos. 1–8; Vol. XXXV. Nos. 1–3.—*From the Society.*
Perth.—Perthshire Society of Natural Science.
Transactions and Proceedings. Vol. I. Part 1.—*From the Society.*
Petersburg, St.—Hortus Imp. Bot. Petropolitanus.
Acta. Tom. X. Fasc. 1.—*From the Directors.*
Philadelphia.—Academy of Natural Science.
Proceedings. Parts 2 and 3, 1887; Part 1, 1888.—*From the Academy.*
Plymouth.—Plymouth Institution and Devon and Cornwall Natural History Society.
Transactions. Vol. X. Part 1.—*From the Society.*
Raleigh, U.S.—Elisha Mitchell Scientific Society.
Journal. Vol. IV. Part 2.—*From the Society.*
San Francisco.—California Academy of Sciences.
Bulletin. Vol. II. No. 8.—*From the Academy.*
Sydney.—Royal Society of New South Wales.
Journal and Proceedings. Vols. XX., XXI.—*From the Society.*
Trenton, U.S.—Trenton Natural History Society.
Journal, No. 3, 1888.—*From the Society.*
Wellington.—Colonial Museum and General Survey Department.
Report. 1886–87.
Index to Reports from 1866 to 1885.
Studies in Biology. No. 3.—*From the Director.*

PERIODICALS.

The Garden. 1887–88.—*From R. Lindsay.*
The Gardeners' Chronicle. 1887–88.—*From R. Lindsay.*
Nature. Nos. 940–988.—*From the Editor.*

DONATIONS TO HERBARIUM.

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——— Cape Plants. Series II.
——— Cape Plants. Series III.
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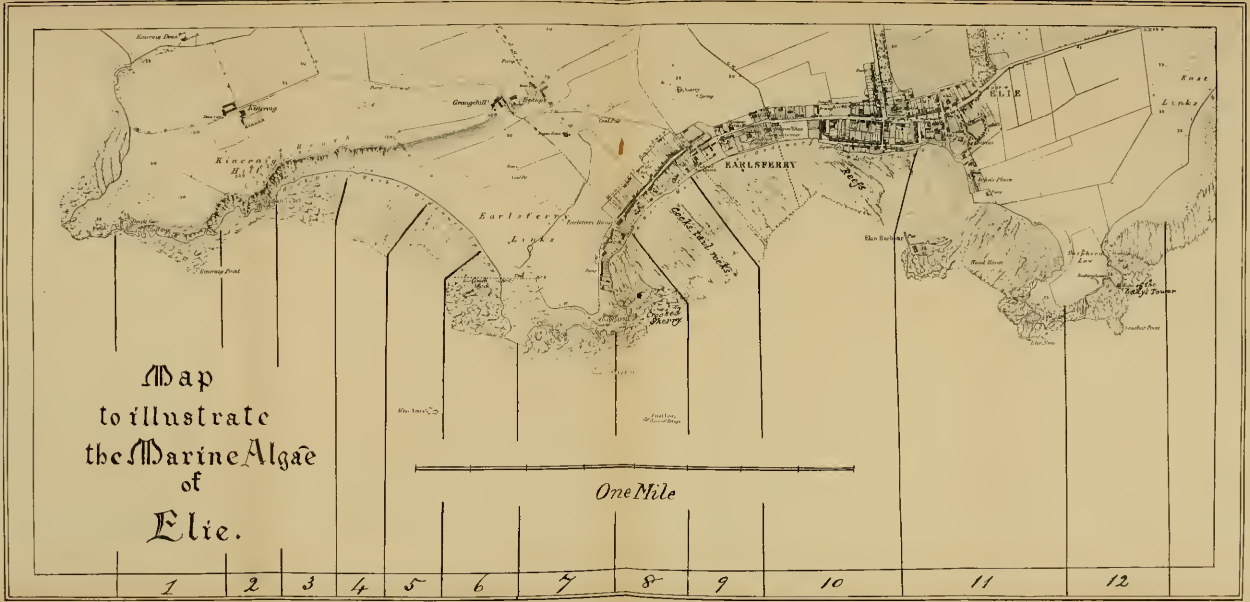
Map
to illustrate
the Marine Algae
of
Elie.
One Mile
ELIE
EARLSFERRY
Earlsferry
Links
Kincraig
Hill
Kincraig
Grangehill
East
Links
Reefs
Cocks tail rocks
Crooked Skerry
Elie Harbour
Wood Haven
Shepherd Law
Lady's Tower
1
2
3
4
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6
7
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11
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Fig 1

Fig 1a

Fig 2

Fig 2a

HETEROPHYLLY IN NEW ZEALAND VERONICAS.


Fig. 3.


Fig. 4


Fig. 3[a]


Fig. 4[a].

HETEROPHYLLY IN NEW ZEALAND VERONICAS.

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Botanical Society of Edinburgh

TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

SESSION LIII.

8th November 1888.—William Craig, M.D., F.R.S.E., F.R.C.S.E., President, in the Chair.

The President made the following introductory remarks:—

Gentlemen,—My first duty to-night is to return you my sincere thanks for the high honour you have conferred upon me by electing me a second time to be your President. I can assure you I esteem the honour very highly. Whilst conscious of many imperfections and shortcomings on my part, I shall endeavour to discharge the duties of the office to the best of my ability, relying on your kind indulgence for the future, as I have experienced it in the past.

The last Session will long be remembered as one in which the Society lost by death many of its most distinguished members. I question if, during the previous fifty-one years of its existence, it ever happened that the names of so many distinguished Fellows had to be removed from the roll of membership in one year. Of the six Honorary Fellows who are British subjects, we lost one, namely, Dr J. T. Boswell of Balmuto—long known and possibly better known to some as Dr J. T. Boswell-Syme. Dr Boswell was one of the most distinguished botanists of the present century, and his great work on the British Flora will perpetuate his name to generations yet unborn. Dr Boswell was elected an Honorary Fellow of this Society 10th December 1885, to fill the vacancy on our list caused by the lamented death of the founder of this Society, Professor John Hutton Balfour. An obituary notice of this distinguished botanist is being prepared by Dr Cleghorn, and in due time will be presented to the Society, and will appear in the next fasciculus of our *Transactions.*

Of the twenty-five Foreign Honorary Fellows, we have lost two during the Session, but these two were among the most distinguished on that honoured list.

By the death of Professor Anton de Bary of Strassburg, the Society lost one of its most eminent Foreign Honorary Fellows, and botanical science one of its most distinguished exponents. De Bary was eminent not only as a botanist, but also as a physiologist and zoologist, and was cut down in the very prime of his manhood. An obituary notice of De Bary was presented to the Society last session by Professor Bayley Balfour, and appears in the present fasciculus of our *Transactions.* He was elected a Foreign Corresponding Member 8th December 1870, and 11th January 1872 was promoted to the list of Foreign Honorary Fellows.

The Society has also to lament the death of Professor Asa Gray, one of the most eminent of American botanists. He died full of years and of honours, having been on our list of Foreign Honorary Fellows for more than twenty years. An obituary notice of Professor Asa Gray, by Mr Andrew Taylor, appears in the present fasciculus of our *Transactions.*

During the past Session we have also lost by death several of our Ordinary Fellows, but amongst them the name of Dr Alexander Dickson stands pre-eminent. I have now been a member of this Society for more than twenty years, and I do not remember of any death producing such a sensation among us. So unexpected and so terribly sudden, it produced a profound impression upon us all, and completely paralysed all our actions for the time. An obituary notice of Professor Dickson is being prepared for this Society by his friend and colleague Professor T. R. Fraser, and would have been ready last Session, but for the lamented illness of the late Professor's brother, Dr Archibald Dickson. Whilst unwilling to anticipate Professor Fraser, I cannot, in taking a review of last Session, omit to refer to the irreparable loss which this Society sustained by his lamented and untimely death. The name of Alexander Dickson was well known and highly esteemed wherever botanical science was studied. We had no more honoured name on our list of Ordinary Fellows than his. In many departments of botanical science he held a foremost place, and in morphological botany he had few equals and no superiors. But whilst we all honoured and admired him as the scientific botanist, we all loved and revered him still more as the warm-hearted and much-trusted friend. He was one of the truest friends and most genial companions I ever met, or can ever hope to meet. As a county gentleman on his ancestral estates of Hartree and Kilbucho, he was much beloved, and in our Society he had greatly endeared himself to us all. In his warm and generous heart no selfish thought ever found a place. His constant care at all times was for the good of others. He was President of this Society during the Session 1864–65, and also held the office of President during the three years preceding my term of office. He died suddenly at Hartree on 30th December last, and out of respect to his memory, the ordinary meeting of the Society in January was not held.

> "The vital spirits sink
> To see the vacant chair, and think
> How good! how kind! and he is gone."

The Society lost two other Resident Fellows during the past Session—Rev. R. F. Colvin, who had been a Fellow for nearly twenty-four years, and was frequently present at our meetings, and R. M. Smith, F.R.S.E. Mr Smith was a person of eminent scientific attainments, and was elected a Fellow 11th November 1869.

We lost two Non-Resident Fellows—Mr Edwin Lees, F.L.S., Worcester, and Emeritus Professor John Wilson, both of whom were amongst the oldest members of the Society. Professor Wilson was well known to many of us, and by all who knew him was much esteemed and greatly beloved.

In addition, we lost by death two Foreign Fellows—Professor H. Leitgeb of Gratz, and Dr J. E. Planchon, Professor in the Faculty of Science, Montpellier.

Whilst during the past Session we as a Society were called upon to mourn the removal by death of Professor

Dickson from the Chair of Botany of the University of Edinburgh and from the Regius Keepership of the Royal Botanic Garden, we were all subsequently delighted to see these appointments conferred upon Professor Bayley Balfour, a person so well qualified for these important situations, and on whom the mantle of his late honoured and revered father had fallen, and we trust that he will long be spared to maintain and even advance the reputation of the Botanical Chair in our University.

But whilst the Society has had occasion to deeply mourn the loss of so many distinguished members, it had also cause to rejoice in its continued prosperity. The past Session will compare favourably with the former ones for the number and value of its communications, several of these being communications of the highest scientific value. We have in this Society several young and enthusiastic botanists, who are working in various departments of the science, and several of these furnished us with valuable communications during the past Session. In the department of field botany we had interesting papers from Mr Scott Elliot on the Flora of the Canary Islands, from Mr Landsborough on the Flora of California, from Mr Bennett on additions to the Scottish Flora, from Mr Gray on the Flora of Sutherlandshire, besides reports from the Camp Committee and the Scottish Alpine Botanical Club.

In other departments of the subject we had excellent contributions from Professor Balfour, Mr Geddes, Mr Sewell, Mr Fothergill, Mr John Wilson, and Mr Turnbull. We had a further communication from Dr Christison on the Measurement of Trees, and I am sure I express the mind of every member of this Society when I say that we are greatly indebted to Dr Christison for so vigorously carrying on this elaborate work which was begun by his late honoured father. We had also valuable communications from Mr Traill of Joppa on the Marine Algæ of the Firth of Forth; whilst Mr Lindsay favoured us from month to month with his careful and very interesting papers on the Temperature and Vegetation at the Royal Botanic Garden; and lastly, I must not forget to mention the very valuable contribution to botanical science of Professor Trail on the Galls of Norway. This is a subject in which Professor Trail is well known to be a devoted worker, and his paper is one of the most valuable that has appeared in our *Transactions* for several years. We expect another communication from Professor Trail this Session on the Fungi of Norway, and this paper will greatly enrich our *Transactions.*

There is another subject of the utmost importance to this Society, to which I must refer before I close, namely, the transfer of the Royal Botanic Garden from the Crown to the University of Edinburgh. This subject has already engaged the attention of the Society, and must of necessity do so still. If such a transfer should take place, it will be unfortunate for this Society, and for horticulture and botanical science in Scotland.

It is a curious and significant fact, that this transference is desired only by Government—but by Government of both shades of politics—and by no other party. The University authorities do not wish it; the Town Council and the citizens of Edinburgh are equally opposed to it; the Regius Keeper and other officials in the Garden are also strongly opposed to it; and notwithstanding this powerful opposition, one Government after another has tried to force this upon us. It becomes all of us, therefore, to use whatever influence we possess with members of Parliament to prevent such an unfortunate transference. If London has a Kew, and Dublin a Glasnevin, surely Edinburgh should have her Royal Botanic Garden in Inverleith Row. I wish the University authorities could influence their Lord Rector to save the University from what the late Professor Dickson said could only be a "white elephant" to them. The removal of the clause about the Botanic Garden from the Universities Bill need not affect the passing of the Bill in the least.

I have also to congratulate the Society on the publication of the *Transactions* of the past Session in time to be delivered to the members at our first meeting of a new Session.

During the past Session there have been added to our list 12 Resident Fellows, 2 Non-Resident Fellows, and 2 Foreign Fellows,—in all, 16 new members, which is above the average.

We are to-night commencing the 53rd Session of our Society, and I hope the Session of 1888–89 will be one of great prosperity.

The Society now numbers 29 Honorary Fellows, four of whom are Royal Personages; 147 Resident Fellows, 199 Non-Resident Fellows, 68 Foreign Fellows, 10 Lady Associates, and 30 Associates,—in all, 453 members.

Excursion of the Scottish Alpine Botanical Club to Sutherland and Caithness in 1888. By WILLIAM CRAIG, M.D., F.R.C.S.E., F.R.S.E.

(Read 8th November 1888.)

The Annual Excursion of the Scottish Alpine Botanical Club last autumn was to Sutherland and Caithness, the two principal centres being Tongue and Thurso. The following members were present:—Mr William B. Boyd, Vice-President; Rev. George Alison, Chaplain; Dr A. P. Aitken, Dr Charles Stuart, Mr P. Neill Fraser, Mr Robert Lindsay, Mr A. H. Evans, Captain Norman, Mr G. H. Potts, and Dr William Craig. There was also present as a visitor Mr J. K. Milne of Kevock Tower. At the business meeting of the Club suitable reference was made to the irreparable loss which the Club had sustained since last meeting by the sudden and lamented death of our honoured and beloved President, Professor Alexander Dickson. It was felt by us all that by his untimely death, in the prime of his manhood and in the midst of his usefulness, botanical science had lost one of its most enthusiastic votaries and most accomplished exponents, and that our own little Club had lost its most loved and honoured member.

Professor Isaac Bayley Balfour was elected President, in room of the late Professor Dickson, and all the other office-bearers were reappointed. The Club elected one new member, Rev. W. W. Peyton, Broughty Ferry, a most accomplished geologist and a very enthusiastic botanist. Mr Peyton was present with us in all our excursions.

The majority of the members left on Friday 27th July, and spent the night at Blair Athole. They stayed at the Athole Arms Hotel, the "Blair Athole Inn" famed in the battle of Glen Tilt. It has now developed into one of the large hotels of the Highlands. Early next morning we left Blair Athole, and travelled by the express train to Sutherland, and took up our quarters at the Station Hotel, Invershin. This hotel is beautifully situated on the north side of the Kyle of Sutherland. It has recently been newly furnished, and is now one of the most charming inns in the Highlands. Here we were very well entertained by Mr and Mrs Mackenzie, our host and hostess. Nothing could exceed their kindness and attention, and here we had all the luxuries of a private mansion in the city. We reached Invershin about 3 P.M., and so had time to examine the flora along this part of the Kyle of Sutherland. Among the places visited were the Falls of the Shin. Of the plants observed may be mentioned:—*Trollius europæus*, Linn.; *Reseda lutea*, Linn.,—growing on the railway bank above Invershin station; *Viola lutea*, var. *amœna*, Syme; *Drosera anglica*, Huds. This species was the common one in those districts of Sutherland visited by the Club. *Filago minima*, Fr.; *Senecio sylvaticus*, Linn., var. *lividus*, Sm. This form is not uncommon on the roadsides in this district of Sutherland. The late Professor Graham in 1827 found the same variety "abundant on the roadsides near Lairg," in the present district. *Arctostaphylos Uva-ursi*, Spreng.; *Pyrola media*, Sw.,—in beautiful flower; *Trientalis europæa*, Linn.; *Scrophularia nodosa*, Linn.; *Scutellaria galericulata*, Linn.; *Populus tremula*, Linn.; *Listera ovata*, R. Br.; *Sparganium minimum*, Fr.; *Triglochin palustre*, Linn.; *Potamogeton natans*, Linn.; *Eriophorum latifolium*, Hoppe; *Carex glauca*, Murr.; *C. binervis*, Sm.; *Melica nutans*, Linn.; *Brachypodium sylvaticum*, Roem.; *Polypodium Phegopteris*, Linn.; *P. Dryopteris*, Linn.; and *Selaginella selaginoides*, Gray.

Monday, 30th July.—We left Invershin this morning about eight o'clock for Tongue. We posted all the way,—about 45 miles. We went by Lairg and Altnaharrow. The day was fine, and we had a pleasant drive. The greater part of the road was rather dreary. We passed through vast tracts of moorland, which tended to make the journey somewhat monotonous. We reached Tongue early in the afternoon, and took up our quarters in Campbell's Hotel. Before dinner we had a walk down to the shore, and observed the following plants:—*Cochlearia danica*, Linn.; and *Aster Tripolium*, Linn.; *Asplenium Adiantum-nigrum*, Linn.; *A. Trichomanes*, Linn. In a ditch on the roadside near Tongue we observed *Myosotis cæspitosa*, Schultz, and *Pinguicula lusitanica*, Linn.

Tuesday, 31st July.—Our excursion to-day was to Beinn Laoghal, a mountain 2504 feet in height. This is a beautiful mountain, and has several distinct summits. After a walk of 3 or 4 miles, we arrived at the foot of the mountain, and ascended it from the west side. To-day we were accompanied by Dr Gunn of London; and it is right to mention that Mr Mitchell of Ribigill, the lessee of the shootings of Beinn Laoghal, kindly gave us full permission to examine the mountain, and in addition sent his keeper to act as our guide. The day was fine, and we had a very enjoyable excursion. Among the plants collected may be mentioned:—*Thalictrum alpinum*, Linn.; *Cochlearia alpina*, Wats.; *Viola canina*, Linn.; *Viola lutea*, var. *amœna*, Syme; *Polygala vulgaris*, Linn.; *Silene acaulis*, Linn.; *Cerastium alpinum*, Linn.; *Stellaria Holostea*, Linn.; *Sagina Linnæi*, Presl; *Montia fontana*, Linn.; *Hypericum pulchrum*, Linn.; *Linum catharticum*, Linn.; *Oxalis Acetosella*, Linn.: *Lotus corniculatus*, Linn.; *Vicia lutea*, Linn.; *Lathyrus macrorrhizus*, Wimm.; *Spiræa Ulmaria*, Linn.; *Rubus saxatilis*, Linn.; *R. Chamæmorus*, Linn.; *Geum rivale*, Linn.; *Potentilla Sibbaldi*, Hall; *Alchemilla alpina*, Linn.; *Saxifraga oppositifolia*, Linn.; *S. stellaris*, Linn.; *S. aizoides*, Linn.; S. *hypnoides*, Linn.; *Chrysosplenium oppositifolium*, Linn.; *Sedum Rhodiola*, DC.; *Drosera rotundifolia*, Linn.; *D. anglica*, Huds.: *Epilobium palustre*, Linn.; *E. alsinefolium*, Vill.; *E. alpinum*, Linn.; *Pimpinella Saxifraga*, Linn.; *Conopodium denudatum*, Koch.; *Angelica sylvestris*, Linn.: *Cornus suecica*, Linn.; *Galium saxatile*, Linn.; *G. palustre*, Linn.; *Asperula odorata*, Linn.; *Valeriana dioica*, Linn.; *Solidago Virgaurea*, Linn.; *S. cambrica*, Huds.,—we saw many plants in beautiful flower not more than 2 inches in height; *Antennaria hyperborea*, Don: *Gnaphalium supinum*, Linn.; *Achillea Ptarmica*, Linn.; *Matricaria inodora*, Linn.; *Senecio aquaticus*, Huds.; *Saussurea alpina*, DC.: *Vaccinium Vitis-Idæa*, Linn.; *V. Myrtillus*, Linn.; *Arctostaphylos alpina*, Spreng.; *A. Uva-ursi*, Spreng.; *Loiseleuria procumbens*, Desv.; *Armeria maritima*, Willd.; *Primula vulgaris*, Huds.; *Lysimachia nemorum*, Linn.; *Gentiana campestris*, Linn.; *Lycopsis arvensis*, Linn.; *Digitalis purpurea*, Linn.; *Veronica humifusa*, Dicks.;

Melampyrum montanum, Johnst.; *Pinguicula vulgaris*, Linn.; *Thymus Serpyllum*, Fr.; *Myrica Gale*, Linn.; *Betula glutinosa*, Fr.; *Alnus glutinosa*, Linn.; *Salix aurita*, Linn.; *S. herbacea*, Linn.; *Empetrum nigrum*, Linn.; *Listera cordata*, R. Br.; *Orchis mascula*, Linn.; *O. maculata*, Linn.; *Habenaria viridis*, R. Br.; *Iris Pseud-acorus*, Linn.,—very abundant; *Narthecium ossifragum*, Huds.; *Juncus bufonius*, Linn.; *J. squarrosus*, Linn.; *J. conglomeratus*, Linn.; *J. supinus*, Mœnch; *J. lampocarpus*, Ehrh.; *J. acutiflorus*, Ehrh.; *Luzula maxima*, DC.; *L. spicata*, DC.; *L. campestris*, DC.; *L. congesta*, Koch; *Triglochin palustre*, Linn.; *Eleocharis palustris*, R. Br.; *Scirpus cæspitosus*, Linn.; *Eriophorum vaginatum*, Linn.; *E. angustifolium*, Roth; *Rhynchospora alba*, Vahl; *Schœnus nigricans*, Linn.; *Carex echinata*, Murr.; *C. rigida*, Good.; *C. glauca*, Murr.; *C. pilulifera*, Linn.; *C. panicea*, Linn.; *C. binervis*, Sm.; *C. flava*, Linn.; *Phragmites communis*, Linn.; *Brachypodium sylvaticum*, Roem.; *Hymenophyllum unilaterale*, Borg.,—very abundant on one part of the hill; *Asplenium Adiantum-nigrum*, Linn.; *Cystopteris fragilis*, Bernh.; *Lastrea dilatata*, var. *alpina*, Moore. Professor Graham mentions that, during his excursion to Sutherland in 1827, he visited Beinn Laoghal, and that he found "a remarkable variety of this fern, with long straggling alternate pinnæ," on the side of the mountain towards Tongue. We also found several plants of the same variety in the same situation. We also gathered a large quantity of that variety of *Lastrea dilatata*, Presl, known as *erosa*: *Polypodium Dryopteris*, Linn.; *P. Phegopteris*, Linn.; *Botrychium Lunaria*, Sw.; *Lycopodium Selago*, Linn.; *L. clavatum*, Linn.; *L. alpinum*, Linn.; *Selaginella selaginoides*, Gray.

On the invitation of Mr and Mrs Mitchell, we called at Ribigill on our way down from the mountain, and were most hospitably entertained. After a very enjoyable day, we arrived at our hotel in good time for dinner.

Wednesday, 1st August.—To-day the party divided, some going to the shore and examining the rocks along the coast, whilst the others visited Ben Hope. Those who went to the shore observed the following plants:—*Aster Tripolium*, Linn.; *Listera ovata*, R. Br.; *Epipactis latifolia*, Sw.; *Orchis latifolia*, Linn.; *Habenaria bifolia*, R. Br.; *Scilla verna*, Huds.; *Triglochin maritimum*, Linn.; *Carex arenaria*, Linn.; *Asplenium Adiantum-nigrum*, Linn.; *A. marinum*, Linn.; *A. Trichomanes*, Linn.; *A. Ruta-muraria*, Linn.; *Scolopendrium vulgare*, Symons.

The day was again fine, and those who went to Ben Hope had a most enjoyable excursion. Having engaged a waggonette, we drove to Kinloch House, the residence of Mr Deverell, the lessee of the shootings of Ben Hope, a distance of 6 miles from Tongue. Here we left our conveyance. Mr Deverell kindly granted us permission to examine Ben Hope, and sent his keeper to act as our guide. The walk from Kinloch House to Ben Hope is about 6 miles. Ben Hope rises to a height of 3040 feet, and is the fourth highest mountain in Sutherland. We reached the summit about noon, and had a most extensive view, the island of Lewis being distinctly visible. The best rocks on Ben Hope are on the west side of the mountain, which we had not time to examine. Among the plants collected may be mentioned:—*Thalictrum alpinum*, Linn.; *Caltha minor*, Syme; *Nymphæa alba*,—very abundant in several lochs; *Cochlearia alpina*, Wats.; *Viola palustris*, Linn.; *Silene acaulis*, Linn.; *Cerastium alpinum*, Linn.; *Montia fontana*, Linn.; *Hypericum pulchrum*, Linn.; *Linum catharticum*, Linn.; *Oxalis Acetosella*, Linn.; *Lotus corniculatus*, Linn.; *Lathyrus macrorrhizus*, Wimm.; *Spiræa Ulmaria*, Linn.; *Rubus saxatilis*, Linn.; *R. Chamæmorus*, Linn.; *Alchemilla alpina*, Linn.; *Saxifraga oppositifolia*, Linn.; *S. stellaris*, Linn.; *S. aizoides*, Linn.; *S. hypnoides*, Linn.; *Chrysosplenium oppositifolium*, Linn.; *Sedum Rhodiola*, DC.; *Drosera rotundifolia*, Linn.; *D. anglica*, Huds.; *Epilobium palustre*, Linn.; *E. alpinum*, Linn.; *Pimpinella Saxifraga*, Linn.; *Cornus suecica*, Linn.; *Lonicera Periclymenum*, Linn.; *Galium saxatile*, Linn.; *G. palustre*, Linn.; *Valeriana officinalis*, Linn.; *Solidago Virgaurea*, Linn.; *S. cambrica*, Huds.; *Antennaria hyperborea*, Don; *Gnaphalium supinum*, Linn.; *Achillea Ptarmica*, Linn.; *Centauria scabiosa*, Linn.; *Leontodon autumnalis*, Linn.; *Lobelia Dortmanna*, Linn.; *Vaccinium Vitis-Idæa*, Linn.; *V. uliginosum*, Linn.; *V. Myrtillus*, Linn.; *Arctostaphylos alpina*, Spreng.,—very abundant; *A. Uva-ursi*, Spreng.; *Loiseleuria procumbens*, Desv.; *Armeria maritima*, Willd.; *Gentiana campestris*, Linn.; *Menyanthes trifoliata*, Linn.; *Digitalis purpurea*, Linn.;

Veronica humifusa, Dicks.; *Melampyrum montanum,* Johnst.; *Pinguicula vulgaris,* Linn.; *Thymus Serpyllum,* Fr.; *Polygonum viviparum,* Linn.; *Oxyria digyna,* Hill; *Myrica Gale,* Linn.; *Betula glutinosa,* Fr.; *Alnus glutinosa,* Linn.; *Salix herbacea,* Linn.; *Empetrum nigrum,* Linn.; *Juniperus nana,* Willd.; *Listera cordata,* R. Br.; *Habenaria viridis,* R. Br.; *Iris Pseud-acorus,* Linn.; *Narthecium ossifragum,* Huds.; *Tofieldia palustris,* Huds.; *Juncus trifidus,* Linn.; *J. supinus,* Mœnch; *J. lampocarpus,* Ehrh.; *Luzula spicata,* DC.; *L. campestris,* DC.; *Triglochin palustre,* Linn.; *Potamogeton polygonifolius,* Pour.; *Scirpus cæspitosus,* Linn.; *Eriophorum vaginatum,* Linn.; *E. angustifolium,* Roth; *E. latifolium,* Hoppe; *Schœnus nigricans,* Linn.,—very abundant; *Carex pulicaris,* Linn.; *C. echinata,* Murr.; *C. rigida,* Good.; *C. glauca,* Murr.; *C. pilulifera,* Linn.; *C. pallescens,* Linn.; *C. panicea,* Linn.; *C. binervis,* Sm.; *Avena pratensis,* Linn.; *Kœleria cristata,* Pers.; *Athyrium alpestre,* Milde; *Cystopteris fragilis,* Bernh.; *Lastrea spinulosa,* Presl,—some good varieties of this fern were found; *L. dilatata,* var. *alpina,* Moore; *Polypodium Dryopteris,* Linn.; *P. Phegopteris,* Linn.; *Osmunda regalis,* Linn.,—only a few plants of this fern were seen,—it was, however, growing on both banks of the stream, and several of the plants were evidently seedlings; *Botrychium Lunaria,* Sw.; *Equisetum sylvaticum,* Linn.; *Lycopodium Selago,* Linn.; *L. alpinum,* Linn.; *Selaginella selaginoides,* Gray.

On the invitation of Mr and Mrs Deverell, we were most hospitably entertained to tea at Kinloch House on our way home. Our conveyance met us here, and we got safely back to Tongue in time for a nine o'clock dinner.

Thursday, 2nd August.—We left Tongue this morning for Thurso, having engaged conveyances to drive us as far as Melvich. At Bettyhill Inn, on the mouth of the Naver, about 14 miles from Tongue, we rested the horses fully two hours, to enable us to examine the botany of Farr Head. The day was very fine, and we found this part of the coast very productive. We were prepared to find some good plants here, for Professor Graham in 1827 visited the place, and recorded some good finds. We had only two hours to examine the district, and among the plants collected may be mentioned:—*Thalictrum minus,* var. *maritimum,* Syme; *Nymphæa alba,* Linn.,—was seen in several lochs; *Fumaria officinalis*

Linn.; *Draba incana*, Linn.; *Cochlearia danica*, Linn.; *Cakile maritima*, Scop.; *Silene maritima*, With.; *Oxalis Acetosella*, Linn.; *Ononis inermis*, Lange; *Anthyllis Vulneraria*, Linn.,—a white variety; *Lotus corniculatus*, Linn.; *Oxytropis uralensis*, DC.,—very abundant; *Dryas octopetala*, Linn.; *Saxifraga aizoides*, Linn.: *Parnassia palustris*, Linn.; *Sedum Rhodiola*, DC.; *S. acre*, Linn.; *Pimpinella Saxifraga*, Linn.; *Ligusticum scoticum*, Linn.; *Daucus Carota*, Linn.; *Scabiosa arvensis*, Linn.; *Chrysanthemum segetum*, Linn.; *Matricaria maritima*, Linn.,—very abundant on the rocks; *Artemisia vulgaris*, Linn.; *Senecio Jacobæa*, Linn., var. *flosculosus*, Jord.,—this is a remarkable variety without the ray; *Centaurea scabiosa*, Linn.; *C. Cyanus*, Linn.; *Hypochæris radicata*, Linn.; *Tragopogon pratensis*, Linn.; *Arctostaphylos Uva-ursi*, Spreng.; *Armeria maritima*, Willd.; *Primula veris*, Linn.; *P. scotica*, Hook.,—very abundant, and several plants quite sessile—the variety *acaulis*, Lond. Cat.; *Gentiana campestris*, Linn.; *Menyanthes trifoliata*, Linn.; *Lycopsis arvensis*, Linn.; *Digitalis purpurea*, Linn.; *Pinguicula vulgaris*, Linn.; *Thymus Serpyllum*, Fr.; *Plantago maritima*, Linn.; *P. coronopus*, Linn.; *Salix repens*, Linn.; *Orchis latifolia*, Linn.; *Habenaria viridis*, R. Br.; *Iris Pseud-acorus*, Linn.; *Scilla verna*, Huds.,—very abundant; *Juncus squarrosus*, Linn.; *J. acutiflorus*, Ehrh.; *Luzula campestris*, DC.; *Scirpus cæspitosus*, Linn.; *Eriophorum vaginatum*, Linn.; *E. angustifolium*, Roth; *Schœnus nigricans*, Linn.; *Carex incurva*, Lightf.; *C. arenaria*, Linn.; *Kœleria cristata*, Pers.; *Asplenium Adiantum-nigrum*, Linn.

Farr Head is rich botanical ground, and well worthy of a more extended search than we were enabled to give it. Having thus rested our horses for fully two hours, and improved the time by examining the district, we resumed our journey, our next resting-place being Melvich, a small inn near the confines of Caithness, and situated on the west of Halladale river. Here we had luncheon, and dismissed the carriages which had brought us on from Tongue. Melvich is 28 miles from Tongue, and 20 miles from Thurso. Here carriages from Thurso met us, and conveyed us in safety to our destination. At Thurso we were very comfortably entertained in Henderson's Royal Hotel.

Friday, 3rd August.—Our excursion to-day was to Dunnet Head. We drove by Castletown and Dunnet as far as the small village of Brough. The morning was very fine, and the day looked promising. It soon, however, began to rain very heavily, which caused one half of the party to return much sooner than was intended. Others, however, remained till the afternoon; and some went as far as Dunnet Lighthouse, which stands on the most northerly point of land on the mainland of Scotland. The rocks were productive of some good plants. Among the plants gathered were—*Artemisia vulgaris*, Linn.; *Conium maculatum*, Linn.,—this plant was very abundant on the roadsides near Thurso; *Vaccinium Vitis Idæa*, Linn.; *V. Myrtillus*, Linn.; *Arctostaphylos Uva-ursi*, Spreng.; *Primula vulgaris*, Huds.; *P. veris*, Linn.; *P. scotica*, Hook.; *Anagallis tenella*, Linn.,—abundant at St John's Loch, near Dunnet; *Gentiana campestris*, Linn.; *Menyanthes trifoliata*, Linn.; *Polemonium cœruleum*, Linn.,—on a moor in the middle of Dunnet Head. It was found by Mr Potts far from any house, and it is just possible it may have been an escape from a garden. The plant, however, is a native of the far north, and is one of the few flowering plants found in Spitzbergen, and this is just such a locality for its being truly wild as any other in Britain. It was very interesting to find this plant in the midst of a moor on the most northerly point of land in Scotland. *Lycopsis arvensis*, Linn.; *Digitalis purpurea*, Linn.; *Veronica Anagallis*, Linn.; *Pinguicula vulgaris*, Linn.; *Plantago maritima*, Linn.; *P. coronopus*, Linn.; *Salix repens*, Linn.; *Empetrum nigrum*, Linn.; *Orchis latifolia*, Linn.; *Iris Pseud-acorus*, Linn.; *Juncus balticus*, Willd.; *Eleocharis palustris*, R. Br.; *Asplenium marinum*, Linn.,—abundant; *Selaginella selaginoides*, Gray.

Two of our number—Dr Stuart and Captain Norman—went to Sutherland by Caithness, and spent two nights at Thurso on their way to join us. Whilst at Thurso they visited Holburn Head, to the north-west of Thurso. On the Head they saw abundance of *Lychnis diurna* and *Primula scotica*, some of the plants of Primula being sessile—the var. *acaulis*. They observed a curious form of *Anthyllis vulneraria* in the cracks in the layers of sandstone. The plant was minute in habit, the flowers being crimson outside and white-coloured inside. This variety is mentioned in a pamphlet on Caithness by Canon Fox. They also gathered *Juncus balticus* on the Thurso river.

Saturday, 4th August.—We all left Thurso this morning. Captain Norman and Mr Evans went to Wick, and were successful in gathering on the Wick river *Eleocharis uniglumis,* Link.; *Carex salina,* var. *kattegatensis,* Fr.; and *Carex Watsoni*; and near Castletown, *Calamagrostis strigosa,*—all very rare plants in Britain.

The rest of the party returned by train. Leaving Wick at 8 A.M., we only reached Edinburgh at 10 P.M., after a long and wearisome journey.

We were all delighted with our trip to the extreme north of the mainland of Scotland. With the exception of Farr Head, the parts botanised were not rich botanically. This, however, was a rich field, and we were all sorry we had not more time to examine it. We were disappointed in not finding *Luzula arcuata,* Swartz, either on Beinn Laoghal or Ben Hope, although it must grow on both these mountains. On Ben Hope we spent a considerable time looking for it in the very kind of places where it generally grows. It is worthy of note that on a great portion of Ben Hope *Arctostaphylos alpina* was very abundant, in fact the only vegetation on certain parts. We had far too little time to do this mountain justice.

On the rocks on Dunnet Head, Mr Lindsay gathered a plant in fruit which has not yet been identified. Cuttings of it, however, are growing in the Royal Botanic Garden, and it will be identified when it flowers. It apparently belongs to the Compositæ.

On Beinn Laoghal, Mr Boyd gathered two mosses, *Splachnum sphæricum* and *Tetraplodon mnioides.*

Observations on the Wood of certain Resin-Producing Trees. Part II. By A. Galletly.

(Read 13th December 1888 and 10th January 1889.)

I begin this second note on the resinous and other characters of some woods with that of the *Dalbergia cultrata*, since it links on with the other woods belonging to that genus referred to in my former communication on this subject.*

Mr Gamble, in his book on Indian Timbers, points out that, contrary to the general rule, the genus *Dalbergia* is one of which the component species yield woods of a dissimilar type. Among Indian species the *D. latifolia, D. Sissoo,* and *D. cultrata* have hard, heavy, dark-coloured highly resinous heart-woods. On the other hand, *D. lanceolaria* and *D. paniculata* have no heart-wood, differing in its appearance from the secondary wood, and the timber obtained from them is light coloured and of low specific gravity. It very probably contains only a small quantity of resinous matter, but this point has yet to be determined.

As the timber of the *Dalbergia cultrata* resembles, in its physical properties, that of the other two Indian species of *Dalbergia* with dark heart-woods, so it nearly resembles them in its resinous character. It is the heaviest of the three, and appears to vary less in its specific gravity than the wood of *D. latifolia,* which is known in this country as Indian rosewood. The dark heart-wood of these three species is strong, close-grained, very durable, and much liked in India for constructive and ornamental purposes. It has been ascertained that the *Sissoo* wood is one of the best ever tried for the construction of gun carriages. Experiments prove that the wood of *D. cultrata* is even stronger than that of *D. Sissoo*, as well as harder and heavier. The annexed figures show that the amount of resinous matter obtained from a specimen of this wood, when treated with the solvents used in former experiments, is not far short of what was extracted from *D. latifolia* and *D. Sissoo.*

Wood of *Dalbergia cultrata* (specific gravity, 1·064) gave resinous extract—

* *Trans. Bot. Soc. Edin.*, vol. xvi. p. 371.

With naphtha, . .	2·026	per cent.
With ether, . . .	5·200	,,
With alcohol, . .	7·418	,,

The naphtha extract from this species is a soft yellow substance without the odour, or at least without the distinct odour, of ordinary pine resin, which that from some other species of *Dalbergia* gives on heating.

On the other hand, the resins extracted by ether and alcohol, which are almost the same in their nature, nearly agree in their characters with those obtained from several other dark woods belonging to this genus. These dark and brittle resins from the *cultrata* species are—

1. Insoluble in bisulphide of carbon.
2. Do. in spirits of turpentine.
3. Do. in olive oil.
4. Slightly soluble in benzole.
5. Do. in chloroform.
6. Soluble in acetic acid.
7. Readily soluble in acetone.

SAL—*Shorea robusta.*—This is a large gregarious tree forming extensive forests in India. It yields one of the most important woods of that country, and is hard, heavy, and cross-grained. Gamble says of this timber that it seasons with difficulty, that during the process it dries with great rapidity on the surface, while beneath it remains as wet as when first cut, and evaporation goes on afterwards with extreme slowness. Even when well dried, it absorbs moisture with avidity in wet weather. Nevertheless, when once thoroughly seasoned, it is a wood which stands almost without a rival for strength, elasticity, and durability. Sal is the timber most extensively used in Northern India for constructive purposes, being in request for piles, parts of bridges, railway sleepers, and house carpentry.

The Sal tree, when tapped, yields large quantities of a pale, transparent, aromatic resin called dammar.

Wood of *Shorea robusta* (specific gravity, ·970) gave resinous extract—

With naphtha, . .	1·000	per cent.
With ether, . . .	·920	,,
With alcohol, . .	8·020	,,

Naphtha Resin.—The solution on cooling shows whitish flocculent matter separating, proving that at least a portion of it is not very soluble in cold naphtha, and therefore different from ordinary pine resin. It is brittle, semitransparent, and pale yellow in colour. In cold alcohol this resin is insoluble, but when the spirit is heated the resin turns opaque, and swells without wholly dissolving. Nitric and sulphuric acids give with it no reactions.

The alcohol resin of Sal is darkish brown in colour and brittle. It is—

1. Insoluble in bisulphide of carbon.
2. Do. in spirits of turpentine.
3. Do. in benzole.
4. Do. in chloroform.
5. Do. in olive oil.
6. Very soluble in acetone.

This resin has no marked reaction with sulphuric acid. In nitric acid it dissolves, and turns dark brown.

The ether resin is light brown and brittle. It gives no reaction with sulphuric, but with nitric acid it turns dark brown. The quantity of it obtained was too small to test its solubilities.

LIGNUM VITÆ.—The *Guaiacum officinale* which yields this wood is a slow-growing evergreen tree, native of Jamaica, Cuba, and other West Indian Islands, and also of some of the northern parts of the South American continent. The older accounts of this tree state that it attains a great size. On the other hand, Bentley and Trimen, in their recent work on Medicinal Plants, give its height at from 20 to 30 feet; while Laslett, an excellent authority, says that it is from 30 to 40 feet high. Can it be, that, owing to *Lignum vitæ* being much in demand, the trees are now cut down at a younger age than formerly?

The heart-wood of *Guaiacum* is of a brownish colour, changing apparently to a peculiar greenish-brown, after a fresh cut surface has been exposed a short time to the air. As is the case with many other woods, the colour is due to the resin which it contains. The sap wood, though durable, is said to contain little or no resin, but I am not aware whether this has been determined by experiment. The heart-wood at all events contains an exceptionally large amount of resin—part of it being the well-known medicinal guaiacum resin—which is obtained as a natural exudation or by incisions made in the bark. *Lignum vitæ* is so heavy, hard, tough, and even when exposed to much friction, so lasting, that perhaps more than any other wood whose properties are known, it approaches a moderately hard metal in strength and resistance to wear. Sheaves of pulley-blocks made of it have been known to last in constant use for seventy years. It has one remarkable application, namely, its use for the particular bush, or bearing of the screw shaft of steamships, next to the screw itself, where only a substance able to bear much friction could possibly last for any length of time. Its highly resinous character renders it self-lubricating in a position where no other lubricant is practicable except water.

The following figures show that the amount of resinous matters obtained from *Lignum vitæ* (duramen) reaches the high total of 30 per cent. of the wood.

Wood of *Guaiacum officinale* (specific gravity, 1·332) gave resinous extract—

With naphtha, . .	9·400 per cent.
With ether, . .	18·370 ,,
With alcohol, . .	2·220 ,,

The specific gravity of a second specimen tried was 1·287.

The naphtha extract is a soft, very sticky resin, adhering to the evaporating basin, and drawing out in long strings when touched with the finger. It has a yellowish-grey colour and an odour recalling gum benzoin. It is only slightly soluble in turpentine, ether, alcohol, and even in acetone, thus differing in a marked way from the naphtha resins of almost all the other woods examined. But it is soluble to a greater extent in carbon bisulphide. Sulphuric and nitric acids darken it slowly, but with fuming sulphuric acid it gives a deep blood-red colour. It does not harden in the air-bath at 150° C., and it gives only slight indications of the blue reactions characteristic of ordinary guaiacum resin.

The ether resin is a brittle brown substance, and is—

1. Insoluble in bisulphide of carbon.
2. Partially soluble in hot turpentine, but separating out on cooling.

3. Partially soluble in warm benzole.
4. Do. in warm chloroform.
5. Insoluble in olive oil.
6. Soluble in acetone.

It has the properties of ordinary medicinal guaiacum resin as to acid and soda reactions. The tincture, spread on blotting paper and held over chlorine or bromine water, or nitric acid, gives at once a splendid deep blue. This colour is also got by adding a drop of ferric chloride to the tincture. The colours disappear rapidly in excess of reagents, so that they must be applied cautiously.

The alcohol resin has a rather darker appearance than the ether one. It is evidently the same body obtained in small quantity, on account of the higher boiling point of the spirit enabling it to act more searchingly on the fibre of the wood. The alcohol resin gives a black with sulphuric and a greenish-black with nitric acid at once.

Purple Heart—*Copaifera Martii.*—This wood appears to have been first imported into England in the decade 1820–30. The tree is a large one, the wood being hard and strong, but containing a compartively small proportion of resinous matter. It is not very easily dressed, being what workmen call stringy. Its peculiar colour had plainly at once attracted notice in England, for soon after its introduction it was employed for parquetry floors at Windsor Castle, Buckingham Palace, and other important buildings.

A remarkable property of this wood is its behaviour when exposed to light after being freshly cut. It has an unattractive brown colour when newly split and newly planed, but unless kept in the dark, it becomes, sometimes in the course of a few hours, at other times after the exposure of a day or two, of a fine purple colour. This is no doubt caused by the oxidation of its resinous colouring matter. Experienced cabinetmakers say that the purple colour is fairly permanent. It does, however, sometimes alter in the course of years. But even if it becomes dingy, a slight paring of the surface will serve to restore the colour.

The "purple heart" appears to be one of the trees which yields balsam of copaiba. It is a native of British Guiana and North Brazil. It is there used for constructive purposes, being a strong and durable wood. The Indians of Guiana use it for the shafts of arrows and its bark for canoes.

Purple heart wood (specific gravity, ·927) gave resinous extract—

With naphtha, . .	·100	per cent.
With ether, . . .	·690	,,
With alcohol, . . .	4·540	,,

Naphtha Resin.—Quantity got exceptionally small; solution yellowish, resin brown and hard, but not brittle; not readily soluble in cold alcohol. It gives a dark wine colour with sulphuric acid, but no reaction with nitric acid.

Ether Resin.—Solution a fine pink, bleaching in the light; resin powdery, not very brittle, pinkish in colour.

Alcohol Resin.—Solution a fine purple of a very deep colour; resin of the same colour but very nearly black; brittle, scaling off basin. It is—

1. Insoluble in bisulphide of carbon.
2. Do. in cold turpentine.
3. Do. in benzole.
4. Do. in chloroform.
5. Do. in olive oil.
6. Soluble in glacial acetic acid.
7. Do. in acetone.
8. In heated turpentine it swells largely into a semi-transparent purple mass.

Gives a very dark brown with nitric and an almost black colour with sulphuric acid.

TULIP WOOD, the product of *Physocalymma floribundum*, a Brazilian tree.—This wood is only used for inlaying costly furniture or small ornamental articles. Some specimens are striped like the petals of a tulip. Many woods are more beautifully figured, but perhaps none are more delicately yet richly coloured than some examples of tulip wood. Its rose-red bands or streaks render it extremely well suited for inlaying, but its colour unfortunately fades somewhat if much exposed to the light. The French botanist Vesque calls it *le véritable bois de rose.*

It is hard and heavy, and contains a considerable quantity of resin, which can be seen by the naked eye in some of the larger pores of the wood.

Tulip wood (specific gravity, 1·113) gave resinous extract—

With naphtha, . .	·600 per cent.
With ether, . . .	2·200 „
With alcohol, . . .	5·460 „

Naphtha Resin.—The solution is colourless, but dries up to a semi-liquid yellow resin, spreading over the dish as it evaporates. It gives a greenish reaction with nitric acid. With sulphuric acid it is at first greenish, but turns brown.

Ether Resin.—In solution a fine ruby colour. The resin is a fine reddish-brown when dry, and is brittle if well dried. It is—

1. Insoluble in bisulphide of carbon.
2. Do. in turpentine.
3. Do. in benzole.
4. Do. in chloroform.
5. Do. in olive oil.
6. Soluble in acetone, with its ruby colour.
7. Do. in glacial acetic acid, with brown colour.

The alcohol resin has the same solubilities with similar but more intense colours. It is brittle when fully dried. The coloration with sulphuric acid is greenish-black, and with nitric acid nearly black.

MYALL WOOD—Spearwood.—*Acacia homalophylla.*—This is an Australian tree of small size, growing on salt-bush plains on the Murray River and on barren scrubs from the Lachlan to the Barren Range. The heart-wood is dark brown, hard, and with a smell resembling that of violets. It was used by the aborigines for making spears, and the name spearwood is sometimes given to it by the colonists, who consider it an excellent wood for cabinetmaking. It is well known in this country through its being used for tobacco pipes.

Myall wood (specific gravity, 1·060) gave resinous extract—

With naphtha, . .	·380 per cent.
With ether, . . .	5·040 „
With alcohol, . . .	7·380 „

The naphtha resin in solution has a fine rich yellow colour. The resin itself remains soft, and on drying loses this colour, which does not re-appear on being again dissolved. It is only slightly soluble in cold alcohol, but readily in acetone. Sulphuric acid gives with it a deep brown at once, but nitric acid produces no colour.

The ether resin is dark brown in colour. It is—

1. Insoluble in bisulphide of carbon.
2. Do. in turpentine.
3. Do. in benzole.
4. Do. in chloroform.
5. Do. in olive oil.
6. Readily soluble in acetone.

The alcoholic resin is brittle and dark brown. It is the same in soluble characters as that got with ether. Both give reddish-brown with nitric and brown with sulphuric acid.

IVY—*Hedera Helix.*—The specimen examined was a large stem (about 5 inches in diameter) of the common ivy, the specific gravity of which was ·607. A second specimen of this wood was found to have a specific gravity of ·540.

The heavier of these gave of resinous extract—

With naphtha, . .	1·125	per cent.
With ether, . . .	·200	„
With alcohol, . . .	3·218	„

Naphtha Resin.—This is a very pale resin in solution but darkens to brown on drying. It keeps soft, and gives no colour reaction with nitric, but turns dark brown with sulphuric acid.

Ether Resin.—Creeps up basin on drying. No colour reactions with acids.

Alcohol Resin.—The solution of it is pale; the dried resin brownish and brittle, transparent in thin layers. It is—

1. Insoluble in bisulphide of carbon.
2. Do. in turpentine.
3. Do. in benzole.
4. Do. in olive oil.
5. Very slightly soluble in chloroform.
6. Slightly soluble in glacial acetic acid.
7. Soluble in acetone.

It has no reaction with nitric, but blackens at once with sulphuric acid.

Ajuga pyramidalis *in Dumfriesshire* (*with Exhibition of Specimen*). By J. Thorburn Johnstone, Moffat.

(Read 14th February 1889.)

The specimen of *Ajuga pyramidalis*, Linn., exhibited was gathered on June 17, 1888, in Black's-Hope Glen, one of the side glens of Moffat water vale. As far as I am aware, its occurrence in this district is now recorded for the first time; its name at least does not occur in any of the local lists to which I have had access. It was found growing on a small grassy plot, a couple of yards square, formed by a slip in the rocky sides of the glen, at an elevation of about 1750 feet above the level of the sea. There would not be more than six plants growing at this place, and I saw none at any other part of the glen; the specimen exhibited being the only one that was in flower, or had any appearance of flowering. I brought away another specimen, and planted it in my garden. It has grown very well, but has not as yet flowered; just now it looks quite green and healthy. I may state that I visited this glen three times last year, and it may be of interest to note the names of a few of the plants gathered on these occasions, thus:—

June 17, 1888. *Rubus Chamæmorus*, Linn.; *Sedum Rhodiola*, DC.; *Vaccinium Vitis Idæa*, L.; *Oxyria reniformis*, Hook.; and *Ajuga pyramidalis*, L.

July 1. *Cerastium alpinum*, L.; *Saussurea alpina*, DC.; and *Salix herbacea*, L.

August 12. *Thalictrum alpinum*, Linn.; *T. minus*, L.; *Sedum villosum*, L.; *Galium boreale*, L.; and *Polystichum Lonchitis*, Roth.

On the 6th of May I also got *Saxifraga oppositifolia*, Linn., at the Grey Mare's Tail, a few miles farther up than Black's-Hope.

Observations on the Annual Increase in Girth of Trees in the Royal Botanic Garden, and at Craigichall, near Edinburgh, from 1878 *to* 1887. Part II. By David Christison, M.D., F.S.A. Scot.

(Read 14th February 1889.)

The Second Part of this paper gives, under several heads, the general conclusions which may be drawn from the facts recorded in the First Part.

1. *Annual Rate of Girth Increase in different Species of Trees.*

In determining by measurement the comparative rate of growth in trees, or different species of trees, we must take into account various considerations which may affect the fairness of comparison, even when the trees are situated in the same locality and are planted in the same soil. Thus the rate may be influenced by depth of soil, degree of shelter, freedom from overcrowding or the reverse, and by the age of the trees concerned. The last consideration is a perplexing one, as it seems probable that there is a natural rise followed by decline in girth-increase, the limits of which in different species have not been, perhaps cannot be, determined; and it is certain that a great decline takes place long before any sign of decay is visible in old trees.

In the following Table I have selected the quickest growers as being on the whole the fairest exponents of the capacity of soil and climate to maintain the growth of the different species. In the statement the species which proved quite unreliable are not included, and the rates are given roughly, so as to show their amount in a general and simple way. On account of the disturbing causes described in the Introduction to the First Part, the general estimates may be too low. I have allowed a little, however, for them, in some cases in which it seemed justifiable to do so. The *age* of the trees being unknown, their approximate *size* is given instead.

It appears from the table that the Hungary oak has gone far ahead of all the other deciduous species in rapidity of growth, having averaged in fact upwards of 1½ inch during the decennial period, while no other surpassed an inch. It is a comparatively young tree indeed, and there is already some indication, both from measurement and visible thinning in the ramification, that this rate may not be maintained in future; but the rate to its present age has been confirmed by two other examples, somewhat younger, which have been under observation for eight years, and which both have averaged about 1½ inch.

Annual Rate of Girth-Increase in different Species of Trees.

	Annual Rate of Growth.	Species.	Girth of Tree at narrowest, 1887.
Deciduous Class.	About 1½ inch.	Quercus conferta, ...	About 3 feet.
	1 ,,	Castanea vesca, ...	6 ,,
	,,	Fagus sylvatica, ...	6 ,,
	,,	*Quercus Cerris, ...	6 ,,
	¾ ,,	*Fagus sylvatica, ...	12 ,,
	⅔ ,,	*Quercus Robur, ...	10 ,,
	½ ,,	Cratægus oxyacantha, . . .	3 ,,
	,,	Liriodendron tulipifera, . . .	6 ,,
	,,	Ornus europæa (grafted), . . .	6 ,,
	,,	*Acer Pseudo-Platanus, . . .	10 ,,
	,,	*Betula alba, ...	5 ,,
	⅓ ,,	Tilia europæa, ...	4 ,,
	,,	Acer Pseudo-Platanus, . . .	5 ,,
Evergreen Class.	1½ inch.	Pinus Douglasii, ...	till 45th year.
	,,	Cedrus africana, ...	3 feet.
	,,	*Pinus austriaca, ...	2 ,,
	,,	Sequoia gigantea, ...	3 ,,
	1 ,,	Abies Lowiana, ...	2 ,,
	,,	Cedrus Deodara, ...	2 ,,
	6/7 ,,	*Cupressus Lawsoniana, . . .	18 inches.
	⅔ ,,	Araucaria imbricata, ...	2 feet.
	½ ,,	Taxus baccata, ...	6 ,,

A group of three trees follows, comprising a beech and Spanish chestnut in the Botanic Garden, and a Turkish oak at Craigiehall, all about 6 feet in girth, which have maintained the annual rate of about an inch. A beech at Craigiehall, as much as 12 feet in girth, has reached the rate of ¾ of an inch, and an oak 10 feet in girth, in the same locality, ⅔ of an inch. It is somewhat unexpected that the latter should have surpassed a flourishing sycamore

* In this, as in the previous Part, trees marked with an asterisk are at Craigiehall.

of the same size in the same park, besides a much younger one in the Botanic Garden, and younger limes in both situations.

Among the evergreens, a *Sequoia gigantea* and an African cedar in the Botanic Garden, and an Austrian pine at Craigiehall, averaged about $1\frac{1}{2}$ inch, the two first being a little below and the last a little above it; an *Abies Lowiana* and a *Cedrus Deodara*, 1 inch, all being between 2 and 3 feet in girth. A Douglas pine in the Botanic Garden averaged $1\frac{1}{2}$ for forty-five years, before failing, just as the decennial observations began. The rate of a *Cupressus Lawsoniana*, 18 inches in girth, at Craigiehall, was $\frac{6}{7}$ of an inch; of an Araucaria there and another in the Botanic Garden, neither of them fine specimens, about $\frac{2}{3}$ of an inch; and that of the largest yew, 6 feet in girth, nearly $\frac{1}{2}$ an inch.

2. *Annual Rate of Increase in Height in different Species of Trees.*

The rate of upward growth is much more difficult of measurement than the rate of girth-increase. In deciduous trees of any size it is impossible by the direct means of measuring rods, and if a rough estimate of height may be obtained by the hypsometer, the difficulty of fixing the position of the true top, on which accuracy with this instrument depends, is so insurmountable, that it is vain to attempt *annual* observations in this way. In the case of young deciduous trees, although the difficulties are less, they are sufficient to make experiments troublesome and unreliable.

With evergreens, and particularly pines, it is different. Their erect and well-defined top-shoot shows the top unerringly; yet even in them it is surprising how difficult it is to attain accuracy with measuring rods, except in quite young trees not much above the height of a man.

Probably for these reasons Sir Robert Christison made no attempt to measure the upward growth from year to year; but in 1879 he took the height of a Hungary oak and of a considerable number of evergreen trees by means of rods, and in 1887 I retook them by the same method, with the aid of my brothers. The total amount for nine years is thus known, and a fair margin for inaccuracy obtained in striking the averages. In addition to the results of these observations, the age of four measured yews being known to be eighty-four in 1878, we arrive at their annual upward growth for that period previous to our experiments. In the same way the rate of an *Abies Douglasii* for fifty-four years has been ascertained.

Species.	Girth of Tree, 1887.	Rate of Annual Increase in Height.	
		Before 1879.	1879 to 1887.
	About	Inches.	Inches.
Abies Douglasii, .	5½ feet.	Till 54th year, 12	(?)
Sequoia gigantea, .	2½ ,,		12¼
,, .	3 ,,		12
,, .	3 ,,		11
Abies Lowiana, . .	2 ,,		10
Quercus conferta, .	3 ,,		7
Pinus excelsa, . .	3 ,,		5½
Pinus Laricio, . .	5 ,,		4½
Taxus baccata, . .	3 ,,	Till 64th year, 4½	4
,, . .	2½ ,,	,, 3½	3
,, . .	3 ,,	,, 4	1
,, . .	3 ,,		0⅔
,, . .	6 ,,	Till 193rd year(?) 1¾	0⅓
,, . .	2½ ,,	Till 64th year, 4	(?)

From this table I have excluded some trees which were measured, but which proved very unhealthy. The very slow upward rate of the largest yew is probably due to its great tendency to spread outwards. *Abies Lowiana*, *Pinus excelsa*, and *Pinus Laricio* can only be classed as fairly healthy but not vigorous trees.

3. *Annual Range of Girth-Increase in the Trees individually.*

On taking a general view of the ten years' observations, one of the most striking results is the great variation in the annual increase of the vast majority of the trees, indicative, it is to be presumed, mainly of a marked sensitiveness to the varying meteorological conditions of the different seasons through which they have passed. Not one of the measured trees has escaped without suffering a marked depression in its growth in one or more seasons, while in the majority of instances the amount of this depression has been very large. Thus in no less than eight out of thirty-four deciduous trees available for this investigation, the maximum annual increase was more than four times greater than the minimum annual increase, and in only seven was the maximum less than twice as great as the minimum. Even in the tree which varied least, the proportion of the maximum to the minimum was as 4 to 3, while in that which varied most it was as 65 to 0. The maximum and minimum increase in these two categories of trees is here given.

Thirty-four Deciduous Trees Measured.

Seven which varied least.	An. Increase.		Eight which varied most.	An. Increase.	
	Max.	Min.		Max.	Min.
	inch.	inch.		inch.	inch.
8. Fagus sylvatica, .	1·20	0·80	2. Tilia europæa, .	0·65	0·00
4. Castanea vesca, .	1·00	0·75	*11. Quercus Robur, .	0·50	0·00
40. Quercus conferta, .	1·85	1·35	9. Æsculus Hippocastanum,	0·75	0·05
44. Quercus rubra, .	0·50	0·30			
15. Fagus sylvatica, .	0·85	0·50	16. Cratægus oxyacantha,	0·80	0·10
*20. ,, .	0·95	0·60			
*10. Quercus Cerris, .	1·25	0·70	*21. Tilia europæa, .	0·25	0·05
			33. Carpinus Betula, .	0·55	0·10
			18. Tilia europæa, .	0·70	0·15
			*8. Fagus sylvatica, .	0·65	0·15

A similar investigation of the evergreen trees yields quite as extreme results. Of twenty-nine available trees, in eight the annual maximum was more than four times greater than the annual minimum, and in only ten was the maximum less than twice as great as the minimum. In the tree which varied least the proportion was as 9 to 7, while in that which varied most, discarding trees which were killed, it was as 16 to 1.

Twenty-nine Evergreen Trees measured.

Ten which varied least.	An. Increase.		Eight which varied most.	An. Increase.	
	Max.	Min.		Max.	Min.
*2. Pinus austriaca, . .	1·80	1·40	34. Pinus sylvestris, .	0·30	0·00
39. Cedrus africana, . .	1·75	1·30	37. ,, .	0·25	0·00
19. Taxus baccata, . .	0·45	0·30	10. Pinus Douglasii, .	0·80	0·05
31. Abies Lowiana, . .	1·40	0·90	42. Taxus baccata, . .	0·50	0·05
25. Sequoia gigantea, .	1·15	0·65	24. Pinus excelsa, . .	0·40	0·05
1. ,, .	1·85	1·05	30. Cedrus Deodora, .	1·20	0·20
2. ,, .	1·70	0·95	17. Pinus Laricio, . .	0·50	0·10
35. Araucaria excelsa, .	0·90	0·50	53. Taxus baccata, . .	0·45	0·10
29. Sequoia gigantea, .	1·80	0·95			
*10. Cupressus Lawsoniana,	1·15	0·60			

As it happened that the second, third, and fourth years of the decennial period were seasons of unusual severity, it would not be safe to conclude that the results obtained represent the usual average of variation in the annual girth-increase. At the same time, in other years great variations occurred in not a few trees which had either escaped the effects of the three consecutive bad seasons, or had entirely recovered from them.

Thus, taking only trees which always preserved a healthy appearance, the following variations, quite independent of the three severe seasons, may be quoted:—

Beech,	0·65	and	0·25	Sequoia,	1·80	and	0·95
Ornus,	0·50	,,	0·20	Deodar,	1·20	,,	0·45
Sycamore,	0·55	,,	0·20	Yew,	0·65	,,	0·20
Oak,	0·95	,,	0·50	Evgn. Oak,	0·55	,,	0·25

From these facts it follows that the average rate of growth in trees cannot be ascertained even approximately by a single year's measurement, or with any great accuracy unless by several years' measurements.

4. *Annual Range in the Aggregate Girth-Increase.*

The aggregate range is naturally not so great as the individual range, as the maxima and minima of the separate trees are not concentrated on two or three particular seasons, but are distributed throughout the decennial period, so as partially to counteract each other when taken in the aggregate. Still the aggregate results are remarkable enough. In the deciduous class, comprising 28 trees, the maximum was nearly double the minimum, the figures being 19·35 inches and 10·15 inches. In the evergreens, comprising 19 trees, the difference was not quite so great, the maximum being 16·60 and the minimum 9·60. As in this comparison the species in which several trees were tested exercise a preponderating influence over those in which only one tree was tested, I have reduced them all to a common value by taking the average amounts for the *species* instead of the amounts for the *individual trees.* This proceeding, however, does not materially modify the results.

Table of Annual Girth-Increase in different Species.

Species.	Number of Trees under Observation.	Years.										Total.
		1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	
A. *Deciduous Species.*												
1. Betula alba,	One	0·25	0·05	0·05	0·10	0·10	0·00	0·10	0·00	0·10	0·00	0·70
2. Fagus sylvatica,	Seven	·81	·61	·49	·61	·79	·64	·76	·63	·66	·56	6·56
3. Tilia europæa,	Three	·47	·23	·08	·37	·17	·25	·30	·25	·18	·17	2·77
4. Acer Pseudo-Platanus,	Three	·50	·40	·27	·27	·43	·43	·51	·48	·20	·17	3·66
5. Castanea vesca,	One	1·10	·90	·85	1·10	·90	1·00	1·00	·85	1·00	·75	9·45
6. Liriodendron tulipifera,	One	1·00	·40	·30	0·65	·60	0·45	0·65	·55	0·75	·65	6·00
7. Æsculus Hippocastanum,	One	0·75	·50	·35	·70	·10	·30	·20	·5	·20	·20	3·35
8. Cratægus oxyacantha,	One	·80	·10	·75	·35	·65	·65	·45	·55	·60	·60	5·50
9. Ornus europæus,	One	·60	·40	·30	·75	·50	·45	·35	·25	·20	·35	4·15
10. Fraxinus excelsior,	One	·70	·25	·30	·40	·35	·35	·35	·35	·30	·40	3·75
11. Quercus Robur,	Three	·58	·57	·22	·32	·40	·40	·48	·53	·37	·32	4·19
12. ,, conferta,	One	1·80	1·70	1·40	1·85	1·85	1·85	1·55	·35	1·70	1·50	16·55
13. ,, Cerris,	One	0·60	0·65	0·35	0·60	0·65	0·55	0·60	0·55	0·65	0·50	5·70
14. ,, rubra,	One	·50	·40	·30	·50	·40	·40	·40	·55	·45	·55	4·45
15. Carpinus Betula,	One	·40	·35	·10	·55	·50	·45	·55	·40	·30	·50	4·10
16. Juglans regia,	One	·50	·40	·00	0·25	·10	·10	·15	·0	·15	·15	1·30
		11·36	7·91	6·11	8·87	8·79	8·27	8·40	7·29	7·81	7·37	82·18
B. *Evergreen Species.*												
1. Pinus Laricio,	One	0·40	0·10	0·50	0·50	0·45	0·30	0·45	0·50	·45	0·45	4·10
2. ,, Douglasii,	Two	·70	·37	·40	·42	·47	·25	·17	·22	·20	·12	3·32
3. ,, excelsa,	Two	·37	·20	·20	·32	·27	·30	·45	·60	·47	·40	3·58
4. Abies Lowiana,	One	1·40	1·25	1·40	·90	1·05	·80	1·00	1·10	1·15	1·05	11·10
5. Sequoia gigantea,	Four	1·50	1·41	1·46	1·17	1·37	·91	1·02	1·37	0·96	0·99	12·16
6. Cedrus Deodara,	Two	1·15	0·65	0·42	0·30	0·82	·32	0·80	0·90	1·00	·87	7·23
7. ,, africana,	One	1·65	1·40	1·75	1·60	1·60	1·30	1·55	1·45	1·55	1·30	15·15
8. Araucaria imbricata,	Two	0·55	0·70	0·65	0·55	0·65	0·55	0·52	0·47	0·45	0·47	5·56
9. Taxus baccata,	Two	·55	·37	·27	·40	·37	·30	·45	·32	·45	·15	3·63
		8·27	6·45	7·05	6·16	7·05	5·03	6·41	6·93	6·68	5·80	65·83

Taking a general view of the annual aggregate variations in the *species*, it will be seen from the Table that in the deciduous class of 16 species the maximum, 11·36, occurred in 1878, the first year of the decennium; that a progressive decline took place to the minimum, 6·11, in 1880; that a marked rally to 8·87 took place in 1881; that the rate continued much the same till 1884; and that it was reduced by about an inch in the last three years, that for 1887 being 7·37. In the 9 evergreen species the sequence was different. The maximum 8·27, indeed, was also in 1878, but there was no rally in the third of the three succeeding hard years, the amount falling on the third of them to about 6 inches, and a rally to 7 in the next year was immediately followed by a fall to 5 inches, the minimum, in 1883. In the next three years there was a return to an average of about 6½ to 7 inches, but in the last year there was again a fall to 5·80.

Thus it appears that the increase never rallied effectually from the great depression of the years 1879–80–81. For while in the deciduous group the amount in 1878 was 11·36 inches, it never afterwards reached 9 inches, and in the evergreens the amount of 8·27 in 1878 was not afterwards approached nearer than 7·05. This result is probably due chiefly to the prolonged effects of injury done in the three consecutive bad winters 1879–80–81, operating mainly, however, on trees which had already reached or passed the meridian of their growing power.

Another result shown is that the deciduous or evergreen groups did not always suffer equally, or at all, in the same years. Thus the deciduous species, as a whole, were subjected to serious depression in 1879, 1880, 1885, 1886, and 1887, while the evergreens suffered in 1879–80–81, 1883, and 1887. It does not follow, however, that these differences were due to any inherent tendencies in the two classes as such, because, in the first place, the number of species tested may be insufficient to establish general rules; and, secondly, in each of the depressions to which a *class* was subjected, certain *species* of that class escaped. In the succeeding divisions of my subject, I have endeavoured to analyse these depressions, and to show the degree to which each species was affected by them.

5. *The Depression in Girth-Increase of* 1879, 1880, *and* 1881.

The three successive seasons of 1879, 1880, and 1881 present a series which has probably been unprecedented in Scotland for low winter temperature and other circumstances which may be supposed to be unfavourable to tree-life. In that respect, therefore, it is fortunate that these seasons fall within our decennial period, as we are enabled to appreciate in some measure their effects upon the growth of timber, although in other respects it is unfortunate, as these effects have greatly complicated the general investigation by producing abnormal results upon the whole period.

I shall consider the subject under several heads:—

1. *The Nature of the three consecutive Bad Seasons and the general Effects they produced upon Girth-Increase.*—The failure

of girth-increase in 1879 was attributed by Sir Robert Christison to three climatic causes—a great reduction of the mean temperature of every growing month, a similar reduction of sunshine, and as a result of both these climatic causes, the loss of June as a growing month. Of low winter temperatures he makes no mention, but perhaps their influence ought not to be entirely ignored, as it appears from Mr Buchan's returns that the mean temperature of December was only 31°, and that the minimum was so low as 9°. The result in this first year of depression was that both the deciduous and evergreen classes suffered a heavy loss of girth-increase, the former falling from $11\frac{1}{3}$ to 8 inches, and the latter from $8\frac{1}{2}$ to 6 inches.

The depression of 1880 was attributed by Sir Robert to the extraordinary low temperatures of the previous December, succeeding an autumn unfavourable to the ripening of wood and formation of buds. The lowest temperature of December at Edinburgh, as recorded in Mr Buchan's tables, was 7°·5; and the unprotected thermometer at the Botanic Garden gave the low temperatures of 1°, 4°, 13°, and 17° on different nights. Great damage to trees took place throughout Scotland in this season, and in the measured deciduous trees, as a class, the annual girth-increase fell to its decennial minimum, that is to say, from the maximum $11\frac{1}{2}$ inches in 1878 to 6 inches in 1880. The evergreens, as a class, however, fell no lower than in 1879.

The following winter was even more trying, at least in the Botanic Garden. The greatest cold fell in January, when the minimum recorded in Mr Buchan's tables was 9°·4; but the unprotected instrument at the Garden fell to 0°, 4°, 7°, 10°, 11°, 12°, 12°, 12°, 13°, and 14° in different periods of twenty-four hours. Unusual cold was also prolonged far into spring. Nevertheless, the deciduous group as a class, instead of suffering a further fall, rallied to the highest point attained after 1878, or from 6 to 9 inches, while the evergreen class fell a little below even the low level of the previous years. The prosperity of the deciduous class may have been due to perfect ripening of the wood in the previous favourable autumn, while the increase of the evergreens may have been kept down by the circumstance that, as my observations on monthly growth show, this class makes an earlier start in spring than the deciduous class, and therefore may have suffered more from earlier exposure to the prolonged cold of that season. The fact, however, that the deciduous girth-increase rallied materially in the third severe season, when the winter temperatures were lower than in the other two, proves that excessively low winter temperatures may not be sufficient in themselves to produce disastrous results, and that other circumstances are required to conduce to that end, such as deficient ripening of wood in autumn, the period in winter when the low temperatures occur, warm sunshine quickly following frost, protection or the reverse by snow, sudden thawing, and unfavourable weather in spring.

2. *Loss of Timber produced by these Severe Seasons.*—This was both direct and indirect; that is to say, loss in the unfavourable years themselves, and loss from the prolongation of their effects to subsequent years. In estimating the first, the most natural mode might seem to be by comparison of the increase in these years with the average increase for the decennial period. But by this method not only the depressing effect of the seasons at the time, but their prolonged effects on girth-increase would be ignored. A fairer comparison may be made with the year 1878, which preceded the disastrous seasons. It is true this season may have been unusually favourable, but I do not think it was remarkably so, as not a few of the trees, which escaped lasting injury, grew more rapidly in some of the years after the severe seasons, than in 1878, the year before them. By this comparison a loss comes out in the deciduous *species*, as distinguished from *trees*, of 30, 46, and 22 per cent., and in the evergreens of 22, 15, and 25 per cent., in 1879, 1880, and 1881 respectively.

It would be rash to assume, however, that this loss represents the loss sustained by trees in full vigour in the Edinburgh district, because a number of the selected trees, judging from the slowness of their growth, were no longer in their full vigour in 1878; and it is remarkable that almost without exception it was in such trees that the greatest loss was sustained. Still, even as applicable to trees past their prime, a permanent or serious temporary check to growth represents a very heavy loss.

To estimate the indirect or prolonged loss caused by the three severe seasons is naturally unattainable with any precision. Perhaps it is fairly represented at the very least by the difference between the amount in the year before the disastrous seasons and the highest amount reached after them. This, as we have already shown, would represent a loss to the deciduous class of 22 per cent., and to the evergreens of 15 per cent. Against this we have to set off the loss which might have been sustained, even in ordinary seasons, from natural diminution of growth in trees past their prime, but which in so short a period would probably not have been great, and the possibility of the girth-increase rallying in some trees even after nine years of depression, which I am inclined to think is quite possible.

3. *Incidence of the Loss in the three consecutive Severe Seasons.*—The depression of the girth-increase during the three trying seasons did not go on augmenting from year to year, as might have been expected. On the contrary, in the deciduous class, as a whole, there was a great rally in the third year, and in the evergreens there was at least no great additional loss in that year. Taking the trees individually, not a single case of progressive decrease throughout the three years occurred among the reliable deciduous trees, while there were eight such cases among the evergreens. In further illustration of this fact, I have ascertained that in the deciduous class the maximum loss occurred in 23 out of 26 trees, and in 13 out of 15 species in 1880, and in only 2 trees in 1881; while in the evergreens it occurred in only 5 out of 24 trees in 1880, and in 11 trees in 1881. Also that, if we take the trees in the Botanic Garden only, 19 in number of each class, the following are the variations in incidence that occurred:—

	19 Deciduous Trees.	19 Evergreen Trees.
Not affected in 1879, . .	2	4
Fell off in 1879, . . .	17	15
Fell off in 1880. . . .	15	7
Improved in 1880, . .	2	11
Fell off in 1881, . . .	3	12
Improved in 1881, . .	15	4

4. *Comparative Effect upon Girth-Increase of the three consecutive Bad Seasons in the different Species.*

(*a*) Species either not affected at all or only to a slight degree.—*Quercus conferta, Castanea vesca, Quercus Cerris, Pinus austriaca, Cedrus africana.*

(*b*) Species severely affected in one or more of the bad seasons, but not permanently injured, unless in exceptional instances.—*Fagus sylvatica* (nine tested, of which three suffered but little); *Æsculus Hippocastanum, Ornus europæus, Cratægus oxyacantha, Carpinus Betula, Pinus Laricio* (one of each tested); *Acer Pseudo-Platanus* (two); *Taxus baccata* (five tested, of which one was retarded in growth afterwards, possibly as a result of the bad seasons); *Cedrus Deodara* (four tested, of which one was apparently retarded in growth afterwards).

(*c*) Species severely affected, at the time and afterwards.—*Liriodendron tulipifera* (one tested). No visible damage to this tree, but growth subsequent to the primary severe depression was considerably slower than previous to it. *Fraxinus excelsior* (one); rate of increase greatly diminished subsequently, and the tree becoming a wreck, but it was past its prime in 1878. *Betula alba* (two), one apparently dying from the effects of the severe seasons, although possibly in a weak condition when attacked; the other only slightly affected. *Tilia europæa* (three), growth subsequently much retarded in two, but no appearance of injury to them or to the third one tested. *Quercus Robur* (five), all suffered severely at the time, and in two the subsequent growth has been retarded. *Quercus rubra* (one), not seriously affected in its growth at the time nor afterwards, but visibly damaged. *Pinus excelsa*, of the two tested one has grown very slowly since. *Pinus Douglasii* (two), one probably weakened, as subsequently it gradually became a wreck from branches being blown down in gales. *Abies Lowiana* (two), one killed, but probably weak when attacked; the other, although little affected in its girth-increase at the time, lost its top-shoot and its former handsome aspect, and was probably somewhat retarded in growth. *Pinus sylvestris* (three), all three apparently mortally injured, but not vigorous when attacked. *Quercus Ilex* (two), apparently retarded in their growth. *Araucaria imbricata* (three), girth-increase not seriously affected at the time, but two of the three visibly injured, and growth retarded in at least one of them afterwards.

Depressions of 1883, 1885, 1886, *and* 1887.

The rally from the first prolonged depression was neither complete nor permanent. It was incomplete, because although the amount of increase in the deciduous class in 1881, and in the evergreens in 1882, was the highest ever attained after that of 1878, the amounts were, nevertheless, 22 per cent. and 15 per cent. in these classes respectively below the increase of 1878. And the rally was not permanent, as the deciduous class, after maintaining a fair average of about 8·50 till 1885, fell to 7·29 in 1886, a position from which but little rise took place in the two following years; while the evergreen class actually fell to its absolute minimum in 1883, the very year after the rally from the first depression, and although it regained a better average for the next three years, it was again seriously depressed in 1887.

The most remarkable fact in regard to these depressions is, that as in the prolonged depression of 1879–81, the effects did not fall alike on both classes in the same years, the deciduous class, as a whole, suffering in 1885, 1886, and 1887; while the evergreens, as a whole, were affected in 1883 and 1887.

It would be unwarrantable, however, to conclude that these differences in the incidence of the depression are due to *class* distinctions, because there are exceptions to the general conduct among the *species* of both classes, and the number of species tested is too small to establish a law of general application. At the same time, the theory of *class* distinctions is strengthened by the all but universal rallying of the deciduous species in the third of the three consecutive bad seasons, while the evergreens were almost all further depressed in that year.

But however it may be with the *classes*, the differences in the incidence upon the *species* are indubitable, and deserve a detailed investigation.

1883.—As we have just seen, the evergreen species rallied from the severe depressions of 1879–80–81 from 6·16 in 1881 to 7·05 in 1882; but they had no sooner done so than some new evil influence lowered their increase in the following year to the decennial minimum of 5·03. Of the nine species three reached their absolute minimum, and two their minimum subsequent to the three severe winters. The unreliable species *Pinus excelsa* alone showed no decrease compared with the previous year, and the fall in *Taxus baccata* was so slight as to be hardly worth regarding; but in all the others the fall was severe, particularly in the two well-tested species, *Sequoia gigantea* and *Cedrus Deodara,* of which every tree suffered. The following table showed the degree to which the species and trees were affected:—

Species.		Percentage of Fall in 1883 below the			Remarks.
		Year 1878.	Decennial average.	Av. of last 6 years.	
Sequoia gigantea, four trees.	a,	43	20	15	Min. after depression 1879–81.
	b,	48	33	23	Min. of decennial period.
	c,	43	23	17	Do.
	d,	20	22	14	Second lowest of do.
Species averages,		38	24	17	
Cedrus Deodara, four trees, two measured for only 6 years.	a,	59	47	54	Min. after depression 1879–81.
	b,	83	67	66	Min. of decennial period.
	c,	...	...	43	Min. of last 6 years.
	d,	...	...	33	Do.
Species averages,		71	57	49	
Abies Lowiana, 1 tree,		42	28	21	Min. of decennial period.
Cedrus africana, ,,		21	14	11	Do.
Pinus Laricio, ,,		25	27	31	Min. after depression 1879–81.
,, excelsa, ,,		12	27	40	Do.
Quercus Ilex, 2 trees,		...	...	37	Do.

It is somewhat doubtful whether any of the well-tested deciduous species shared in this depression, but it is just possible that *Fagus sylvatica* and *Tilia europæa* did, for although they scarcely fell lower than their average, they experienced a sharp fall below the previous year. The only other defaulter was the single *Liriodendron.*

1885, 1886.—I shall not dwell on the depressions of these years, as they were comparatively unimportant. They depended upon moderate decreases in a number of the deciduous species, although not in all instances affecting the same ones each year. In the first of these depressions no evergreen species shared, unless *Taxus baccata*, to a very slight degree, but in the second the *Sequoia* suffered almost to as great a degree as in 1883. As this is the most remarkable circumstance, I give the results in this species in detail—

Species.	Percentage of Fall in 1886 below		
	1878.	Aver. of 10 years.	Aver. of last 6 years.
Sequoia gigantea—*a*,	43	20	15
,, *b*,	37	19	11
,, *c*,	40	20	12
,, *d*,	20	22	14
Averages, . .	35	20	13

1887.—Looking only at *class* results, this depression seems no worse than the two preceding ones, as far as the deciduous trees are concerned. But a more minute investigation shows that most of the better-tested species experienced a considerable decline, and that the *class* result is only saved from being extremely low by the average of the less well-tested species being high. In three of the better-tested species, *Tilia europæa*, *Acer Pseudo-Platanus*, and *Quercus Robur*, the conclusions are obscured by the probable subjection of these species to prolonged depression from the effects of the hard winters 1879–80–81, but as the best trees in each suffered severely, there can be little doubt that these species were

Species.	Percentage of Fall in 1887 below the		
Fagus sylvatica.	Year 1878.	Decennial average.	Average of last 5 years.
No. 7	16	3	10
,, *14	41	28	28
,, 14	58	48	47
,, 38	58	42	42
,, *9	62	42	42
,, *8	...	...	63
,, *20	...	...	25
,, *22	...	...	41
Averages, . .	47	32	37

affected. It is in the healthy and well-tested species, *Fagus sylvatica*, that the results are most unmistakable. Two of the species, indeed, escaped entirely, one of them having even a slight increase; but it is noteworthy that these were quick growers, one being the quickest of the Botanic Garden beeches, and the other the quickest of the three "island" beeches at Craigiehall. The table at the foot of page 404 gives the loss sustained by the other eight.

But it was on the evergreens that this depression fell with the most marked severity. The *Deodars*, indeed, and probably the *Araucarias*, were only slightly affected, but three of the *Sequoias* suffered quite as much as in 1883, the fourth, which was above average, being an unhealthy-looking tree, erratic in its growth, and therefore little reliable. The solitary *Cedrus africana* and *Cupressus Lawsoniana* both touched their absolute minimum. It was in *Taxus baccata*, however, that the most remarkable effect was produced. This species had escaped almost entirely in the years 1883, 1885, and 1886, but now it reached by far the lowest point in the decennial period—and no less than 45 per cent. below the average of the last six years, during which all the seven yews were under observation.

I give in detail the results for the species affected :—

Species.	Percentage of Fall in 1887 below the			Remarks.
	Year 1878.	Whole Period.	Last 6 years.	
Sequoia gigantea—*a*,	43	29	20	Second lowest of decen. period.
,, *b*,	43	23	17	Min. of decennial period.
,, *c*,	24	26	18	Do.
Averages, . . .	37	26	18	
Taxus baccata— *a*,	58	47	43	Min. of decennial period.
,, *b*,	66	81	79	Do.
,, *c*,	...	37	37	Min. after depression 1879-81.
,, *d*,	...	0	8	
,, *e*,	...	45	44	Min. of period (nine years).
,, *f*,	...	44	50	Do. do.
,, *g*,	...	60	64	Do. (eight years).
Averages, . . .	62	44	45	
Cedrus africana, . .	21	14	11	Min. of decennial period.
Cupressus Lawsoniana,	...	30	26	Min. of period (nine years).

It will be observed that of the twelve trees in this table nine touched their absolute minimum in 1887, the period during which they were under observation ranging between eight and ten years.

Taking a general view of the depressions in girth-increase, they show a singular variety in their incidence, not only upon the deciduous and evergreen *classes*, but also on the *species* within each class. Thus, to take some pronounced examples of the latter kind:—*Cedrus Deodara* suffered a great decline in 1880, 1881, and 1883, but none in 1886, and but little in 1887; *Sequoia gigantea*, on the other hand, was seriously affected in 1883, 1886, and 1887. So that, in five years of depression, these two species were affected in the same year only once. Again, in 1883, the year of greatest depression in the evergreens, *Araucaria imbricata* escaped entirely, and *Taxus baccata* almost entirely. Lastly, *Taxus baccata*, after nearly altogether escaping the previous depressions, suffered a fall of nearly 50 per cent. in 1887, when the only other evergreen species affected was *Sequoia gigantea*. It is also worthy of note that in no instance, as far as I could see, did the depressed species show any external marks of sickliness.

Inquiry into the causes of these differences is beset with difficulty from the variety of effects upon species growing in the same locality, some, which differ greatly in results, like the Deodars and Sequoias, side by side. It is to meteorological returns that we must look for the solution of these difficulties, but these have not yet been fully published for the period under review. For this reason, and as it is desirable to study the question in connection with monthly as well as annual growth, I postpone its consideration till all the necessary data have been obtained.

Miscellaneous Results and Queries.

1. Loss of the top-shoot in pines does not seem necessarily to check the growth of wood. Thus in *Pinus austriaca* at Craigiehall, two years' growth of the top-shoot perished from the low temperature of 1880, yet no diminution occurred in the girth-increase of the following years, and the results continued to be the highest of all our measured trees. In the *Abies Lowiana*, indeed, a lasting, though not extreme,

diminution did occur after the loss of its top-shoot in the same winter, but there were other causes of failure.

2. Density and healthiness of foliage are not necessarily proofs of rapid growth. The most striking example of this occurred in the lime at Craigiehall, a perfectly healthy looking tree, well clothed with foliage every summer, which nevertheless increased in girth at the annual rate of only about one-sixth of an inch in ten years. But other examples, almost equally remarkable, may be quoted, such as the two younger limes and the young sycamore in the Botanic Garden. It does not follow, however, that a tree should be condemned for slow growth near the ground, as it may be adding substantially to its timber higher up.

3. Unusual density of foliage in a tree does not necessarily imply quicker growth than in other trees of the same species and age. Thus the density of foliage in the beech No. 8 is nearly every year twice as great as in its neighbour No. 7, a tree of about the same age, yet the latter grows somewhat quicker than the former.

4. Early foliation does not necessarily produce greater growth. This is illustrated by the two trees just mentioned, as No. 8 comes into leaf from ten days to a fortnight sooner than No. 7, yet grows a trifle slower.

5. We cannot with safety conclude that a tree is increasing well in girth merely from its healthy appearance. This follows from conclusions 2, 3, and 4.

6. It is only by measurement that we can ascertain positively whether a tree is increasing in girth rapidly or not. But measurement for a single year only is insufficient, and even for three years, as suggested by Sir Robert Christison, may be misleading. The great annual range in the girth-increase of almost all the trees proves this in a general way. But taking particular examples:—For a period of three years we may select beech No. 7, which grew at the rate of 0·81 from 1879 to 1881, and at the rate of 1·17 from 1884 to 1886; and for single years—avoiding the three consecutive bad seasons when extreme differences might may be expected—we may quote the horse chestnut No. 9, which increased 0·70 in 1882 and only 0·05 in 1885, although in both years the foliage seemed perfectly healthy, and the sycamore No. 28, which grew 0·55 in 1884 and only 0·20 in 1887. These

are perhaps extreme cases; but taking quite ordinary examples, we have the beech No. 14, with an increase of 0·60 in 1882 and 0·40 in the next year; the oak No. 16, with 0·95 in 1885 and 0·50 in 1887; and even among the steadiest of the evergreens we have Sequoia No. 1, with 1·75 in 1882 and 1·05 in the next year. Perhaps five years may be sufficient to establish a fair average, if any very unfavourable year be rejected.

7. The depressing effect upon girth-increase of disease or injury may be prolonged for years after the date of the disease or injury, even when the affected trees appear perfectly healthy. It has been shown that the effects of the hard winters of 1879, 1880, and 1881 were prolonged in not a few of the trees till 1887. But special diseases or injuries may produce the same effect. Thus the horse chestnut No. 9 increased three-quarters of an inch in 1881, but the foliage was destroyed apparently by early frost in 1882, the growth almost entirely ceased that year, and during the next five years, although the foliage was always healthy and remarkably luxuriant, the increase averaged only the 5th of an inch.

8. A question of much interest is whether trees which have suffered a prolonged depression in their girth-increase, from low winter temperatures or other causes, will eventually recover their normal rate. A longer period of observation must elapse before this question can be settled in the case of most of the affected trees. Undoubtedly in the decennial period under review, the majority of such trees have shown no tendency to improve, and some have gone on from bad to worse, but in a few instances a decided and probably lasting rally has taken place, as in *Pinus excelsa* No. 26, which, after six years at the low average of 0·34, has improved in the last four years to 0·68; and in *Cedrus Deodara* No. 29, which, after five years at the average of 0·58, has risen in the last four years to 1·12. The two evergreen oaks also rallied in a marked degree in 1886 from their long seven years' depression, each of them having increased half an inch, and although a new wave of depression swept over them in common with other evergreens in 1887, and reduced their increase to a quarter of an inch, the reduction may prove to be only temporary.

9. Of a similar nature are the questions whether, how soon, and to what degree, recovery of girth-increase may be looked for in trees which, after suffering from overcrowding, have been cleared and opened up. I have no evidence on this point, but the yew No. 47 would be a fit subject for experiment, as during the decennial period, when it has been much overcrowded and overshadowed, it has only increased at the rate of barely one-tenth of an inch, whereas for the previous sixty-four years the rate was above half an inch.

10. Do the "annual rings" correspond strictly with the age of trees in temperate climates? The rings in tropical dicotyledons, it is well known, are not annual, as they are apt to be irregular and confused, and to immensely exceed in number the years of age of the trees. From recent experiments in the United States, it appears that even in temperate latitudes the rings may be considerably greater or fewer in number than the age of the trees; and quite recently my friend Mr Charles Hall of San Jorge has been led strongly to suspect that in central Uruguay the rings and years do not strictly correspond even in young trees. In this country, however, it is generally believed that the age of a tree can be told unerringly by the number of rings. This is a matter not so easily proved as might be expected. It is seldom that one has the opportunity of testing a tree whose age is accurately known, and errors may be caused by a false appearance of rings, by the difficulty of counting them when very close to each other, even when the surface is highly polished, or in the case of detached sections by ignorance as to the height above ground where the section was made. Still the rings and years have been so invariably found to correspond closely in well-ascertained cases, that there can be little doubt of their strict correspondence in healthy trees of moderate age. My measurements, however, throw some doubt on the applicability of the rule to old or prematurely old trees, as they prove that such trees may not only cease to increase, but may for a series of years actually diminish in girth. For example, the Scots fir, No. 37, for nine successive years either did not increase or actually diminished in girth, and measured nearly an inch less at the end than at the beginning of the nine years, and the Scots fir No. 4 diminished for four successive years to the amount of half an inch in all. Now,

unless in such cases an even larger amount of shrinkage or loss takes place in the old wood or in the bark, it is evident that no room can be left for the deposit of new rings. Such decrease may have occurred either by imperceptible wearing away on the surface, or by an internal shrinkage from enfeebled vitality, but in the instances given, there was no visible loss in the smooth, regular, closely-fitting bark.

11. Can any reliable estimate of the age of very old trees be made by means of measurement? Certainly not in the case of trees which have long ceased to make appreciable increase in girth, or which are in a ruinous state from decay, and perhaps with difficulty even in the case of gnarled stems of ancient trees which are still apparently vigorous. But in the latter instances we may at least be enabled to say that they need not exceed a certain age, and thus check that tendency to exaggerate the antiquity of trees of extraordinary magnitude, which is very naturally fostered in our minds by our incapacity to appreciate by the eye their increase from year to year. As experiments which I have instituted on this subject are incomplete, I shall postpone its consideration until a future occasion.

Notes on some of the Rarer Plants found on the Dovrefjeld, Norway, in July 1888. By George Bird.

(Read 13th December 1888.)

During a short tour in Norway this summer, I had the opportunity of making several excursions in search of alpine plants, and these notes are intended to call attention to some of the rarer species met with on the Dovrefjeld. I had in 1887 visited the western coast of Norway, in the neighbourhood of the Hardanger, with the view of forming an acquaintance with the flora, so far as this could be done in a limited time. In the plants which came under my notice then, there was an absence of many alpine species one would have expected to find in a country so far north. It was therefore with considerable expectation that I looked forward to exploring some of the mountains in a more northern part of Norway, where the alpine flora is better represented.

The Dovrefjeld range has long enjoyed the reputation of having a rich alpine flora. It can be reached in a week from Leith, and this without any fatigue beyond constant travelling by steamer, railway, and posting; but when the journey can be done more leisurely the interest is much enhanced.

I proceeded by steamer to Christiania, spending a day at Christiansand on the way. The sail from Christiansand was most enjoyable, and the weather being fine, we were able to see a large extent of country as we steamed up the fjord to Christiania.

We devoted two days to the Norwegian capital, visiting the public institutions and parks, including a morning at the Botanic Gardens, where a good collection of native alpine plants is under cultivation, and including many of those we were afterwards to find in their native habitats.

Taking an early train from Christiania, we continued our journey, reaching Lille-elvedal late the same evening. Lille-elvedal is the point where the road is joined to reach the Dovrefjeld, and the distance, some 60 miles, is accomplished by driving, and generally occupies very pleasantly a whole day. There are stages in this drive where one could break the journey, but it is usual to push on until you are well in the heart of the Dovrefjeld. The road for many miles takes you through a wild and picturesque country, diversified by river, rocky scenery, woodland, and mountain. The valley on either side is bounded by mountains; and as the road has a steady upward incline almost the whole way, the elevation is not so much observed, but you gradually find that a very considerable ascent has been made, and the surroundings become more alpine in their character. The Dovrefjeld comprehends in its area some of the loftiest mountains in Norway, many of which, including the Snehettan, 7770 feet, have their summits and slopes whitened with eternal snow. The scenery has a great resemblance to many of the wilder parts of our Scottish Highlands, and consists of undulating table-lands of great extent, with lofty mountains rising from them. This immense plateau has an average elevation of about 3000 feet above sea-level, the mountains being from 5000 to 7000 feet.

Though the Dovrefjeld is usually described as tame and uninteresting, we did not find it so. It is not wanting in much that is grand and impressive, and in the traveller it inspires a feeling of vastness. As a home of an alpine flora, it offers an extensive field for exploration. The Dovrefjeld was visited by the late Professor Blytt in 1824, and a complete list of the plants found at that time was published shortly thereafter. It has since become a favourite resort of Norwegian and Swedish botanists. Most of the alpine plants found in our Scottish Highlands occur on the Dovrefjeld as well as many of our lowland species, and many of the latter, such as *Geranium sylvaticum* and *Trientalis europæa*, are found on the higher elevations side by side with the alpine species. A very frequent plant by the roadside and in the meadows is *Lychnis alpina*, its rich rose-coloured flowers attracting attention. This species is rare in the Scottish Highlands, occurring only on the Clova mountains. *Silene acaulis*, *Cerastium alpinum*, *Astragalus alpinus*, *Saxifraga oppositifolia*, *Gentiana nivalis*, and *Primula farinosa* are all plentiful. *Saxifraga cernua* was in great abundance, usually near shady rocks or by streamlets, the specimens in many cases being tall (10 inches) and well flowered. This is also a rare plant with us, found only on Ben Lawers, and then seldom in flower. Some of the mountains are more favoured than others in respect of their flora; and perhaps the Kundshoë, 6700 feet, is one of those best known for its richness, as on its slopes are found many of the rarest plants. We had taken up our quarters at Kongsvold, and as Kundshoë is quite contiguous, we had ample opportunity of exploring it. I was fortunate in being joined in these excursions by a gentleman from Christiania who was thoroughly familiar with the botany of the district, having gone over it a few years previously. On the morrow we ascended Kundshoë to its summit, having previously made preparations for an early start; and, with every promise of fine weather we were full of anticipations. Taking a conveyance a few miles down the valley, we alighted by the river side to examine a shingly bank. We found *Papaver nudicaule* and *Artemisia norvegica*, both good plants, and characteristic of northern latitudes. These were also frequently met on the mountain side. We commenced to ascend the mountain at a point where there were overhanging rocks and ledges, which continued until we had reached a great height. It required very careful climbing, but in the examination of these rocks we were able to note many alpine plants. Several hours were spent in this way, until we were well on the mountain slopes; and the higher we got, the view became more extended, which added very considerably to the interest of our ascent. The plants we had gathered were—*Thalictrum alpinum, Anemone vernalis, Draba alpina, Arabis alpina, Cerastium stellarioides, Sagina nivalis, Alsinella stricta, Phaca oroboides, Astragalus oroboides, Dryas octopetala, Alchemilla alpina* (sparingly), *Potentilla norvegica, Saxifraga stellaris, S. aizoides, S. nivalis, S. cæspitosa, Rhodiola rosea, Erigeron alpinum, Saussurea alpina, Valbergella apetala, Mulgedium alpinum, Gnaphalium supinum, Pedicularis Œderi, Bartsia alpina, Veronica alpina, Oxyria reniformis, Salix herbacea*, and *Eriophorum alpinum.*

As we gained a higher elevation we got on to an immense moorland, entirely covered with lichens. We had now met the course of the stream, which rushed with great velocity down the mountain; and as we picked our steps amongst the huge boulders, we enjoyed the cool and bracing air and the alpine landscape which stretched away to the distant mountain peaks. Pursuing our upward course, the stream became smaller, indicating that we had almost reached its source; and this proved to be the case, for immediately above us, lying in a valley recess, and coming full in our view, were immense wreaths of snow of great depth. On the outer edge of the snow, in the damp ground, were found *Ranunculus glacialis* and *R. nivalis*, and these, occurring in great profusion and beauty, gave quite a charm to the scene. The recollection of this sight will long remain in my mind.

The summit of the mountain was now in the immediate distance, and after a steady climb it was reached at 4 P.M. Plant life had almost disappeared, though some of the species we had met farther down were found in a very stunted and diminutive form on the summit. There was still the covering of lichens, and growing amongst them we noted *Ranunculus glacialis, Draba alpina, Saxifraga cæspitosa, Pedicularis Œderi, Salix polaris*, and *Luzula confusa.*

Resting a while in this lofty region, we could form a better idea of the surrounding country. In front of us, at a considerable distance in a western direction, we had an imposing view of the snow-clad Snehettan, a principal feature in the landscape. To the north the extensive range of mountains seemed to be covered in their higher reaches with snow; while to the east, peak above peak, with their bare outline, stood out clearly against the horizon. A dull, leaden sky was overhead, but the occasional glinting of the sun as it penetrated the hanging cloud threw its shadow on hill and valley.

We descended the mountain in a different direction, walking many miles over lichen-covered ground, and as we came to a favourable spot now and again we made a careful search for plants. In one locality there were large quantities of *Campanula uniflora*, rather an interesting species; and we also gathered *Alsinella biflora*, *Petasites frigida*, *Andromeda hypnoides*, *A. polifolia*, *Azalea procumbens*, *Menziesia cærulea*, *Arctostaphylos alpina*, *Pedicularis lapponica*, *Betula nana*, &c. As we got lower down there were many species of willow, including *Salix lapponica* and *S. Myrsinites;* but the other plants were much the same as in the earlier part of the day, though not in such variety.

Part of the enjoyment of a stay in the Dovrefjeld is due to the excellent accommodation to be had at the various inns or stations. The most convenient are Jerken, Kongsvold, and Drivstuen, these being at distances of about 10 miles from each other on the main road, and they afford every comfort a traveller could wish. We remained principally at Kongsvold, which has the advantage of being well situated in a good plant district, and it has also attractions in the way of scenery equal to many of the more favoured parts of Norway. To those who may be disinclined for mountain climbing, there is ample opportunity of occupying oneself with the botany of the lower ground, where many species of alpine and other plants cover the rock ledges and river side.

We next removed to Drivstuen, a station a few miles farther on. The road from Kongsvold to Drivstuen was one of the finest drives we had. It was a deep ravine, and as we passed along the overhanging rocks were covered with alpine plants. At Drivstuen the flora was less alpine on the lower ground, but on the mountains adjoining there were many of the rarer forms we had found at Kongsvold.

Mulgedium alpinum was in great abundance. We also got *Polemonium cæruleum, Ranunculus aconitifolius, Menziesia cærulea, Linnæa borealis* (the latter very plentiful throughout Norway), and *Saxifraga Cotyledon*—a species which is more abundant amongst the mountains on the western coast. We spent the morning on the heights on the western side above Drivstuen, but in consequence of their steepness the ascent was rather difficult, requiring a wide detour to be made to clear the chasms and perpendicular rocks. The inducement to undertake this excursion was the hope of finding *Diapensia lapponica,* which was said to grow on the edge of the cliffs. Looking down from these dizzy heights on the valley below, the sensation was a very curious one. The neighbouring hills seemed to be quite dwarfed; the hotel and contiguous houses, though considerable in their way, appeared as mere specks; and the river, which flowed in heavy flood, looked like a streamlet. We were pleased to have seen this alpine view, though we found it almost more tedious to get down from the steep cliffs, with snow lying in their recesses, than to make the ascent. This mountain climb formed a fitting conclusion to our visit to the Dovrefjeld, and the pleasure of finding *Diapensia* in fine flower added another gratifying association with its alpine flora.

On the Occurrence of Zostera nana, Roth, *in the Firth of Forth.* By William Evans, F.R.S.E.

(Read 14th March 1889.)

Zostera nana, Roth, has not, so far as I am aware, been hitherto recorded from the Forth district. It is not mentioned in the second edition of Balfour and Sadler's *Flora of Edinburgh,* and Professor Bayley Balfour informs me that the only Scottish districts given for it in Watson's *Topographical Botany* are Ayr, Forfar, Argyle, and Clyde Isles.

I first recognised it on the mud-flats of Aberlady Bay in September 1884, and the specimens (in seed) now exhibited were collected by me there on the 24th of that month. Since then I have observed it in abundance on the mud-flats near Torryburn, and also at a short distance to the west of the mouth of the Almond at Cramond. The living specimens on the table were gathered at the last-mentioned locality a few days ago.

The Herbarium at the Royal Botanic Garden contains specimens from Montrose basin, with which I have compared mine.

Wigdeon feed on this Zostera as well as on *Z. marina*, their favourite food, and it was while studying the habits of these ducks that my attention was first drawn to the plant.

On the Occurrence of Calamagrostis stricta, *var.* borealis, Hartm., *in Scotland.* By ARTHUR BENNETT.

(Read 14th March 1889.)

Last summer Mr G. C. Druce, F.L.S. of Oxford, sent me specimens of a *Calamagrostis* he gathered on the banks of the Tay, in Mid Perth, in a marsh, which I saw at once was not our usual state of *stricta;* and Mr Druce recorded the plant in the *Scottish Naturalist*, with a note, that I thought it near *borealis.* He has lately sent specimens to Professor Haeckel of St Poeltens, and he decides that it is the *borealis* of Hartmann's *Flora.* This is again a most interesting addition to the Scottish flora, and another link in the evidence of its close similarity to that of Scandinavia.

I give its synonymy and distribution, with the original description and remarks of Læstadius, its describer.

Calamagrostis borealis, L. L. Læstadius, in "Anamärkningar om vegetationen i Karesuando och Enontekis," quoted by C. P. Læstadius in *Bidrag till kannedomen om växtligheten i Torneå*, Lappmark, 1860, pp. 28 and 44; Nyman, *Conspectus Floræ Europææ*, p. 799; *Deyeuxia neglecta*, Kunth, var. *borealis*, mihi.

Arista subdorsali, lana corolla brevior, caulis foliatus. Panicula stricta patens, folia radicalia dilata, aspera, stricta, elongata. Hujus forma primaria paludosis in Pajala et Kengis.

β arenivaga, Læst., panicula stricta patens, radix longe lateque repens, folia stricta dilatano, sub exsiccatione convoluta, filiformia. Hab. Enontekis in ripa arenosa inter Karesnando et Kuttainen copiose.

Cum *C. stricta* maximam similitudinem habet. Differt autem arista subdorsali, hoc est infra apicem, supra medium corallæ fixa, brevissima; pilis corollam non æquantibus, longora autem quam strictæ. A. *C. epigejos*, cujus formam depauperatum primum putavi, differt glumis duplo brevioribus non acuminatis, et a *C. strigosa* eadem nota.

It occurs in Finmark, Lapland, and West Bothnia in Europe. In Greenland given by Dr Lange in his *Conspectus Floræ Grœnlandicæ* with a mark of doubt; but it was gathered by the Swedish Expedition in 1883, and recorded by Berlin in the Stockholm *Transactions*.

I do not find it recorded for the Asiatic coast in Kjellman's account of the Vega Expedition; and Professor Macoun does not give it in his lately published Canadian Catalogue, though I should not be surprised to hear that it has been discovered in Arctic British America.

I have much pleasure in sending a specimen for the Herbarium.

Notes on the Records of Scottish Plants during 1888. By Arthur Bennett, F.L.S.

(Read 11th April 1889.)

Last year I gave a résume of the principal records that were made in 1887, which the Society has done me the honour to print in the *Transactions*. I propose here to briefly notice the results of 1888.

I cannot report such an array of new species to the country as in 1887, but I have to notice one belonging to *Characeæ*, viz., *Nitella batrachosperma*, A. Br. (or a boreal form of *N. tenuissima*, Kütz.), which is an addition to the Scottish Flora, and new to Britain if it prove the former. It was gathered last July near Obbe, in Harris, one of the Outer Hebrides, in a loch, by Mr Duncan, and sent to me by Mr King of Preston, Lancashire. Perhaps one of the most interesting of the plants gathered in 1888 is *Calamagrostis stricta*, Nutt., var. *borealis*, Hartm. (*Deyeuxia neglecta*, Kunth, var. *borealis*, mihi), found by Mr G. C. Druce in a marsh by the Tay side in Mid Perth; thus restoring to Scotland a plant, the type of which Don and Robert Brown had gathered in Forfar, but whence it has been lost for many years. I am very glad to be able to send a specimen for the Herbarium (see record of last meeting).

So far as *Hieracia* are concerned, my records will not be complete, as my friend Mr Hanbury is still working out the new forms, &c.

As Dr Buchanan White of Perth has taken up the study of the genus *Salix*, I would ask all who can to aid him, either by remitting specimens or submitting their collection to him. Already he has found some interesting new forms among our plants.

I wish I could induce some one to take up the genus *Atriplex* in the same way. I shall be glad to place at the disposal of any one who would, a series of specimens from the eastern and southern coasts of England, and also from the Danish and Swedish coasts.

Proceeding with my enumeration in the same way, as before, by beginning with the Shetland Isles, I give all the new records found in them, as it seems to me that every species that is found in these northerly islands is of great interest, as touching on the immigration of our flora. Mr Beeby's finds in 1888 include *Polygala eu-vulgaris*, *Vicia sepium*, *Geum rivale*; *Sparganium simplex*, var. *longissimum*, Fr.; *Ruppia rostellata*, *Scirpus setaceus*, and *Carex Œderi* of authors (but not of Ehrhart), a paper on which and other European Carices I should like to call attention to, which will appear in the *Botanical Gazette* or *Torrey Bulletin*, U.S.A., by my friend Professor L. H. Bailey of the Cornell University—the result of a tour he made to European Herbaria last autumn.

In the Orkneys, Professor J. W. H. Trail has found 11 species not before recorded, including *Potentilla procumbens*, *Trientalis europæa*, and *Atriplex littoralis*.

From the Outer Hebrides, Mr A. Somerville has sent me over 50 additional records, a few of which are noted in Macgillivray's *Account of the Outer Hebrides*, 1830, pp. 91–95, but were not taken up by Watson, being held doubtful. These include *Cicuta virosa* (occurring plentifully in the marshy border of a loch in South Uist), *Viola Curtisii*, *Œnanthe crocata*, *Hedera Helix* (on rocks), *Scutellaria minor*, *Atriplex arenaria*, *Allium ursinum*, *Potamogeton Friesii* (*mucronatus*, Auct.), *Scirpus Savii*, &c.

In Caithness, Mr Henderson has added *Thalictrum alpinum* and *Tofieldia palustris*; Messrs Hanbury and Grant *Rumex domesticus*, and 6 species of *Hieracia*.

In Sutherland West, Mr Gray has recorded a large number of additional species; and in East Sutherland, Mr J. F. Grant over 100, mostly common species, but with a few varieties.

From Cantyre, Mr P. Ewing has sent some 20 additions—among them *Drosera anglica, Arctium intermedium, Allium ursinum, Sparganium affine; Carex filiformis, curta, pauciflora,* and *limosa; Elymus arenarius,* and *Hymenophyllum Wilsoni.*

From Dumbarton, Mr Somerville sends 8 species, and Mr L. Watt the same number—comprising *Orobus tuberosus, Hieracium anglicum, Carex acuta,* &c.

Argyle has produced a large number (68), found by Messrs T. King, G. C. Druce, and the Rev. Mr Marshall—including *Sagina saxatilis,* several *Hieracia, Stachys ambigua, Pyrola rotundifolia, Betula nana, Rumex domesticus, Juncus castaneus, Carex vaginata, Cystopteris montana,* &c.

In West Inverness, Mr Symington Grieve and the Rev. Mr Marshall found 20 fresh records, of which *Hieracium calenduliflorum* and *argenteum, Salix Lapponum, Potamogeton natans,* at 2300 feet (being 500 feet higher than any record known to me), *Carex vaginata,* and *Melica nutans* are the most interesting.

From East Inverness, Mr G. C. Druce has among others *Hieracium gracilentum, H. eximeum, Pinguicula vulgaris,* var. *alpina,* Reich; and the Scottish Alpine Club (1886), *Dryas octopetala, Saxifraga rivularis,* and *S. cæspitosa.*

From Elgin, Mr Druce also has several records—*Aira uliginosa, Myosotis repens,* and *Allium oleraceum* the most noticeable.

In Counties 94 to 90 we get few records, but several *Hieracia.*

In East Perth, the Rev. Mr Fergusson's find of *Oxytropis campestris* is most interesting, and will, let us hope, long retain the species in our flora, for it seems to be now very rare in Forfar.

Mid Perth has produced *Hieracium aggregatum,* one of the rarer Backhousian species, and three others; Mr Druce's find of the *Calamagrostis,* and some others.

In West Perth, Mr S. Grieve has found *Carex pulla, Cerastium alpinum,* and others.

To Peebles, Mr G. C. Druce contributes 50 new records, with *Meum athamanticum, Ligustrum vulgare, Scirpus sylva-*

ticus, Potamogeton rufescens, Carex aquatilis, C. rigida, and many commoner species.

Mr J. M'Andrew has added 6 species to Kirkcudbright; and Mr Fingland *Thalictrum montanum, Polygonum viviparum, Oxyria reniformis* to Dumfries.

I have thus run through the series of 584 records, known to me as being found in 1888. It may be asked, "Will equally large numbers of records be given year by year as during the last three or four years?" I think not. We have now on record most of the very common plants for all the Scotch counties; and while I fully believe we are far from having filled up all the gaps, still I do think we are approaching the time when we shall be able to say with some degree of certainty what are present and what are absent in most counties of the common and generally distributed species.

To work of this sort there is of necessity no finality; still we shall be justified in making some inquiries regarding "the why and the wherefore" of our flora, such as Professor Axel Blytt has done in his able paper "On the Immigration of the Norwegian Flora," which, being in English, is accessible to all British botanists.

I conclude by giving the numbers of the new records in the different counties, as I did in my former paper:—

County.	Name.	No.	County.	Name.	No.
				Brought forward,	144
72	Dumfries, . .	8	96	Easterness, . .	16
73	Kirkcudbright, .	6	97	Westerness, . .	43
75	Ayr, . . .	18	98	Argyle, . . .	68
76	Renfrew, . .	2	99	Dumbarton, . .	15
77	Lanark, . . .	3	100	Clyde Isles, . .	3
78	Peebles, . . .	57	101	Cantyre, . . .	21
83	Edinburgh, . .	1	102	South Hebrides, .	2
85	Fife, . . .	1	103	Mid Hebrides, .	3
87	West Perth, . .	8	104	North Hebrides, .	2
88	Mid Perth, . .	11	105	West Ross, . .	3
89	East Perth, . .	2	106	East Ross, . .	1
90	Forfar, . . .	3	107	Sutherland, East, .	118
92	South Aberdeen, .	4	108	Sutherland, West, .	77
94	Banff, . . .	1	109	Caithness, . .	10
95	Elgin, . . .	11	110	Outer Hebrides, .	50
111	Orkney Isles, . .	12	112	Shetland Isles, .	8
	Carry forward,	144		Records,	584

A Summary of the Botanical Features of the Country traversed by the Afghan Delimitation Commission during 1884–85. By J. E. T. Aitchison, M.D., C.I.E., F.R.S.

(Read 11th April 1889.)

In the present paper I propose to give a short summary of the botanical features of the country traversed by the Afghan Delimitation Commission during 1884 and 1885, to which I was attached as naturalist, and as I proceed in this description, to introduce some information relative to the more valuable products which are grown in and exported from these regions.

The expedition left Simla about the middle of August, and Quetta on the 22nd September. Owing to the heat of the day, our marches between Quetta and Hadj-ali on the Helmand were made during the night, and in our course we were guided by fires lit at certain distances. For guidance during the day the whole of the route had been run over by a plough, the furrow thus made directed those who from necessity had to travel by daylight.

The physical features of Baluchistan consist of gravel and clay plains, bounded by low ranges of limestone, and trap hills, intersected by numerous dried-up water-courses and undulating expanses of sand, which are said to be continuously shifting, owing to the action of the wind. The few shrubs or bushes which occurred were tamarisks along the margins of the dry water-courses, or were genera of Chenopodiaceæ, such as *Salsola*, *Suæda*, *Anabasis*, and Polygonaceæ, such as *Calligonum*, *Atraphaxis*, and *Pteropyrum*, irregularly dotted over the great plains. At the bases of the limestone hills, the only tree of the country, *Pistacia Terebinthus*, var. *mutica*, was seen to exist in small clusters. This is a small tree about 18 feet in height, with a tolerable stem of from 3 to 5 feet in circumference. The nuts are crushed to yield an oil, which is eaten as a relish to bread, or used by the local sportsman as shot, and the leaves are employed in dyeing. In the vicinity of trap rock formations shrubs were more common, and *Stocksia Brahuica* occurred as a large shrub, or small tree, extremely attractive at this season of the year from the brilliant colouring of its clusters of membranaceous inflated fruit, remarkable as one of a monotypic genus, belonging to the natural order Sapindaceæ. In the sandy hillocks *Haloxylon Ammodendron* grew in great profusion in some localities, often almost to a tree size; this is celebrated as fodder for camels, who can live upon its twigs and branches, without a change of diet, for a long period. Owing to its resemblance to a tamarisk, it is so called by both Europeans and natives. Its wood makes excellent fuel, and at Herat a green dye is extracted from it.

We reached Hadj-ali, on the Helmand, on the 16th October. Its altitude above the sea-level was about 1500 feet. From this we travelled down the left bank of the river, until almost opposite to Chakar-burja, where we crossed it, and then marched down the right bank until we reached the great expanse of water called the Hamun. On the islands of the river and low-lying land we had forests of the Euphratic poplar, with tamarisks, and large grasses and reeds. On the main land, but where the river's moisture reached the surface, there were forests of *Tamarix articulata*, some trees being 15 feet in circumference, and owing to their peculiarity of always being found growing on mounds, were called by the natives the "mound- or hill-tamarix." The table-lands and plateaux on either side of the river much resembled the desert country of Baluchistan, and were seen to be similarly dotted with shrubs of *Salsola*, Polygonaceæ, and tamarisk. Over the whole country which we had as yet crossed, *Alhagi camelorum*, or the camel thorn, another great fodder, had been a luxuriant shrub. It is said here not to produce the manna, Tar-anjabin, but in Khorasan I collected manna from it in some quantity,—occurring in small transparent nodules on the upper parts of the branches and stems. It is said to be collected usually at the end of July, after the hot winds have set in, and just as the wheat harvest has been gathered.

Hamun, in this country, means a locality with a certain depth of water that allows of the growth of bushes and reeds, tamarisk, and *Arundo*. It is, in short, the overflow of the lake at certain seasons of the year, on an almost level piece of land. Much of the Hamun, at the season of the year that we passed it, was dry, and the jungle was traversed for pasturage by immense herds of cattle, sheep, and goats, which at the same time are protected by the jungle which overtops them, from the continuous blow of cold wind, that is well known to last at this season for two or three months, and which was then blowing most unpleasantly for us.

We arrived at Anar-darra (2100 feet alt.), or the Pomegranate Pass, on the 7th June. It consisted of a lovely village set in orchards, lying at the base of two low ranges of limestone hills, between which a tolerable-sized stream of good sweet water made its escape into the Harút river. The presence of this fine stream accounted for the fertility of the soil, and for the numerous orchards and gardens producing quantities of fruit. Pomegranates, as large as a child's head, with a papery rind, and grains almost seedless, are grown here; these are exported more especially to India and Afghanistan proper. Another of its noted products is madder, the dye stuff obtained from *Rubia tinctorum*. This is chiefly exported to Herat, thence to India. Herat itself does not produce first class madder, but gets its character for doing so from what it imports from Koin, Yezd, and Anar-darra. Madder is cultivated under the shade of the trees in the orchards, and this cultivation is said rather to improve the orchard than to cause it to deteriorate.

On the 14th of November we reached Pahir, at the extreme eastern end of the Doshakh range (4500 feet). Pahir is about 3450 feet in altitude, and from this we had our first view of Herat (which is 3000 feet), and the valley of the Hari-rud, while in the distance beyond were the mountains of the Paropamisus range,—certain peaks standing out in their grandeur to an altitude of nearly 7000 feet. Before us lay a treeless, almost shrubless, barren arid country, as far as we could see, extending in great plateaux down towards the Hari-rud river.

In our march between this and Khusan we did not see a single indigenous tree, and we could have counted the few shrubs we did meet with, which were chiefly species of *Salsola*. We rarely came across one or two stems of the larger Umbelliferæ, standing, as some one of the mission said, "like sentinels in the wilderness." How very scarce vegetation was on this part of our journey may well be understood, when I state that our camp followers grumbled that they could not pick up a scrap of bush or twig, to add to the small quantities of fuel doled out to them by the Commissariat.

At Zindijan we saw good large trees of *Pinus halepensis*; this is cultivated usually only at Ziarats or Shrines, in Afghanistan. At Karokh, in the hills between Herat and Kallanau, a small wood of it which has spread from the shrine has become naturalised. In Persia, at Sangun, and some other localities, it is cultivated in rows on the windward side of orchards, to protect them from the continuous gales that blow there, and there I saw trees of fully 80 feet in height, showing fine timber. That pines are scarce in these parts may be seen from the fact that the ladies of the nomad population place a pine cone in their work-bags, believing it to bring luck to their household. In Persia, where these trees have been more numerously cultivated, they are cut down for their timber,—not so in Afghanistan. At Sha-bad we met with some grand old elm trees, all the result of cultivation.

We reached Khusan, 2000 feet in altitude, on the 18th November, and found it a tolerably large village, containing some 400 or 500 inhabitants. The houses in this part of the country are, with rare exceptions, built entirely of sun-dried bricks; the roof being domed, with a small aperture for smoke, and are usually not 15 feet in height. The dome appears to form the greater part of the building, and this gives them a very bee-hive-like appearance. Except in the doors and lintels, no other wood work is employed; and there are no windows of any sort. These dwellings are extremely comfortable during winter, and as long as the cold weather lasts, but in summer are quite unbearable to live in, hence during the heat of summer the inhabitants turn out and live in blanket tents in the vicinity of the village, in the open country, where they get full benefit of any air that may be in motion.

The village is usually built so that all the houses open into a common enclosure or yard, having an entrance and exit gate at each end of the enclosure, and the back walls of the united houses thus form a common fortified place of residence. These great gateways are large enough for the inlet of laden camels, and the gates are usually made of the wood of the Oriental plane, which gives size along with strength and lightness. The wood comes either from Persia or Maimannah, in northern Afghanistan, where the plane is a large and plentiful tree. The beams which made up one gate that I measured were 18 feet long, 18 inches broad, and 4 inches thick; these were united by cross bars of wood studded all over with great iron bolt heads. Outside the gate, rolled to one side, and fixed in a groove or slot, was a huge millstone 6 feet in height. It is only a very few years ago since all this country was open to the Turkoman raiders. Upon news being received that Turkomans were in the vicinity, the gates were closed, and the millstone rolled in front. Each orchard is surrounded by a wall from 4 to 20 feet in height, built of sun-dried bricks, primarily to protect the orchard from men and animals, and secondarily, from the cold bleak winds of winter and the hot dry blasts of summer. The ordinary orchard consists of a row of mulberry trees round the inner side of the surrounding wall, with a few apricots, plums, an occasional quince, pear, and vine, the rest of the ground being laid in plots of vegetables, one or two shrubs of the damascene rose, and the remainder with lucerne (*Medicago sativa*). I may here mention that none of these would exist at all were it not for a supply of water from irrigation. Mulberry trees are grown for the sake of the silk-worms, whose produce of silk is still considerable, but not a tenth of what used to be a few years ago, owing to the disease amongst the worms. The fruit is collected, dried, and eaten, after being made into a kind of bread, or is drunk as an infusion, whilst eating bread. Apricots and plums are the common fruits of the country; they are largely dried, and exported from this locality towards India. Lucerne is grown and used either in a green state, or is given in a dry condition as hay to horses, mixed with, and as an improvement upon the dried crushed straws of wheat and barley.

In the smallest village there is to be found some one to whom the few roses that grow in each orchard are daily taken, and from these rose-water is distilled. The common vegetables are turnips, carrots, beetroot, and beans; these are all excellent, and quite equal to their ordinary English brethren, besides several pot herbs, which are not used in England. Outside the orchards we come upon fields of wheat, barley, melons, cotton, tobacco, and occasionally opium. No crops worth growing can be produced under 3500 feet altitude, without irrigation, owing to the absence of dew in summer under that altitude, and two crops are never obtained from the same land in one season.

From Herat westwards the irrigation is all led from the Hari-rud river by means of canals. Wheat is the chief crop; the grain is certainly not equal in quality to that produced in the Punjab. Most of this is exported, and chiefly, it is said, to Turkistan. The next most valuable crop is that of the water melon, which is entirely kept for local use; on these the inhabitants live, with bread alone, for two or three months during the year. These are very fine and extremely sweet, containing so much saccharine matter that the juice is said to be converted into a syrup in Herat. Barley is chiefly grown for the use of cattle, either as grain or it is cut green for fodder; cotton and tobacco apparently occur only in sufficiency for local consumption. Beyond the fields, and where the effects of irrigation cease, the country is a dreary arid waste, more especially in the vicinity of villages, as seen in our march from Pahir to Khusan, since every twig and scrap of material that can be so employed is used as fuel by the inhabitants, and all herbage is utterly destroyed by the donkeys, goats, and sheep of the village. There is a great absence of fuel, but, notwithstanding this, all manure is carefully applied to the orchards or fields; none is burnt, as is the habit in India. The barren character of the country, and the want of indigenous trees, is due to the extreme dryness of the soil and aridity of the atmosphere, with the great extremes of intense winter cold and summer heat, the temperature falling some degrees below zero in winter, and rising for some days over 105° in the shade in summer. The struggle of plant life for existence is great. The plants which are seen to exist through it all are either annuals or those possessing great root stocks, tubers, tuberous roots, rhizomes, bulbs, or other such structural developments as assist them to battle and survive through the extremes of temperature. When there is moisture, as on the islands in the river and along its bank, we find a good-sized tree in *Populus euphratica,* with a few tamarisks and *Haloxylon,* but except for these from Herat to Zulfikar, there is not an indigenous tree. As a proof of the aridity of the climate, I may state that only on two occasions did I collect any ferns. Once, at the Sim Koh Hills, at 3500 feet, I gathered *Adiantum Capillus-Veneris,* and on the second occasion in the hills near Bezd in limestone at 5000 feet, *Cheilanthes Szovitsii.* The latter, however, was quite an exceptional locality, being a very deep narrow defile, with a northern exposure, and having apparently a perpetual spring oozing through the rock structure. Here, therefore, and only here, were found growing *Dionysia tapetodes,* a very moss-like primulaceous plant; a creeping rock bell-flower *Campanula canescens;* our common wall pellitory, *Parietaria officinalis,* with a very curious small *Euphorbia,* imitating the form and method of growth, in the clefts of the rock, of an Asplenium; indeed, when I first noticed it, I certainly thought that I had got another fern.

We left Khusan on the 26th November, crossing the great plateaux that intervene between this and the Paropamisus range, and entered the Badghis by crossing the Chashma Sabz Pass. As we neared the hills we found shrubs more numerous, especially several species of *Prunus,* but only when we had got up to 5000 feet, and when crossing the pass, did things begin to look interesting. From the position of the Badghis, lying as it does to the north and east of the Paropamisus range, one naturally expects to find a very different climate to that of the country we have just described as the valley of the Hari-rud. Such is the case; as here we have an atmosphere of an ordinarily moist character, owing to the great masses of hills, which lie exposed to the north, becoming covered with snow much earlier in the year, whilst snow lies unmelted to a late date, and thus a long constant supply of water is distributed to the valleys below. This humidity, and the protection given by the mountains from the blighting hot winds of the south and west, give to the Badghis a climate allowing of the existence not only of a splendid herbage, but of various species of fine trees.

The general appearance of the Badghis, including the mountain range and rock formation, is that of a continuous succession of rolling downs, consisting of a loamy, sandy soil, covered with a pasturage of herbs and grasses. The absence of trees and shrubs on this down country is not due to climate, I should say, but rather to the continuous grazing for centuries past of goats and sheep. To note the effect of from 5000 to 10,000 goats and sheep suddenly spreading over one of these pasturages, is heartbreaking to a botanist. Locusts are nothing to them.

On the top of the Chashma Sabz Pass, fine trees of *Juniperus excelsa* were numerous, and in the gorges and deep cuttings, the Hawthorn, *Cratægus oxyacantha;* the Oleaster, *Elæagnus hortensis;* the Cotoneaster, *Cotoneaster nummularia;* a new species of *Prunus, P. calycosus;* some species of *Eremurus; Rheum Ribes;* with roses, brambles, and barberries, could be recognised. The most interesting of these subsequently proved to be the Cotoneaster, which in this locality yields from the surface of its branches, in certain seasons only, a manna called Shir-Khist (curded or hardened milk), much valued by the natives, and largely exported, through Herat, to Cabul and India. The Oleaster is interesting as being the indigenous form of the cultivated tree; its fruit is collected to be eaten, as well as to be crushed for oil. The wood is considered valuable in the construction of bridges. The new *Prunus, P. calycosus,* is remarkable in having no corolla, and in having its calyx coloured as if it were the corolla. The bark of the root is largely employed in dyeing, and for this purpose is valued by the Turkomans.

In continuing our march at Palounda, 6th December, in the deep valleys amongst the hills, I came across trees of a wild pear, the fruit of which is said to be dried and converted into flour, to be subsequently made into bread. A jungle of the Jujube Anáb, *Zizyphus vulgaris,* apparently in an indigenous condition, grew much in the same way as it does where indigenous in Kashmir. The cultivated form, without spines, yields the fruit of which the natives are very fond, and which is carried by them as a luxury on long journeys. We found here *Berberis vulgaris,* the fruit of which, collected by the Afghans, is dried, preserved, and exported to India as Zirishk. The Afghans are very fond of adding this barberry fruit, as we do pickles, to their diet. A maple is also found here, from the bark of whose roots a dye stuff is obtained.

On the 7th December, we passed through our first forest of *Pistacio vera,* although we had seen single trees and occasional clumps as we came along. This forest was especially interesting, as a few years ago Sir Joseph then Dr Hooker, as Editor of the English translation of Decaisne's *Botany,* at page 363, called attention to the fact that the native country of this tree was unknown. When I was in Ladak I found out that natives from Central Asia spoke of the tree occurring in forests, and apparently as indigenous. Here, throughout the Badghis, there can be no doubt but that it is so, and these forests of Kalla-nao have been known for ages. Owing to the presence of these forests, certain parts of the Badghis are called Pistalik, or Pistacio bearing. The Pistacio nut is one of the great fruit exports from Afghanistan to India, and, often along with it, the galls produced on the same tree, which are valued for dyeing. The natives assert that the trees bear in alternate years nuts and galls. It is to be noted, that some trees only bear nuts that are partially dehiscent, whilst on others the nuts are altogether closed and indehiscent. Those collecting the nuts for immediate eating always choose the trees on which the nuts are dehiscing. A gum resin exudes from the tree, very like mastich, which is valued as a remedy for cuts and sores. The wood makes the finest fuel of any in these parts. The tree, so far as I observed, was not cultivated in Afghanistan, but was cultivated in orchards in Persia, the fruit from these being much larger and of a superior quality.

At Gulran, where we were encamped for some time, I first met with *Apocynum venetum,* a shrub throwing up stiff erect annual shoots of from 5 to 6 feet in height, from an underground rhizome. It grew luxuriantly in marshy saline soil. From the bark of the annual shoots the Turkomans obtain a strong fibre, from which they make a cloth. This is called Katan, but Katan in Persia means *linen.* I believe this to be the same plant from which, at Lobnor in Eastern Turkistan, the natives make a cloth, which was considered by the late lamented Colonel Prejvalski, the celebrated Russian traveller, to be the produce of an Asclepiad. Experts in

England consider the fibre very fine, and one that may probably be turned to valuable account. It is curious that this shrub, though it grows in the Adriatic, so near home, has not as yet been heard of as regards the value of its fibre, although other species of this genus are known in America as producing fibre for fishing lines and such purposes.

We crossed the Paropamisus range from Gulran back into the basin of the Hari-rud on the 1st April, but how different did the plateaux now look in their spring garb! Shrubs covered with foliage seemed to have suddenly sprung from the ground, and the whole country, that was an arid waste on our previous journey, was now beginning to show a sea of lovely greens, interspersed with the bright colouring of a tulip, *T. montana*, in full flower, the tints of which varied from deep red, striped red, to a bright yellow. All the great Umbelliferæ had now developed their basal leaves; some, indeed, such as Asafœtida, were beginning to throw up their flowering stems. These great Umbelliferæ were *Ferula fœtida*, which yields the Asafœtida gum-resin, *Ferula galbaniflua*, which yields galbanum, and *Dorema ammoniacum*, which yields ammoniacum. The habit of growth of these is much the same; they all produce a great show of foliage surrounding their perennial root stocks. This spreads out on the ground, forming a circle round the base of each plant over 6 feet across, and it is the approximation of the foliage of adjacent plants that gives to the country its wonderful appearance of a continuous pasture land. Later in the season, upon each species throwing up its own peculiar form of inflorescence, the landscape becomes much altered, more especially from the presence of *Ferula galbaniflua*. When this is in full flower, with its golden-coloured panicled inflorescence from 3 to 4 feet in height, representing a miniature forest, the sight is one to be dreamed of rather than believed in or described. This wonderful verdure lasts from the end of April to the beginning of July; by the end of that month it has as suddenly disappeared as it originated, even to the fruit-bearing stems. The hot sun dries the plants to tinder, and the prevailing hot winds finish the work of destruction so thoroughly, that by August not a trace of the past season's vegetation is left. While speaking of Umbelliferæ, I may here note that at certain altitudes in

Afghanistan, from 3000 to 5000 feet, and in peculiar exposures on the great arid plains and ridges, we find hummock-like forms occurring similar to the peculiar South American genus *Bolax*, which vary from the size of a football to small mounds 12 feet across and 5 feet high. The plants here taking this form are usually species of *Acanthophyllum* belonging to the Caryophyllaceæ, *Astragalus* and *Onobrychis* among Leguminosæ, and *Acantholimon* and *Statice* among Plumbaginaceæ. These hummocks in many instances become covered with the most lovely inflorescence, giving the appearance of artificial bouquets of all sizes, and at the varied tints and colourings of which one never tired gazing. Usually the flowers are borne on peduncles raising them well above the surface, but in two instances the spinous leaves protrude beyond the flowers, and thus the latter are protected from goats, those terrible exterminators of vegetation.

On this expedition I collected in all some 800 species, referable to 73 Natural Orders.

Leguminosæ and Compositæ headed the list, by each showing 78 species ; and in Leguminosæ there were no less than 38 species of *Astragalus*, of which some 14 were new to science. Of these, *Astragalus heratensis* and an unnamed species were found to yield a coarse tragacanth called Katira, the origin of which, although credited to several plants in India, has up to this time not been identified with the true plant. The product is merely collected as it is found exuded on the bushes, no special system being adopted for its collection. It occurs usually in wrinkled ribbon-shaped pieces, from fractures in the bark through which it has escaped. It is largely employed and exported in all directions for the facing of cotton cloths and silks. Several of these Astragali —*A. Kahiricus, auganus, buchtormensis*—have long, whip-like roots, the bark of which is employed as twine by the people. These roots are extracted in a very neat way, by attaching a loop of twine to the crown, passing a stick through the other end, and making it act as a lever. When I was in the Kuram valley I heard of this plan, but never saw it adopted until I came here. From *Glycyrrhiza glabra* the extract liquorice is largely prepared for household use, as well as for barter, in every nomad family. The great underground rootstocks, the liquorice stick of shops, make splendid fuel. Our camp followers were the first to detect it, on our marches through the Badghis. They knew it well, as at Kandahar they used to collect it for fuel. *Prosopis Stephaniana.*—This shrub was common from the Helmand over the rest of our journeyings. Its pods, when affected by an insect, become enlarged into great twisted bloated galls; these are collected and exported as a dye stuff. *Cercis siliquastrum,* which I only collected at the base of Mount Doshakh, and beyond Meshad, is valued in Persia for its deep-red coloured annual shoots. These are used for basket work, the manufacture of sieves, strainers, and ladles. They make very pretty baskets.

The chief genera in Compositæ were *Cousinia* and *Centaurea.* The former are usually found associated with the *Artemisiæ,* occupying the great gravel plains and deserts; the latter occur near cultivation, and where moisture is prevalent. A grand enormous thistle-like shrub is *Gundelia Tournefortii,* from 5 to 6 feet in height, which is found in great gregarious masses occupying vast tracts of country, and forming by its bayonet-like leaves impassable thickets, which, as they wither up and dry, from the hot autumnal winds, become friable, and are collected as a substitute for straw fodder for cattle. For this purpose the plant is regularly stacked for winter consumption. *Codonocephalum Peacockianum,* a splendid perennial shrub, equally with *Gundelia,* spreads in masses over certain tracts, and is eagerly grazed upon by goats and sheep.

I had expected to obtain several species of *Artemisia.* I may safely say that there are only two which are at all abundant, these being our common species, *A. maritima* and *A. campestris,* which seemingly defy drought and temperature, existing in all localities, and in many instances forming the only herbage, interspersed with *Stipa pennata.* They give excellent fodder for all animals, as well as yielding fuel to the passing traveller. I got a third species, but it is uncommon.

Of grasses I obtained some 64 species. The most common was *Poa bulbosa,* which covered the great plains that lead down from the Paropamisus, and which is followed as a later herbage by two species of *Agropyrum.* *Hordeum ithaburense,* much more localised than the two former, occurs in great patches, like cultivated barley in general habit of growth and appearance, and is considered as barley gone wild by the nomads. *Hordeum medusæ* is equally characteristic, occupying the great slopes which run down from the higher hills. As already mentioned, *Stipa pennata*, the feather grass of gardens, is characteristic of the great gravel plains, where it is associated with species of *Artemisia*. In the basin of the Harút river we found much of the country covered with an *Eragrostis*, *E. cynosuroides*, resembling in habit the bent grass of Scotland; *Elymus arenarius;* while in the desert country *Aristida plumosa* is one of the chief fodders for the few sheep which occur in that country. In Persia, in the orchards, I found what I believe to be an *Erianthus* cultivated for its culms, which are used as pens.

Of Cruciferæ I noted 57 species. Most of these are showy-flowered small annuals. The most characteristic of the order, as a useful indigenous plant, is *Crambe cordifolia*, which in the loose, loamy sandy soil of the Badghis produces an immense turnip-like perennial woody rootstock. This is collected and stored for winter use as fodder for camels, which are the only animals, I should say, in these parts, capable of masticating such a woody fodder.

Of the Labiatæ I observed 34 species. *Eremostachys labiosa* and *regeliana* bear on their fibrous roots large tubers; these are collected and employed by the Turkomans in rubbing down their bodies after a bath, to act as a rubefacient in lieu of the tubers of *Curcuma*, so largely imported from India for the same purpose. When crushed the tubers of *Eremostachys* give forth a strong pungent odour of mustard, very similar to that given off by the external bark of the turnip-rooted *Lamium napiformis*. On collecting another Labiate, *Teucrium serratum*, I was struck by its being strongly scented with an odour exactly resembling Asafœtida, indeed I looked to see if I had not been accidentally crushing some of that plant.

In conclusion, I draw attention to the fact that there has for some time past been a good deal of talk in India as to what the plant "Soma" of the ancients could be, as from it used to be prepared a strong drink by the priesthood. *Ephedra pachyclada* is known throughout this country as Hum—Huma—Yehma, and is at present employed by the

Parsees in their fire-worship. Some suppose that this may have been the Soma of the ancients, as it corresponds in a degree to a very vague description given in the old Sanscrit writings. On my leaving Tash, in Persia, on the outskirts of the village, I came upon an old woman who held in her hand a small dish, on which were some live coals. As I came near she placed some twigs on these coals; they burnt up, and gave forth an odour long forgotten by me. It was the odour of the burning of juniper twigs. I jumped off my pony, and got my interpreter to question her for me. The lady was a Persian, a Mahommedan, making a fire sacrifice, with good wishes for my journey, and hoping for the charity of the stranger. She allowed me to examine the twigs she was employing. They consisted of *Juniperus excelsa* and *Ephedra pachyclada*, the symbols of two very different religions—the former being used by the Bhudists, and the latter by the Parsees or fire-worshippers.

Was it by accident that these two symbols were thus used together, employed by a follower of a third religion—that of Mahomet? I leave this question for others to answer.

The Source of Badsha, or Royal Salep. By J. E. T. AITCHISON, M.D., C.I.E., F.R.S. (Plate VII.)

(Read 13th December 1888.)

When accompanying the Afghan Delimitation Commission during 1884, I carried with me some specimens of what is known as Badsha Salep, hoping to be able to discover the plant yielding it, and thus extend our limited knowledge of this little known drug. In the vicinity of Herat, and at Meshad, I showed the product to many who might be likely to give me information regarding it, but it appeared to be quite new to all to whom I applied for the information.

Upon examination at Kew of the various substances which I had obtained whilst on my Afghan journey, to enable me to read a short summary regarding the drugs I had collected in those regions before the Pharmaceutical Society of London, I chanced to show some specimens of this Salep to Mr Baker, who drew my attention to Mr Daniel Hanbury's article in the *Pharmaceutical Journal and*

Transactions for April 1, 1858. From the evidence which this article afforded there could be no doubt that my specimens were identical with those so well depicted and described by Mr Hanbury.

Mr Baker, at a meeting of the Pharmaceutical Society on December 8, 1886, at which I read my paper, was of opinion that he had identified the bulb as that of *Ungernia trisphæra*, a plant of the order Amaryllidaceæ. This, however, was an error due to the bulb that he examined having been wrongly labelled; and also owing to its being an only live specimen (the undetermined species of *Allium* of mine from Afghanistan hereafter referred to) a close inspection was not permissible; but, I think, almost the very next day the error was detected, after another more careful inspection of the wrongly-labelled bulb, which subsequently Mr Baker and I were both satisfied was that of an *Allium*, and one very likely to represent in a dried state the form of Salep now under consideration.

During 1881, Dr Wilson Johnstone, F.R.S.E., of the Bengal Medical Service, placed in my hands at Kew, for identification, a collection of plants from Afghanistan that had been made on the line of march between the Kojak Pass, Kandahar, and Cabul. In this collection was an *Allium* to which was attached the note, "Plant said to yield Salep in these parts." When identifying this collection I had not heard of Badsha-Salep, and the above note I had utterly forgotten when investigating the subject during 1886. Only some months subsequently did I remember it, in connection with a large-bulbed herbarium specimen of my own, belonging to my last Afghan collections.

During October 1888, I was in Edinburgh, and upon visiting the Royal Botanic Garden there, I asked Professor Bayley Balfour, the Keeper of the Garden, if he could show me a living bulb of *Allium Macleanii*. Not only did he do so, but most liberally presented me with two specimens of it. The moment I handled the bulb of this species, I recognised at once that there could now be no doubt as to this being the living condition of the dried product under discussion.

The original specimens of the Edinburgh Garden came from Mr Wilson of St Andrews, who had received them from Colonel (now General) Maclean, C.B., from Afghanistan, with a note attached, stating that they were given to him by an Afghan chief as the plant that yielded Salep. Mr Wilson also sent a flowering plant to the Royal Gardens at Kew, which afforded material for its description and delineation as a new species by Mr Baker in the *Botanical Magazine*, pl. 6707; but in Mr Baker's description there is no notice taken of its being a plant said to yield a kind of Salep.

Upon handling the living bulb of *Allium Macleanii* (Pl. VII. fig. 4) at this stage of its growth, I found, with the exception of where there still remained adherent some slight shreds of a cast-off membranaceous scale (fig. 4, *f*, *f*), that the surface had a glistening semitransparent appearance, and that the bulb felt hard, dense, and solid. On one side of the external surface there is a groove more or less apparent, broadest at the greatest circumference of the bulb, narrowing towards the base, where it occupies about one-fifth of the circumference, gradually becoming lost towards the apex, by narrowing off to a short point; dividing this groove into two is a raised convexity passing from the base upwards, and most marked at the centre of the bulb. This convexity may be again divided by a slight groove.

A vertical section (fig. 5) of the bulb, at this stage of its growth, shows a uniform mass (*c*, *c*) of tissue, having a potato-like consistency, in the centre of which a cavity exists (*d*, *d*), and at the base and in the centre of this cavity is the growing axis of the scape with leaves (*e*, *e*) springing from the flattened stem. On a transverse section (fig. 5) the bulb is seen to consist of an external epidermal layer (*H*, *H*), continuous in tissue with the comparatively dense tissue (*c*, *c*) and a central hollow or cavity (*d*, *d*) containing the growing axis (*e*, *e*). The markings on the external surface of the bulb are not traceable into its interior structure, and except the shreds of a single membranous scale (figs. 4, 5, *f*, *f*), no signs whatsoever are to be perceived of any other tunics.

By careful comparison of the bulbs of the following species of *Allium*, for permission to examine which I am indebted to the courtesy of Mr Thistleton-Dyer, C.M.G., the Director of the Royal Gardens, Kew, viz., of *A. giganteum*, Regel; *A. stipitatum*, Regel; *A. Suworowi*, Regel, and an Afghan undetermined species of my own, I have been able to ascertain that the characters above described in *A. Macleanii* exist in these Central Asian and Afghan species. By examination of them in a more mature stage, I find further that the growing axis (fig. 7, *e*, *e*) ascends through the bulb, first of all filling up the central cavity, and then forcing its way upwards through separating the structures of the bulb. In some of the bulbs the apex (fig. 6, *g*; fig. 7, *g*) was seen to consist of two points, being cleft to a greater or less extent. The sap in some of the bulbs, when brought into contact with the oxygen of the air, became highly coloured, an orange-yellow in *A. giganteum* (fig. 7), and brick-red in the undetermined species from Afghanistan (fig. 6), whilst that of the others remained unchanged. The sap of the roots, where the flattened stem was divided, and where the sap escaped from the cut surface of the leaves and scape, took on the colouring, the cut surface of the solid part of the bulb was scarcely affected, but remained almost its original colour.

The development of this bulb-structure will form an interesting physiological study for future investigation; but at present, owing to the limited amount of material at hand, the elaboration of the subject has to be postponed.

Professor Bentley, in his remarks upon Mr Daniel Hanbury's paper, where indeed he foretold that in all probability this product would prove to be an *Allium*, noted that some of the commercial bulbs had a strong alliaceous odour, whereas in others no such odour could be distinctly traced. Now, it is a remarkable fact that in handling the fresh bulbs of *Allium Macleanii*, *A. giganteum*, and the Afghan undetermined species, there was no alliaceous odour to be detected. On sections of *A. Macleanii* being made there was still almost no trace of any alliaceous odour, though there was the odour, as one of the examiners remarked, "of the remains of an old mustard plaster," with a slight pungency; and this chiefly from the surfaces where the leaf-shoots and growing axis had been divided, rather than from the consolidated part of the bulb. Again, in the sections of *A. giganteum* the solid portion when freshly divided smelt somewhat like a newly-cut potato, and the alliaceous odour on the section of the leaves was much more obvious than in *A. Macleanii;* but this might be greatly due to its more advanced stage of growth. But in both the alliaceous odour was certainly localised to the growing axis and young leaves. Whereas the bulbs of *A. stipitatum* and *A. Suworowi*, whilst still entire, gave forth a powerfully alliaceous odour, greatly intensified upon section.

In all probability the bulbs of more than one species of *Allium* are collected as Badsha-Salep. The size of these dried bulbs varies very greatly; this difference in size can, I think, be better accounted for by difference of species than by simple individual variation, when the product is, as in this instance, not that of a cultivated plant.

In the museum at Kew there is a large specimen of a dried bulb called "Giant Salep" from Bombay, presented by Mr R. G. Clements, of which a smaller specimen is represented in fig. 3. Another, presented by Major Hobson, from the East Indies, native name, "Amber-kund," with the note "Considered by the natives a valuable medicine in cases of consumption" (fig. 1). Also a collection of smaller bulbs, of which a type specimen is given in fig. 2, from the Indian Museum collection.* The last are highly alliaceous in odour, which at once apparently led to their identification, the others are all without odour.

Microscopic preparations are easily made from the Badsha-Salep by soaking in water. These exhibit a structure similar to that seen in species of *Allium*, and almost identical with sections made from the bulb of *Allium Macleanii*; the only difference being that the utricular vessels seen in the sections made from Badsha-Salep are densely packed with a yellowish granular substance of which there is little, though some, to be seen in the utricular vessels of the fresh bulb. Its smaller amount in the latter is to be accounted for thus: upon having made sections (not microscopic) of the fresh bulb, they were at once placed in rectified spirits. No sooner was this done, than the spirit seemed to extract the contents of the fresh bulb which issued forth in a stream of the most exquisite opalescent rose-colour. This occurred some days before microscopic preparations were made of the tissues, and hence I believe the absence from the utricular vessels of the densely-loaded condition present in the vessels of the Badsha-Salep. That the sections of the fresh bulb had

* Labelled, No. 21. Materia Medica, No. 5 in Pharmacopœia of India. Punjabee "Piaz." *Allium* species, N.W.I. Prov., No. 3737.

lost most of their contents might be seen by their shrivelled-up and contracted condition, after having lain a few days in the spirit. Dr Macfarlane, who kindly prepared the microscopic sections at Edinburgh, thinks with me that in all probability the granular matter that so fills these utricular vessels yields the mucilage, on account of which the bulb is employed as a Salep.

In conclusion, the results of my investigations as to the source of Badsha or Royal Salep may be summed up in a few words. That we know a species of *Allium*, the bulb of which is considered by the natives of the country where it grows, to be a Salep; that the fresh bulbs of this, in general appearance and in microscopic structure, correspond to certain specimens of a drug known to us as Badsha-Salep. That all these specimens of the dried Badsha-Salep, though varying in size and odour, appear equally to be the products of an *Allium*, and that the differences which exist in the bulbs may be fully accounted for by difference in species.

As far as we know at present, the trade in Badsha-Salep seems to lie between Southern Afghanistan and India; in support of this I could hear nothing of the product, nor was it known near Herat or Meshed, the great centres of trade of North-West Afghanistan and North-East Persia; and that it is conveyed by Afghans along the various routes to India, chiefly to Bombay and Karrachi, as well as to Lahore and Simla, at both of which places I have myself obtained it.

The little knowledge we have of the distribution of *Allium Macleanii* is, that it was sent from Cabul, and Dr Wilson Johnstone's *Allium*, "said to produce Salep," was collected in Afghanistan on the route between the Kojak Pass, Kandahar, and Cabul. In all likelihood the latter was collected in the same locality as the former, as both officers were with the same expedition.

(Since this paper was in print, I have been able to come across a list of the plants that I identified at Kew for Dr Wilson Johnstone, and found that his Nos. 5, 17 were *Allium robustum*, Kar. et Kir., with the note "Salep-misree;" besides his No. 3 (bulbs only), which were the bulbs of an *Allium*, collected on the Altimore Pass in April 1880, and which he had noted as "Orchis, Salep-misree." Some of these bulbs were alive, and were handed over to the gardens at Kew.)

EXPLANATION OF FIGURES IN PLATE VII.

Illustrating Dr Aitchison's paper on Badsha or Royal Salep.

Fig. 1. *a*, Shows the specimens of "Amber-kund" in the Museum at the Royal Gardens, Kew, with separate drawing of the base, *c*, and apex, *b*.

,, 2. *a*, Specimen of "Piaz," from the Indian Museum, now at the Museum, Royal Gardens, Kew; *b*, a separate drawing to show basis of *a*.

,, 3. One of the smaller specimens of "Giant Salep," from Bombay, at the Museum, Royal Gardens, Kew.

,, 4. A bulb of *Allium Macleanii*, Baker, in growing condition, received from the Royal Botanic Garden, Edinburgh, Oct. 12, 1888.

,, 5. Section of bulb of *Allium Macleanii*, Baker, made at the Royal Botanic Garden, Edinburgh, on Oct. 23, 1888, in the Museum of which the specimen now is.

,, 6. Bulb of an undetermined species of *Allium* collected in Afghanistan, 1885, which has been in the Royal Gardens, Kew, but has not as yet flowered. The rootlets on injury and exposure to the air changed their colour to brick-red. *F* = fragments of scales.

,, 7. Vertical section of bulb of *Allium giganteum*, Regel, received from the Royal Gardens, Kew, Nov. 19, 1888.

,, 8. The same after having been placed in a solution of common salt.

,, 9. Transverse section of the same. These specimens are now in the Museum of the Royal Gardens, Kew.

All these drawings are natural size, and were done by Miss M. Smith from the originals, except fig. 2, which was taken from a sketch made by myself.

Notes on some Willows in Edinburgh University Herbarium.

By F. Buchanan White, M.D., F.L.S.

(Read 11th July 1889.)

When recently preparing a *Revision of the British Willows*, I had, through the kindness of Professor Bayley Balfour, an opportunity of thoroughly studying the *Salix* specimens of the British portion of the University Herbarium. Although willows have, to a great extent, been neglected by British botanists, yet that collection, in whose formation many of the most famous Scottish botanists have taken part, contains, as might be expected, several specimens of great interest, and a few short notes on these may not be unacceptable to the Society.

In the following paper I have restricted myself to Scottish plants, although there are many others of interest in the Herbarium. Moreover, as the specimens themselves are available for examination, I have thought it unnecessary to give descriptions, since that has been already done in the *Revision.*

Sheet 406.—Labelled "*Salix fragilis.* From a tree near Duddingston. J. Knapp. 1836." This seems to be almost certainly a form of the rare hybrid (unrecorded as British) *S. hexandra*, Ehrh. (*pentandra* × *fragilis*). It bears some resemblance to *S. viridis.* The leaves are too young, and hence it is desirable that the plant should be rediscovered. It is the only British example of *S. hexandra* known to me.

Sheet 418.—*S. viridis*, Fr. (*fragilis* × *alba*). Though hitherto confounded with one or other of its parents, *S. viridis* is really common in Britain. There are several other specimens in the Herbarium.

Sheet 58.—Labelled "*S. Caprea*," and collected at Dunnikier, Fife, by A. H. Gibson. Though the leaves are rather young, this specimen seems referable to *S. Reichardti*, A. Kern. (*Caprea* × *cinerea*), a hybrid difficult to determine, and of which I have seen very few British examples. The Dunnikier plant should be looked for again.

Sheet 310 (the lower specimens).—In the *Student's Flora* Sir J. D. Hooker says, under *S. Lapponum*—"The Edinburgh specimens seen by me are flowerless; this locality is anomalous for so alpine a plant." The specimens on this sheet are labelled by Greville, "Collington Woods, 1824," have female catkins, and belong beyond doubt to *S. Lapponum.* There, however, seems to be no such place as "Collington" near Edinburgh, but it is certain "Colinton" is meant, since I have seen the name both printed and written "Collington." It would be of much interest to know if the species still occurs there, and if it is indigenous. I have seen it growing on the Ochils at so low an elevation as 700 feet, perfectly wild, and unassociated with other alpine plants.

Sheet 319.—Labelled by Winch, "*Salix glauca,* Ben Lawers," and in another hand, "*Salix arenaria* v. *glauca,* Smith." Smith's *glauca* has long been known to be different from true *glauca,* L., and has been supposed to be either not British or to be only a slight variety of *S. Lapponum.* There is no doubt, however, that it is the same as *S. helvetica,* Vill., now considered to be a variety or sub-species of *S. Lapponum.* If Winch's specimen really came from Ben Lawers (and there seems no good reason to doubt it), it should be looked for again. It is the only reputed *wild* British specimen of Smith's *glauca* which has come under my notice.

Sheet 330.—Amongst *S. Arbuscula,* and labelled by (I think) Professor J. H. Balfour, "Glen Dole, 1826," is a specimen which, though flowerless, must be referred to *S. spuria,* Willd. (*Lapponum* × *Arbuscula*). I have seen other and more recent examples with catkins from Clova, and the hybrid also occurs on the Breadalbane Mountains.

Sheet 336.—"*Salix Myrsinites,* Eng. Bot., Clova Mountains, 1824," Dr Greville. "Either *Myrsinites* or possibly *S. Grahami,*" Leefe. I think that these specimens, which are flowerless, have no connection with *S. Myrsinites,* but are probably my *S. sobrina* (*Lapponum* × *herbacea*). I have found flowerless specimens in Perthshire, and have received catkins from Clova, collected by Rev. E. S. Marshall. Dr Greville's examples are nearer *herbacea* than the others I have seen.

Sheets 337, &c.—A number of specimens from Clova, Caenlochan, Glen Callater, Ben Avon, &c., collected by J. H. Balfour, Brand, and perhaps Greville, and named *Myrsinites* and *nigricans,* belong to *S. Wahlenbergii,* And. (*Myrsinites* × *nigricans*). This hybrid has often been passed over for one or other of its parents. It is not quite certain that it should not bear the name *S. Macnabiana,* Macgilliv. I have not been able to consult Macgillivray's description (*Edin. New Phil. Jour.*, vol. ix. p. 335), and that author's own specimens are too poor and too near *S. Myrsinites.*

Sheet 378.—*S. Sadleri,* Syme. After a long study of *S. Sadleri,* in both a living and a dried condition, I think that there can be no doubt but that it is a hybrid of *S. lanata,* and that the other parent is probably *S. reticulata.* Since it has been in cultivation it has developed some characters not, or scarcely, shown by the original wild specimens.

Sheet 363.—*S. herbacea* (Loch Kandor, 1830, Greville). Remarkable, in that the ovary has several lines of hairs and the style is bifid to the base. I have found, however, nearly similar forms in Perthshire.

Sheet 327.—"*Salix vacciniifolia,* Craig Chailleach, Perthshire, Dr Hooker." The specimen marked No. 1 is, I suspect, one of the series of willows which I have named *S. simulatrix* (*Arbuscula* × *herbacea*). Though the specimen is in too young a condition to afford much evidence, yet, when taken in conjunction with other specimens from neighbouring hills, the affinity with both of the supposed parents is sufficiently clear.

Sheet 377.—"*Salix,* ——, Clova Mountains, 1824 (Loch Brandy)," Greville. "Possibly a pilose state of *S. reticulata,*" Leefe. Though the four small specimens on this sheet are without flowers, they so evidently belong to a hybrid between *S. reticulata* and *S. Lapponum* that I have ventured to give them a name—*S. sibyllina.* It is to be hoped that the plant will be found again.

Although there are no specimens in the Herbarium, a willow cultivated in the Gardens, and for specimens of which I am indebted to Mr Lindsay, may be included in these notes. The plants were originally found by the late Professor Dickson and the late Mr Sadler on Ben Challum, Perthshire; and from the same hill I have seen more recent specimens, collected by Messrs Groves. This willow is evidently a hybrid between *S. herbacea* and *S. aurita,* and as such I have described it under the name *S. margarita.*

The Flora of the Coasts of Lapland and of the Yugor Straits (N.-W. Siberia), as observed during the Voyage of the "Labrador" *in* 1888; *with Summarised List of all the Species known from the Islands of Novaya Zemlya and Waigatz, and from the North Coast of Western Siberia.* By PHILIP SEWELL. (Plate VIII.)

(Read 13th June 1889.)

In presenting to the Society an account of the botanical collections made last summer during the voyage of the "Labrador," it is well to acknowledge at the very outset the valuable aid so kindly given by various botanists who have undertaken to name groups of plants submitted to them.

Next to my indebtedness to Professor Balfour, by whose liberal aid and encouragement I was enabled to make use of the offers of the Phœnix Company, I must acknowledge the kind help of Mr Arthur Bennett, who with Mr C. B. Clarke has not only named for me the species of *Carex*, but who has examined and named every critical species of Phanerogamæ, allowing me to submit to him the greater part of my collection. His work has been the more difficult, because of the extensive revision of the species of many Arctic genera, lately undertaken by Swedish botanists, and because also authentic specimens of certain of the species recently established have not reached this country.

To Mr J. G. Baker, Mr C. B. Clarke, and Dr Buchanan White (who has named the species of *Salix*); also to Mr William Mitten, and to Mr Geo. W. Traill, who have examined for me the *Musci* and such marine *Algæ* as I collected, my very sincere thanks are due.

A small collection of *Lichenes* has been kindly taken in hand by Mr W. H. Wilkinson. A report upon this, and upon certain fresh-water *Algæ*, also collected, must be left over for a future paper.

I take this opportunity also to express my thanks to Mr H. N. Sulivan, managing director of the Phœnix Company, and to Captain Wiggins, who gave me so many facilities for work on board their vessel.

Narrative of the Voyage.

On the 19th of July 1888, we left Newcastle on board the Arctic steamer "Labrador," which, under the command of Captain Wiggins, had for her destination Goltschieka, an anchorage in the estuary of the river Yenisei. We rounded the North Cape on 1st August, and after sheltering for a day in the fiord of Kølle, arrived at the little fishing port of Vardø, a town of 1500 inhabitants, situated on an island in the extreme north-east of Lapland. On the very eve of departure from this port a telegram let us know that the river-steamer "Phœnix," which we were to meet at Goltschieka, was aground; in consequence we were delayed for five weeks until a substitute could be sent out to ascend the river in its stead. On 5th September we left Vardø in the company of this steamer, but next day we were separated in a storm, and so arrived alone on the 11th at the Yugor Straits, the southernmost entrance into the Kara Sea.

After waiting there some days for our companion steamer, Wiggins steered his vessel into the Kara Sea, he rounded the drifted pack-ice, which, in that exceptional year, was abundant, and on 27th September (delays having made it useless to proceed farther) he shaped his course back towards Vardø. There we found our companion, the "Seagull," laid up for the winter, the crew having feared to proceed alone when separated from the "Labrador." After a short stay we steamed homeward, calling in at Tromsø on 14th October, Wiggins having navigated his vessel among the magnificent fiords of the Loffodens. We arrived in the Tyne on the 23rd of October.

Despite this unfortunate miscarriage of all plans, I had the opportunity to see something of the flora of the north-west of Siberia, and also that of the north of Lapland.

When we were anchored in, or near to, the Yugor Straits (lat. 69° 40′ N., long. 60° E.), during a few days in the middle of September, I was able to pay longer or shorter visits to the mainland. These were not so satisfactory as could have been desired, for drift-ice was in the neighbourhood, our stay was every day uncertain, and, finally, during the latter part of the time, the ground was covered by a heavy fall of snow, the frosts of winter having just commenced.

At three stations in Lapland I had hurried opportunities in which to botanise; at Vardø alone had I ample time to collect and to observe.

The stations in Lapland were:—

Kølle, August 1st and 2nd, lat. 70° 55′, long. 27° 20′ E.
Vardø, August 3rd to Sept. 5th, lat. 70° 22′, long. 31° 10′ E.
Vadsø, August 15th, lat. 70° 5′, long. 29° 50′ E.
Tromsø, October 14th, lat. 68° 39′, long. 19° E.

It is very necessary, if comparison be made between the collections from each station, to bear in mind any difference in the time of the year, or in the length of time spent at such. Thus had not winter arrived, or had our stay been for a longer time at Tromsø, much richer results would there have been forthcoming.

Physical Features in relation to the Flora.

The two regions of northern Siberia and Lapland offer almost opposite physical characters, whether comparison be made at first sight in each case, or after more detailed examination.

Northern Siberia extends as an immense plain, which in summer is a vast network of ponds and marshes, such as defy the efforts of the traveller to cross them. This, the "tundra" region, is, however, interrupted immediately to the south of the Yugor Straits, by the outlying northernmost spurs of the Ural range, which, as insignificantly low hills, forming cliffs not 200 feet in height at the eastern entrance to the Straits, extend northwards into Waigatz Island and Novaya Zemlya.

Lapland, on the contrary, is essentially mountainous. Tromsø, the southernmost of the stations visited, is situate on an island in the midst of a noble fiord, around which are peaks, snow-covered throughout the year, and reaching, it is said, to a height of 5600 feet.

It is true that in the vicinity of Kølle, Vardø, and Vadsø there is no land higher than 600 to 800 feet above sea-level (on the island of Vardø itself there is none that exceeds 200 feet), yet at no great distance from these stations are the heights of the Loffodens to the S.W., and to the S.E. the noble range along the Murman shore.

It has been pointed out by Sir Joseph Hooker that there are in Lapland more than twice as many species of Phanerogamæ as there are in Arctic Siberia. Yet although this is the case, and although the flora of Lapland is richer in species than is that of any other region within the Arctic circle, the general appearance of the country is much more bleak and barren than is that of the land about the Yugor Straits. Once you land in the north of Siberia, the poverty of species and the scantiness of the vegetation is apparent, especially so to one who has observed the vegetation of Lapland along the same parallels of latitude. There are not, however, the rocky crags and bare mountain tops as in Lapland, so that, surprised because of the apparently continuous covering of turf as seen from the ship's deck, Wiggins actually compares the appearance of Waigatz Island to that of the Isle of Wight. Seebohm speaks of the richness and beauty of the "tundra" flora. Dr Warming, quoting from Kjellman, in his resumé of *Grønlands Vegetation*, records the phrase *les champs des fleurs*, descriptive of the flora in North Siberia, but, for the regions bordering on the north coast, all such descriptions are fallacious. They may be applicable to regions warmer by 10° C., bordering on the Yenisei, to which doubtless Kjellman and Seebohm refer; they are not applicable to the monotonous expanses of sedge and grass which only in more favourable places are associated with gayer plants, *e.g.*, *Saxifraga*, *Pedicularis*, and *Polemonium*.

If we consider with a little more detail the physical features of the two countries, we shall be able at once to make a fairer comparison as to the vegetation in each, and we shall find that the comparative wealth or poverty of species is thus reconcilable with the known facts as to the physical characters and the climate. Although the rocky character of Lapland gives it a more barren and desolate aspect, yet very slight observation suffices to show its superiority to northern Siberia in the number and variety of the commonest plants, just as it is found to have a richer flora when all its native species are considered.

We may describe as typical of Lapland the nature of the country about Kølle, the first place on the mainland off which we anchored. There were recognisable certain well-defined *areas*, each of which has its fairly characteristic plants, whether at Kølle, Vadsø, or Vardø.

I. Most common were the *exposed slopes* of the hill-side, where was but a scanty covering of peat, which generally appeared almost dry by reason of the excessive drainage and the great exposure to winds and sun. Here typically grow *Diapensia*, *Betula*, *Vaccinium*.

II. Not by any means so characteristic of the country, but commonly enough met with, were the *level places*—

(*a*) Along the sides of the fiords, where generally is a sandy and well-drained subsoil, carpeted with turf, or—

(*b*) In the higher valleys, where the soil is of peat, and more retentive of water. Here are the bogs and pools, with their wealth of *Carex*, *Vaccinium*, *Andromeda*, *Pedicularis*, *Pyrola*, *Bartsia*, &c.

III. Distinct enough in physical character and in characteristic plants are the *essentially rocky places*, those either (*a*) of the hill-top, where drainage and exposure are excessive, and where *Lichenes* alone flourish; or (*b*) those situate at the bases of the hills, where there is always a continuous supply of moisture, where there is afforded protection from winds, and where soil readily collects. This last is the resort *par excellence* of the widely distributed mountain and arctic species.

Compared with the above, the coast-region of the Yugor Straits shows an almost complete absence of the *areas* we have considered under I. and III. *Level places* are everywhere; and most commonly the levels are peat-bogs; there is little sand covered with turf except in isolated places along the rivers or the sea-shore. It is probable that the land of the Yalmal peninsula is more fertile, this being due to the nature of its subsoil, which is essentially a fine sand, washed down ages ago by the river Obi. But Yalmal land is exceptional; the cold blue clays derived from the shales, which, with a few outcrops of limestone, form the rocks about the Yugor Straits, give place only to dreary extents of water-logged peat-bogs; it is very rarely that naturally better drained and turf-covered tracts are to be met with about the Yugor Straits.

The peat is clothed (not sparsely perhaps) with *Carex*, *Eriophorum*, and species of *Poa* and *Glyceria*, for the most part arising from an almost continuous sheet of *Amblystegium uncinatum, Sphagnum, Jungermannia,* &c.

About the Yugor Straits such slight elevations as occurred were but poorly representative of the Lapland hill region (I.); scattered rocks covered with *Lichenes* were noticeable here and there, but the sole place characterised by the plants of the *rocky area* (III.) was the more or less continuous extent of gravel or sand which formed the beach. In the drier places upon the slopes of the low cliffs, and bordering the wide river-beds, wherever indeed the shales were not covered by a marsh or peat soil, the commonest plant was *Dryas octopetala;* among the rough network of this were many plants preferring a comparatively well-drained habitat.

The soils and subsoils are perhaps only of much importance, in so far as their mechanical structure allows of, or prevents, the rapid passage away of the great amount of surface water consequent upon the melting of the snows.

The following lists may serve to indicate roughly the common plants which inhabit more or less closely the different *areas:—Cochlearia, Arenaria peploides, Stellaria media, Saxifraga rivularis, Matricaria,* and *Mertensia maritima* were commonly noticed along the shore.

Upon the exposed hill slopes (I.) were oftenest—*Cerastium, Potentilla, Antennarium dioica, Gnaphalia, Vaccinium, Pyrola, Loiseleuria, Arctostaphyllos, Diapensia, Betula nana, Empetrum, Salix* sps., *Luzula* sps., *Carex* sps., *Juniperus,* and often many Lichens growing among the shrubby prostrate stems.

Upon level turfy places [II. (*a*)]:—

Ranunculus *sps.*	Pinguicula.
Thalictrum.	Trientalis.
Cardamine.	Polygonum viviparum.
Viola biflora.	Veratrum.
Cerastium.	Juncus *sps.*
Geranium sylvaticum.	Eriophorum.
Alchemilla.	Carex *sps.*
Parnassia.	Alopecurus pratensis.
Epilobium.	Deschampsia, Festuca *and* Poa *sps.*, &c.
Angelica.	

In more boggy and peaty places [II. (*b*)]:—

Caltha palustris.	Oxycoccus palustris.
Viola palustris.	Andromeda polifolia.
Cerastium trigynum.	Pyrola minor.
Montia fontana.	Bartsia alpina.
Rubus Chamæmorus.	Pedicularis *sps.*
Potentilla Comarum.	Salix *sps.*
Epilobium.	Tofieldia palustris.
Cornus suecica.	Habenaria viridis.
Vaccinium uliginosum.	&c.

In the richer rocky areas [III. (*b*)] :—*Ranunculus* sps., *Draba* sps., *Cerastium*, *Stellaria*, *Sagina*, *Vicia*, *Alchemilla*, *Potentilla procumbens*, *Saxifraga stellaris*, *S. cæspitosa*, *S. rivularis*, *Sedum Rhodiola*, *Epilobium*, *Linnæa*, *Cornus*, *Saussurea*, *Solidago*, *Gnaphalium*, *Hieracium*, *Euphrasia*, *Pyrola*, *Veronica alpina*, *Trientalis*, *Oxyria*, *Salix* sps., *Veratrum*, *Cystopteris*, *Polypodium*, &c.

In the driest and most exposed positions persisted most commonly *Rumex Acetosella*, *Rubus Chamæmorus*, *Luzula spicata* and *L. hyperborea*, *Festuca ovina* vars.

The *climate* of the two countries deserves attention, although in this case it has probably less influence upon distribution than results from the difference in physical character; we may note that although the dissimilarity of winter temperatures is considerable, yet owing to the heavy covering of snow it is not the extremes of winter, but the slighter variations during the short summers, which are likely to be effective. Summer-isotherms may be drawn approximately parallel to lines of latitude, yet where, as at the Yugor Straits, a large amount of drift ice may often accumulate, the temperature is undoubtedly lowered: thus it is probable that the summer mean for the Yugor Straits is a few degrees lower than it is in the same latitude both east and west. Seebohm judges that the mean for summer will be about 5° C., whereas the mean for regions due east on the Yenisei is nearly 15° C. Nordenskiold recorded in 1876, in the middle of August, a maximum temperature of 20° C. at Goltschicka; but two weeks later, with winds from the ice-floes to the north, the temperature was only 1°·3 C.!

During September, when we were anchored in the Straits, 5° C. was recorded once, with southerly winds; the mean of the readings taken by us was 1°·5 C.; whilst −2° C. was recorded when we were amongst the ice-floes. Berghause calculates the mean January temperature for the Yugor Straits to be -20° C.

It was very evident that, as we proceeded eastward from the North Cape, the temperature of the air (consequent upon that of the water) fell to a noticeable degree; the fall was rapid as we approached the coast of Novaya Zemlya and the shores of the Yugor Straits, about which was abundant drift ice. Signs of the (unusual) cold existed on shore, where *Armeria sibirica*, to mention but one instance, had generally its flower stalks nipped by the frost, instead of developing seed as we should assume would be normal to it even there.

Although at the time of our visit to the Yugor Straits there was only slight evidence of the flow so far to the north-east of the warm Atlantic current, yet the extreme west of Siberia and the islands of Novaya Zemlya clearly gain something from its influence.

But it is in Lapland that its effects are so remarkably evident in producing a mean winter temperature which is not lower than that of Chicago or of the south of Russia; from the same cause, whilst in identical latitudes along the shores of Greenland the summer temperature averages only a degree or two above the freezing point, the shores of Lapland enjoy an average of $+8^\circ$ C. to $+10^\circ$ C.

The average of temperatures recorded at Tromsø and at Vardø are as follows:—

Tromsø mean in winter	$-3^\circ{\cdot}6$ C.;	in summer	$+10^\circ{\cdot}2$ C.
Vardø ,,	$-5^\circ{\cdot}5$ C.;	,,	$+8^\circ{\cdot}0$ C.

Our stay at Vardø during the summer was of sufficient duration to show us that the temperature is a conspicuously even one. During five weeks the variation between the recorded maximum and minimum was only from 13° C. to 6° C.; the average for the last week in August, with predominantly southerly winds, was a little above 10° C.

That we may roughly be able to compare these conditions with those which obtain in our own neighbourhood, I annex the following statistics, from the official reports for 1886–7:—

Leith, mean for Nov. and Dec. 1886,	=	$+4^\circ{\cdot}3$ C.
,, Summer 1887,	=	$+14^\circ{\cdot}3$ C.

The apparent difference is slight, and indeed we only realise its full import when we observe that in Lapland and at the Yugor Straits the mean (in summer at least) is derived from slight extremes, in the British Isles often from very pronounced ones.

A very important condition is that consequent upon the high latitude of these regions, where assimilation and growth are possible for a period extending more or less continuously over three to five months, and where, in the winter, the plant lies inactive for a much longer time than is the case in lower latitudes.*

Observations upon Collections in Lapland.

The commoner plants observed in Lapland were almost without exception present at each station except at Vardø, where the restricted area of the islands does not afford a suitable habitat for several of the species.

At Tromsø was the most extensive flora; due to its more southerly position, its neighbourhood to rich mountain areas, and its small belts of birch trees (among which are also *Salix* and *Pyrus Aucuparia*). Our stay was so short at this place, and the season was so far advanced that I was able to observe very inadequately. I noticed, however, the following commoner plants not met with at the more northerly stations :—

Viola sylvatica.
Lotus corniculatus.
Saxifraga oppositifolia.
,, aizoides.
Heracleum sibiricum.
Œnanthe *sp.?*
Galium boreale?
Gnaphalium sylvaticum.
Calluna vulgaris.
Veronica officinalis.
,, serpyllifolia.
Plantago major.

Many species, also found in the north of Lapland, were here much more luxuriant and vigorous. This was especially noticeable in the following:—*Thalictrum*, *Cochlearia*, *Capsella*, *Lychnis diurna*, *Vicia*, *Geum*, *Alchemilla vulgaris* (which also

* More detailed accounts of the conditions affecting the drift-ice in the Kara Sea, and also a record of temperatures observed during the voyage of the "Labrador," have been published in the Magazine of the *Scottish Royal Geographical Society*, April 1889; and in the *Proceedings of the Scottish Meteorological Society*, 1889.

was extremely abundant near to the houses), *Solidago, Matricaria, Achillea, Gentiana, Euphrasia, Urtica.*

It is more than probable that many plants have in my somewhat hurried excursions been overlooked, but those mentioned from Vardø, Kølle, and Vadsø may be not only sufficient evidence that the flora of northern Lapland is not by any means so extensive as is that to the south, but also when a plant has been noticed as occurring in each of these districts it is likely to be common throughout the northern part of the country.

At Kølle I was able to traverse more ground, and on that account see a more varied flora than elsewhere. Bushes of *Salix Myrsinites* and *S. lanata*, from 3 to 4 feet in height, were not uncommon in the warmer and less exposed places. Four plants growing near together of *Pyrus Aucuparia*, which, however, were not a foot in height, were the only other signs of "trees." A bush, which I have no doubt was *Sambucus nigra*, was growing to a height of 4 feet or so among the scattered rocks of a warm cliff facing south. It was in full flower, and easily recognised as an "Elder" by Mr Sulman, a non-botanical friend, who was with me. I was not aware as to the restricted distribution of this shrub, or I should certainly have secured specimens, and not have hurried past in answer to a summons from the whistle of the "Labrador."

There was a quite noticeable difference between the number and variety of plants to be found on slopes facing the south, which were so protected from the northerly winds, and the number of those growing in exposed places.

The plants frequenting the sheltered valleys were as opposed in character as in habitat to those frequenting the exposed slopes. The prostrate woody lichen-covered stems and the closely-set small persistent leaves of *Loiscleuria, Empetrum, Phyllodoce*, and *Diapensia*, of *Vaccinium, Betula*, and *Juniperus* contrast markedly with the more tender deciduous leaves of such plants as *Veratrum, Angelica, Alchemilla, Trollius, Caltha, Geranium sylvaticum*, &c. The leaves of the latter are produced immediately after the melting of the snows, and when autumn approaches the plant dies back into a small "crown" or resting state, in which form it may best withstand the winter. A large proportion of the plants are those which are able thus to retreat into the smallest possible compass before the long winter sets in. It is, however, worth notice that it is not those plants which inhabit the valleys, and are therefore protected by the early snow, but those frequenting the exposed wind-swept slopes, that are characteristic of the country.

At Vadsø, on the northern shores of the Varanger Fiord, was a more extensive tract of marsh-land than at the other stations, which yielded distinctively *Viola palustris, Sedum palustre, Oxycoccus palustris, Pedicularis sceptrum-carolinum, Myosotis sylvatica, Salix lapponum, Tofieldia*, also *Pyrola secunda* and *Linnæa borealis.*

Lycopodia were more abundant than elsewhere. *Salix* sps. grew in considerable numbers in a sheltered valley, where also were *Spiræa Ulmaria, Geranium sylvaticum*, and *Trollius* in great profusion. There were no trees, except a few birch in one of the small gardens, *Pyrus Aucuparia* and (a sp. of *Pinus* ?). We heard that they were plentiful on the south side of the Varanger Fiord, where the mountains of Russian Lapland afford a rich field for the botanist. *Polemonium cæruleum*, var. *grandiflorum*, and *Arenaria lateriflora*, were sent from this locality by Miss Clarke, an accomplished local botanist.

As is to expected, there are several plants common to Lapland which were absent from the flora of the islands of Vardø, the reason for which may be seen, not so much in its separation from the mainland, as in its restricted area. The straits which cut it off from the mainland are not a couple of miles in width, and it would be easy for seeds to be blown or washed across; but the limited area of the islands does not allow of any extensive peat-bogs, nor are there the exposed slopes which were noticed at Kølle and Vadsø, as the home of *Diapensia, Betula*, &c.

The commonest of these plants absent from Vardø are enumerated below; they are perhaps absent mostly from lack of marsh-land or sheltered places:—

Trollius europæus.	Oxycoccus palustris.
Geum rivale.	Andromeda polifolia.
Rubus saxatilis.	Pyrola *sps.*
Alchemilla alpina.	Veronica alpina.
Hieracium *sps.*	Bartsia alpina.

Melampyrum.	Veratrum album.
Pedicularis *sps.*	Polypodium *sps.*
Salix lapponum.	Cystopteris.
Orchis maculata.	Equisetum *sps.*

Also (from lack of extensive drier slopes)—

Phyllodoce cærulea.	Betula tortuosa.
Arctostaphyllos alpina.	Juniperus nana.
Diapensia lapponica.	Lycopodium.
Betula nana.	

The following have been noticed by Landmark or myself, but with the very rarest occurrence; nor were the last few species at all commonly distributed on the mainland :—

Vaccinium Vitis-Idæa.	Loiseleuria procumbens.
,, uliginosum.	Habenaria viridis.
Pyrola minor.	Allium sibiricum.

Dryas octopetala.	Campanula rotundifolia.
Adoxa Moschatellina.	Myosotis *sps.*

On the other hand, there are to be found several plants, of which (doubtless only for lack of time) no trace was seen at the stations on the mainland, *e.g.*, *Primula stricta* and *Botrychium Lunaria.*

A species of *Carex,* found on the smallest island of the group, deserves more attention. This island is one especially kept by the Government for the breeding of Eider-ducks, and in consequence is the home of a large number of sea-fowl, from which cause its soil is exceptionally enriched. In all the more sheltered places on this island, the vegetation is extremely luxuriant, with masses especially of *Lychnis diurna, Rubus Chamæmorus, Caltha palustris* (specimens with leaves 7 inches in diameter), *Rumex Acetosa, Epilobium angustifolium, Spiræa.*

In a sheltered position at the base of a slight cliff in the centre of the island were several clumps of a comparatively large and graceful species of *Carex* growing in a loose turf; its habit appeared distinct from any I had previously collected in Lapland. Messrs C. B. Clarke and Arthur Bennett have seen sufficient reason to consider this a new species. As it is at least a matter for surprise that Swedish botanists should have overlooked a form so evidently distinct, I think it is quite probable that Pastor Landmark (who has so carefully collected upon the Vardø islands) may have gathered this form and regarded it as *C. norvegica;* for this name appears in his list. It may possibly be that, from the very fact that access to the island is withheld by Government, the plant has been overlooked by botanists visiting Vardø, but I cannot think otherwise than that specimens in certain of the Swedish collections will be discovered approximately identical with mine. If this does not prove to be the case, the extreme rarity of Clarke and Bennett's species—which certainly as far as the islands of Vardø are concerned is restricted to this one alone—naturally attracts attention to the exceptional conditions of its habitat. The soil was unusually rich, the exact habitat of the few tufts was not only sheltered, but the near cliff probably affords an almost continuous shade in the months when the sun's altitude is greatest. Perhaps other instances of similar variation under such conditions may be forthcoming; at present there is no proof, only the suggestion, that the diagnostic features have any especial relationship to the habitat.*

Messrs Clarke and Bennett's description is as follows:—

Carex Sewellii, Arth. Bennett et C. B. Clarke. Sp. nova; spicis 3-6, in apice culmi approximatis, sessilibus, erectis, terminali basi mascula; glumis late ovatis, obtusis, nitidis, castaneis conspicue albo-marginatis; stylo 2-fido aut 3-fido; utriculo ellipsoideo acuminato rostrato. *See* Plate VIII.

C. lagopinæ et *C. heleonasti* proxima, differt glumis magis obtusis, late scarioso-marginatis, spiculis erectis, utriculo rostrato. [C. B. Clarke, Jan. 1889.]

Specimens in herbaria of Edinburgh and Kew; also with Mr C. B. Clarke, Mr Arthur Bennett, and Professor Blytt.

By far the richest locality on the main island of Vardø is an extent of turf covering what is evidently a raised sea-beach. The pebbles and sandy soil underlying this turf have been protected by a considerable crag to the north-west, giving us a small illustration of "crag and tail"

* Professor Blytt, to whom I sent a specimen of this *Carex*, writes, August 21:—"It seems, however, to me to be only a luxuriant form of *C. lagopina*, caused by the exceptionally fertile locality in which it was found."

Mr Baker considers the differences insufficient to require a new species.

formation. It is upon this "tail," about the houses of the port and the whaling stations, that there have been enclosed small fields, which have evidently been manured and enriched by the sowing of grass seed. Towards the end of August we observed a small crop of hay cut from these few meadows, and spread out to dry on hurdles or "perches," after the manner common in many mountain regions.

This attempt at cultivation has from time to time introduced plants into the island, which have lasted, it may be, only for one year, and then succumbed under the influence of the long-continued winter.

The names of several such plants occurring in the MS. list of Pastor Landmark, kindly shown to me by the present Pastor Johanneson, are given below :—

Barbarea vulgaris, *R. Br.*
Erysimum hieracifolium, *L.* (1 specimen).
Brassica campestris, *L.*
Camelina sativa, *L.* (1 specimen).
Githago segetum, *Desf.* (only produced buds).
Linum *sp.*
Trifolium pratense, *L.* (1 specimen).
Potentilla norvegica (1 specimen).
Achillea Ptarmica, *L.*
Galeopsis Tetrahit, *L.*
" versicolor, *Curt.* (These two species came up very plentifully in a meadow in 1858.)
Myosotis sylvatica (2 specimens).
Plantago major, *L.* (2 specimens).
Polygonum lapathifolium, *L.*
" Convolvulus, *L.*
Euphorbia Helioscopia, *L.* (2 specimens).
Chenopodium album, *L.* (2 specimens in 1858).
Urtica urens, *L.* (1 specimen).

It is probable that several species at present found in the cultivated land or about the houses may have been artificially introduced. There are several which are not found in the more remote valleys, but only near to the Norwegian settlements. They, however, exist in sufficient quantity to warrant the supposition that they have become thoroughly naturalised.

It was with some surprise that we noticed in the windows of many of the houses in the various towns and hamlets quite a bright display of our common garden and greenhouse flowers. The colour was rich, and the abundance of the flowers was not short of what is common in our own country. The low wooden houses, warmed by pipes and without gas, are doubtless very suitable for plants. The following list does not, by any means, include all the species observed. In one room alone there were as many as forty species growing in a healthy manner; in some rooms large festoons of ivy were noticed. The seeds of many are obtained from Archangel; in other cases the merchants' wives bring special favourites from Bergen and Christiania, where many spend the winter. We observed especially:—*Aralia, Begonia, Bellis, Cactus, Calla, Campanula,* "*Carnation,*" *Convolvulus, Delphinium, Dianthus, Dracæna, Echeveria, Epiphyllum, Fuchsia, Geranium, Hedera, Helianthus, Hesperis, Iberis, Impatiens, Jasminum, Mesembryanthemum, Mimulus, Omphalodes,* "*Palm,*" *Petunia,* "*Roses,*" *Saxifraga, Sedum, Tradescantia, Vallotta, Veronica, Vinca, Viola.*

In the outside gardens were *Aconitum, Bellis, Beta, Delphinium, Lunaria, Tanacetum,* and some coarse species of *Umbelliferæ,* also lettuce, turnip, and cabbage.

Ferns were noticeably luxuriant on the small island near the entrance to the harbour, where the soil is enriched by the droppings of countless sea-birds. *Aspidium spinulosum* var. *dilatatum,* and here and there *Athyrium alpestre* were the only species. *Botrychium Lunaria* of small habit was growing in the short turf on the main island.

Cystopteris, Polypodium Dryopteris and *P. Phegopteris* were not present on the island, although common on the mainland. Similarly, there was only a starved *Equisetum arvense* and *Selaginella selaginoides.*

Mosses were abundant enough, although not quite so characteristic as might have been anticipated. Mr William Mitten calls attention to *Oreoweisia serrulata,* Tunk., of which he has elsewhere seen no record from a locality so far north, although all the other species have previously been recorded. My collection of these is doubtless very imperfect. I would, however, direct attention to the predominance of *Amblystegia,* which in every small pond and damp place were sure to abound.

The following were observed:—

Dicranum scoparium, *Hedw.*
„ fuscescens, *Turn.*
Oncophorus Wahlenbergii, *Brid.*
„ virens, *Brid.*
Ceratodon purpureus, *Brid.*
Oreoweisia serrulata (*Tunk.*).
Rhacomitrium lanuginosum (*Dill.*).
Syntrichia ruralis, *Brid.*
Aulacomnion palustre, *Schw.*
Splachnum sphæricum, *Linn. f.*
Webera nutans, *Hedw.*
„ albicans, *Schimp.*
„ cruda, *Schimp.*
„ cucullata, *Schimp.*
Leptobryum pyriforme, *Schimp.*
Bryum pendulum (*Hsch.*).
„ inclinatum (*Sw.*).
„ calophyllum, *Brown.*
„ purpurascens (*Brown*).
„ turbinatum (*Hedw.*).
Mnium hornum, *Dill.*
„ affine, *Bland.*
Timmia Megapolitana (*Hedw.*).
Philonotis fontana (*L.*).
Plagiothecium denticulatum (*Dill.*).
„ turfaceum, *Lindb.*
Stereodon patientiæ (*Lindb.*).
Hylocomium Schreberi (*Willd.*).
„ splendens (*Dill.*).
Leskea catenulata (*Brid.*).
Amblystegium uncinatum (*Hedw.*).
„ fluitans, *Dill.*
„ sarmentosum (*Wahl.*)
„ cordifolium (*Hedw.*).
„ stramineum (*Dicks.*).
Camptothecium nitens (*Schreb.*).
Brachythecium reflexum, *W. et M.*
Pogonatum alpinum, *Brid.*
Polytrichum juniperinum, *Hedw.*
Sphagnum acutifolium, *Ehrh.*
„ subsecundum, *Nees et Hsch.*
Jungermannia barbata, *Schreb.*
Martinellia irrigua (*Nees*).
Chiloscyphus polyanthos (*L.*).
Cephalozia bicuspidata, *Dumort.*
Kantia trichomanis, *Gray.*
Blepharozia ciliaris, *Dumort.*
Marchantia polymorpha, *L.*

In addition to some of the foregoing, *Mnium punctatum* (L.), *Hylocomium triquetrum* (L.), *H. squarrosum* (L.), and *Brachythecium rutabulum* (L.), were observed at Tromsø.

Such fresh-water *Algæ* as were obtained have not yet been carefully examined. There were on the island of Vardø and at Kølle several species apparently not British, but *Spirogyra* sps. *Œdogonium*, *Oscillatoria*, *Ulothrix*, *Lyngbia*, and *Cladophora* were not uncommon. A few Diatoms, as *Eunotia*, *Diatoma*, *Pinnularia*, and also *Closterium*, were obtained.

Fungi were apparently scarce. I observed a few species of *Agaricus*, also a *Uredo*-like parasite on *Salix* sps., and some others which I did not collect.

Lichenes, of course, were plentiful on rocks and upon stems of the prostrate shrubby plants in certain localities. They were not so characteristic a feature as I had expected would be the case. W. H. Wilkinson, Esq. of Birmingham, has kindly taken in hand this difficult group.

Marine Algæ were doubtless numerous enough in the neighbourhood of Vardø, despite the steeply sloping shores, but for lack of experience in the collecting of these, I obtained but a poorly representative number of species. These Mr G. W. Traill of Joppa has very kindly named for me as follows :—

Bryopsis plumosa, *Lx.*
Chorda lomentaria, *Grev.*
„ filum, *Lx.*
Chordaria flagelliformis, *Ag.*
Chondrus crispus, *Lx.*
Cladophora rupestris, *Kutz.*
Dictyosiphon fœniculaceus, *Grev.*
Desmarestia aculeata, *Lx.*
„ viridis, *Lx.*
Dumontia filiformis, *Grev.*
Ectocarpus granulosus, *Ag.*
„ littoralis, *Lyngb.*
Enteromorpha compressa, *Grev.*
Euthora cristata, *Ag.*
Fucus canaliculatus, *L.*
Fucus nodosus, *L.*
„ serratus, *L.*
„ vesiculosus, *L.*
Halosaccion ramentaceum, *Ag.*, forma densa, *Kjellman.*
Laminaria digitata, *Lamx.*
Polysiphonia arctica, *Ag.*
„ urceolata, *Grev.*
„ fastigiata, *Grev.*
Porphyra laciniata, *Ag.*
Ptilota plumosa, *Ag.*
Rhodophyllis dichotoma, *Gobi.*
Rhodymenia palmata, *Grev.*
Spongomorpha arcta (*f.* typica), *Kutz.*
Ulva latissima, *L.*

With the exception of *Rhodophyllis dichotoma* and *Polysiphonia arctica*, the above *Algæ*, Mr Traill remarks, are indigenous to the eastern coast of the United States of America, where they are generally of luxuriant growth. Their presence in such a high latitude as that of the North Cape is attributed to the influence of the Gulf Stream. The specimens examined are mostly identical in appearance with specimens of the same species found on our own coasts. The form of *Halosaccion ramentaceum* is, however, extremely robust and proliferous, and is so different in aspect from the typical plant, that one might almost be tempted to call it a distinct species. This genus, however, like our *Gelideum corneum*, assumes different forms according to the locality in which it occurs, and after a comparison of many specimens, there can be no doubt that they belong merely to a somewhat individualised form ; Mr Foslie of Tromsø identifies them as plants of the second year belonging to the *forma densa* of Kjellman.

Observations upon Collectons at the Yugor Straits.

At the Yugor Straits we were at first sight impressed with the widely different character of the vegetation. The plants were growing less closely together, there was less variety of species, the general habit of many that we had observed in Lapland was reduced or dwarfed. Thus *Salix* sps. did not exceed a foot in height, instead of forming bushes of 3 to 4 feet. *Caltha, Dryas, Ranunculus,* also *Vaccinium uliginosum* and *Rubus Chamæmorus* were noticeably different.

A little examination on shore showed quickly that many plants observed in Lapland were absent; it was a long time before we realised that the probable cause of this was to be found in the very distinct nature of the land. We would insist on this dependence upon physical features somewhat strongly, because (as may be seen by reference to the tables in the Summary) most of these plants, so noticeably absent from the shores of the Yugor Straits, are known to be distributed through Western Siberia.

Before giving more detailed attention to these absent forms, we may refer to the essential differences in physical features.

Exposed slopes (Area I. in Lapland) are wanting from the region immediately south of the Straits; the *Vaccinia, Arctostaphyllos, Empetrum, Juniperus, Diapensia,* are therefore absent; *Betula nana* is certainly not at all common, though reported from that region in the account of the voyage of "Dijmpha;" *Lycopodia* similarly are absent, or, as is the case with *Lycopodium Selago,* uncommon.

Nor are *rocky places* (Area III. in Lapland) present. The sandy sea-beach is the only equivalent where alone most of the plants characterising this area were found. A few scattered boulders upon the "*tundra*" were covered with *Lichenes,* which, however, are more conspicuously absent than would be expected.

The characteristic feature is of course the "tundra,"—*level extents* (Area II. in Lapland), only very rarely exhibiting a turf over sandy tracts, and commonly consisting of peaty bogs and pools or ponds of large size. Here is to be found typically a monotonous vegetation, spread probably for thousands of miles over the northern part of the country.

Carex aquatilis, *C. rotundata* and other species, *Eriophorum*, and certain coarse grasses, grow in wearisome sameness out of the swamps, or from amongst carpets of *Amblystegium*, *Sphagnum*, and *Jungermanniæ*. These may be dotted over with *Caltha* and *Pedicularis*, whilst very commonly, where there is the slightest drainage afforded by sloping ground, *Polemonium*, *Saxifraga cernua*, *S. Hirculus*, *S. hieraciifolium*, *Chrysosplenium*, and often *Salix lanata*, or *S. glauca*, are to be met with.

In certain isolated places, as upon old river banks covered with peat and exposed to the south, were gayer plants, some of which were not observed in Lapland. Such were *Astragalus*, *Oxytropis*, *Senecio* (*Cineraria*), *Arnica*, *Myosotis*, *Draba* sps., and *Lloydia serotina*.

Marly places, along the edge of the low cliffs or about the river banks, were most characteristically clothed with *Dryas octopetala*, which spread in great tufts as one continuous network, in which were to be found *Saxifraga* sps., *Androsace*, *Draba* sps., *Papaver nudicaule*, and indeed almost every one of the plants requiring a drier habitat. These grew, not in the bare spaces between the network of *Dryas*, but out from amongst its prostrate stems, as if there alone could the young seedlings find protection sufficient to nurse them into maturity.

Very abundant on slopes of the low cliffs were *Saxifraga cernua*, *S. oppositifolia*, and *Draba* sps. (not met with in the north of Lapland); also *Cochlearia*, *Silene acaulis*, and *Sedum Rhodiola*. Often too, as on the drier beaches, several species of *Salix* grew in profusion, where also many of the plants not found by me in Lapland were observed; such, for instance, were *Lychnis apetala*, *L. affinis*, *Arenaria norvegica*, *Adoxa*, *Artemisia borealis*, *A. vulgaris*, *Armeria*, *Androsace*, *Polemonium pulchellum*, and *Lloydia serotina*.

A glance at the Summary will show what were the plants found at the Yugor Straits exclusively. Many of these are, however, native to Lapland.

Without making an exhaustive list of absentees, we may enumerate the following commoner plants which occurred in Lapland, but of which no signs were seen at the Yugor Straits:—*Trollius europæus*, *Viola biflora*, *V. palustris*, *Lychnis diurna*, *Sagina* sps., *Montia fontana*, *Geranium sylvaticum, Empetrum nigrum, Trifolium repens, Vicia Cracca, V. hirsuta, Spiræa Ulmaria, Rubus saxatilis, Geum rivale, Potentilla procumbens, Alchemilla* sps., *Sedum acre, Epilobium* sps., *Anthriscus sylvestris, Ligusticum scoticum, Archangelica officinalis, Linnæa borealis, Cornus suecica, Valeriana sambucifolia, Carduus heterophyllus, Sonchus alpinus, Saussurea alpina, Solidago Virgaurea, Gnaphalium* sps., *Antennaria* sps., *Hieracium* sps., *Melampyrum, Rhinanthus, Campanula rotundifolia, Vaccinium Myrtillus, V. Oxycoccus, Andromeda polifolia, Arctostaphyllos alpina, Calluna vulgaris, Phyllodoce cærulea, Loiseleuria procumbens, Sedum palustre, Pyrola* sps., *Diapensia lapponica, Menyanthes trifoliata, Mertensia maritima, Veronica* sps., *Bartsia alpina, Euphrasia officinalis, Plantago major, Pinguicula vulgaris, Trientalis europæa, Polygonum Aviculare, Rumex* sps., *Urtica dioica, Orchis maculata, Triglochin* sps., *Tofieldia palustris, Juniperus communis,* var. *nana, Lycopodium* sps., *Aspidium* sps., *Polypodium* sps., and *Cystopteris fragilis.* The species of *Salix* were different; many of the commonest species of *Carex* were absent.

To place these facts in another manner, we may say that out of 110 of the commonest species observed during the voyage of the "Labrador" in the extreme north of Lapland, or upon the coast of the Yugor Straits, only 25 were found in the two countries; 20 species were distinctive of Siberia, whilst 65 were absent from the shores of the Yugor Straits, though present in identically the same latitude in Lapland.

It is more than probable that some of the above-mentioned plants are prevented from reaching the northernmost shores of Siberia by reason of the greater cold; it is certain that a few are absent because no cultivation of land is attempted or possible, but a glance at the above list will show that rock-loving species (those of Area III.) are the ones most conspicuously wanting. Certain of these, as will be seen on comparison with the list given in the Summary of all species known from Novaya Zemlya, are found in the more rocky places along the coasts of that island, whilst the greater number are known from the Urals or from Siberia farther to the east and south. We may notice that some of them occur in the following list of plants collected near Turukansk, a town on the east bank of the Yenisei, within the Arctic circle. The collection was brought to this country by Mr H. N. Sulivan: it is probably not by any means adequately representative of the country, but it suggests a richer flora by far than that found in the colder regions about the Yugor Straits:—

Ranunculus acris, Trollius europæus, Aconitum Napellus, A. lycoctonum, Caltha palustris, Nasturtium terrestre, Erysimum cheiranthus, Cardamine pratensis, C. macrophylla, Geranium pratense, Epilobium angustifolium, Cerastium dahuricum, Stellaria radians, Silene graminifolia, Trifolium repens, T. lupinaster, Vicia Cracca, Lathyrus pratensis, Sanguisorba, Alchemilla vulgaris, Geum urbanum, Potentilla anserina, P. multifida, Rubus arcticus, R. Chamæmorus, Spiraea Ulmaria, Empetrum nigrum, Heracleum, Œnanthe crocata, Galium boreale, Valeriana officinalis, Saussurea, Carduus, Solidago Virgaurea, Anthemis tinctoria, Achillea Millefolium, Tanacetum vulgare, Artemisia vulgaris, Senecio sarracenicus, Ledum palustre, Vaccinium uliginosum, Polemonium cæruleum, P. pulchellum, Myosotis palustris, Veronica longifolia, Pedicularis compacta, Mentha arvensis, Lamium album, Polygonum Aviculare, P. viviparum, Rumex Acetosella, Chenopodium album, Veratrum album, Allium Schænoprasum, Carex glauca, Eriophorum vaginatum, Alopecurus pratensis, Poa pratensis, and *Bromus erectus.*

If we refer to the Summary, it is evident from the present collection and from those made by previous travellers, that whilst most of the Phanerogamæ collected in Lapland are known as common to Siberia, they do not push so far to the north in the latter country as in the former. Whilst many are present in Russian Lapland, the low-lying land from the Petchora to the White Sea affords no suitable foothold which would allow of their distribution eastward along the same line of latitude; the difference in the physical nature of the region of the Yugor Straits, and the greater cold thereabouts, are evidently the chief causes which restrict the distribution of these common Arctic plants, but it is not possible to say, without careful study of the distribution of each species, what prominence must be given to one or the other.

It is a subject of much interest to study as to the further distribution of many of the species enumerated in the various tables. We shall see that a very large proportion are known from the mountain regions of our own country, and I have before me a list of plants collected by Mr Henry Tuke Mennell, F.L.S., during a single day spent (in a lower latitude) among the Rocky Mountains. Out of this list of about 170 species there are rather more than 70 genera, and between 60 and 70 species which are identical with those found in Lapland or about the Yugor Straits. Very complete knowledge as to the further distribution of the plants here enumerated may be obtained from Dr Warming's supplement to his *Grønlands Flora,* and from the older, yet more perfect, monograph by Sir Joseph Hooker.

The "Labrador" collections afford a very striking instance of the fact emphasised by Sir Joseph Hooker, that it may be exceedingly misleading to judge as to the distribution of Arctic plants from records of isolated floras, and it is only possible to treat the facts recorded in the accompanying Summary from the point of view of *local floras.*

The list of Musci, &c., from the shores south of the Yugor Straits which is here given must not be considered by any means as an exhaustive one. They were far from scarce, and it is not probable that I obtained other than a representative collection of the very commonest. The species here enumerated were almost without exception from marshy places:—

Swartzia capillacea, *Hedw.*
Dicranum scoparium, *Hedw.*
„ fuscescens, *Turn.*
Aulacomnion palustre, *Schw.*
Paludella squarrosa (*L.*).
Meesia tristicha, *B. & S.*
Tetraplodon urceolatus, *B. & S.*
Webera nutans, *Hedw.*
Leptobryum pyriforme, *Schimp.*
Mnium hymenophyllum, *B. & S.*
Stereodon Bambergeri (*Schimp.*).
Hylocomium Schreberi (*Willd.*).
Leskea atrovirens, *Hartm.*
Amblystegium uncinatum, *Hedw.*
Campylium stellatum (*Schreb.*).
Camptothecium nitens (*Schreb.*).
Brachythecium glareosum, *B. & S.*
Brachythecium cirrhosum (*Schw.*)
Sphagnum acutifolium, *Ehrh.*
Jungermannia minuta, *Crtz.*
Gymnocolia inflata, *Dumort.*
Blepharostoma trichophylla, *Dumort.*
Blepharozia ciliaris, *Dumort.*

Lichenes, as before mentioned, were not so plentiful as might have been expected. I am unable at present to report upon these.

Fresh-water *Algæ* were not uncommon, *Vaucheria* and *Spirogyra* appearing plentifully in the various smaller pools or over the *tundra*. Any report upon these must also be held over.

Mr George W. Traill has kindly named the few marine Algæ dredged in tow-nets suspended over the vessel's side, or picked up from among a considerable amount of drift on the beach. Probably there are very few Algæ in the immediate neighbourhood of the Straits. The water is shallow, and on that account during winter unusually cold, the Straits being frozen over for nearly half the year.

The species enumerated are common to our own shores, and also to the coasts of the United States, the exceptions being *Polysiphonia arctica*, *Porphyra abyssicola*, and *Cladostephus plumosus*. This last is a true Arctic species, found in Cumberland Sound and on the Labrador coasts. It would seem to be carried by the cold currents setting past Hudson's Bay as far south as to Prince Edward's Island, then probably it is carried by the Gulf Stream current to the British Islands, and eventually beyond the coast of Norway.

It may be worth remark that, of the small number collected, nearly one-half are different from those found at Vardø.

The remarks made by Mr Traill, as to the general habit of the species found near to the North Cape, refer also to these.

There were obtained—

Ahnfeldtia plicata, *Ag.*	Laminaria flexicaulis, *Le Jolis.*
Cladostephus plumosus, *Holmes.*	Polysiphonia nigrescens, *Grew.*
Delesseria sinuosa, *Lx.*	,, arctica, *Ag.*
Desmarestia aculeata, *Lx.*	,, urceolata, *Grev.*
Ectocarpus littoralis, *Lyngb.*	Porphyra abyssicola, *Kjell.*
Fucus *sp.*	Rhodomela lycopodioides, *Ag.*

Also *Rhizosolenia styliformis* and *Chætoceros armatus*, the former of which is not in our seas, were obtained in the tow-net when near to the ice off the south coast of Novaya Zemlya.

In conclusion, we may make certain more general comparisons between the vegetation of these places within the Arctic circle and that of our own country.

Bearing in mind that on no part of the earth, within the

Arctic regions, is there a more poverty-stricken flora than exists in Siberia, it is yet quite possible there to find tracts, of greater or less extent (*e.g.*, over a well-drained, sandy soil), which show an almost luxuriant turf. The country about the Straits presented generally a green appearance, contrasting with the barren, because more rocky, slopes of Lapland, and affording a contrast also with the barren rocky summits of our own mountains, which are, often enough with justice, compared as to their vegetation with these Arctic regions. Thus we may select the following plants, found in greater or less abundance in one or other of these localities, which are among the greatest rarities of our own mountain flora, and are regarded as the relics of an Arctic vegetation which in the glacial epoch covered the whole of Great Britain:—*Astragalus alpinus, Oxytropis campestris, Saxifraga rivularis, S. cernua, S. cæspitosa, Gnaphalium norvegicum, Phyllodoce, Gentiana nivalis, Polemonium cæruleum, Myosotis alpestris, Veronica alpina, Salix lanata, Allium sibiricum, Lloydia serotina, Juncus filiformis, J. castaneus, J. biglumis, Luzula arcuata, Carex rupestris, C. alpina, C. rariflora, C. frigida, C. pulla, Hierochloe borealis, Alopecurus alpinus, Phleum alpinum, Deyeuxia strigosa* and *D. neglecta*. Yet these are not in any sense characteristic of our bare mountain summits; rather are the following (at least on the tops of the Ross-shire mountains), common at an elevation of 3000 to 3500 feet:—*Silene acaulis, Sibbaldia procumbens, Alchemilla alpina, Saxifraga stellaris, Empetrum nigrum, Galium saxatile, Gnaphalium supinum, Antennaria dioica, Solidago Virgaurea, Hieracium alpinum, Achillea Millefolium, Vaccinium Myrtillus, Armeria maritima, Thymus serpyllum, Polygonum viviparum, Oxyria reniformis, Juncus trifidus, Luzula spicata, Carex rigida, Deschampsia flexuosa,* and *Festuca vivipara*. At such elevations these are mostly reduced in habit. In the more sheltered places, or lower down the sides of the mountains, occur *Rumex Acetosa, Cerastium alpinum, Geum rivale, Chrysosplenium oppositifolium, Caltha palustris, Viola palustris, Anthoxanthum odoratum;* whilst there are found, on the mountains to which I have referred, at a still lower elevation, *Calluna vulgaris, Pyrola minor, Parnassia palustris, Arctostaphyllos Uva-Ursi, A. alpina, Vaccinium Vitis-Idæa,* and even *Loiscleuria procumbens*.

These few last-mentioned are (*Calluna* excepted) characteristic of a great part of Lapland, but nowhere in the north of Lapland were the slopes covered with *Calluna*, *Eleocharis*, and *Pteris*, which characterise the Highlands.

Nowhere also were the tangled growths of the plants common to our waysides, and which, on our return in October, gave the impression of a really luxuriant vegetation, in comparison with that to which we had become accustomed. Here and there in favourable positions, as on the sheltered slopes of the naturally manured island at Vardø, before mentioned, was a rich growth of certain deciduous plants, but this was quite the exception; none of the plants commonly seen as masses of bright colour in the Lowlands of our own country occurred as other than isolated plants. Perhaps we should except *Ranunculus acris* in the meadows about the small hamlets, *Matricaria inodora*, also about the houses, and in one place, *Lychnis diurna*.

Nowhere were such masses of *Campanula rotundifolia*, *Solidago Virgaurea*, *Saxifraga aizoides*, &c., as may be seen so commonly in the Highlands.

On the island of Vardø, where the characteristic *Ericaceæ* and *Vaccinia* were wanting, there were, however, masses of white colour, from the abundance of *Cerastium*, *Cornus*, *Trientalis*, *Cochlearia;* also in one place, from exceedingly large flowers of *Rubus Chamæmorus*.

I saw very few insects fertilising these flowers. There were certain small *Diptera*, and about Vardø, other larger ones, attracted perhaps by the amount of animal refuse from the whaling and fishing industries. *Musca vomitoria*, L., var. *mortuum*, Fabr., and *Scatophaga merdaria*, Fabr. (?), were not uncommon. Twice only did I observe moths; one species of which, *Larentia cæsiata*, is common enough on our own moors; the other was a species of *Cidaria*, not known in this country.

Whilst *white* flowers were most abundant on the island of Vardø, where the reddish colours of the *Ericaceæ* characterising the mainland were absent, *yellow* was perhaps the colour most widely dispersed about the Yugor Straits. This was due to the abundance of *Senecio* and other *Compositæ*, *Saxifraga Hirculus*, *Chrysosplenium*, *Draba*, &c. There also *Saxifraga cernua* brought the *Saxifragæ* forward as perhaps the most widespread of any of the more decorative plants. *Cruciferæ* appeared more plentiful than was the case in Lapland—*Caryophyllaceae* not being quite so prominent.

It is useless, however, to dwell upon the predominance of any one colour, so dependent did such appear to be upon the nature of the locality, whether it favoured the spread of one class of plants or another. A mere comparison as to the relative numbers of plants with flowers of one colour or another would be quite or almost useless; such would show to us that a large proportion of the collected species were those with highly coloured flowers, which individually appeared to be quite as brightly coloured as with us; but, as before mentioned, usually they are but sparsely distributed.

It is very difficult to indicate with any precision as to the relative frequency or scarcity of the plants common to these regions. I have endeavoured to indicate the commonest in the notes attached to the Summary.

It is hoped that the present paper may be followed by one dealing especially with the distribution and the remarkable variation of some of the species herein mentioned.

My collections have been presented to the Herbarium of the Royal Botanical Garden, Edinburgh.

Summarised List of Species now known from the Islands of Novaya Zemlya and Waigatz and from the North Coast of Western Siberia.

That the distribution of plants in these Arctic regions to the North-East may be more accurately recorded, I have incorporated the names of all species mentioned by the following authors:—

Kjellman (1882), *Växtligheten på Sibiriens Nordkust, Sibiriska Nordkustens Fanerogamflora; Fanerogamflora på Novaja Semlja och Wajgatsch.*

Holm (1887), *Dijmphna-Togtets; Zoolog-Botaniske Udbytte.*

Warming (1888), *Tabellarisk oversight over Grønlands, Islands og Farøernes Flora.*

In *Växtligheten på Sibiriens Nordkust* will be found full references to the literature of previous expeditions.

None of our countrymen except Wiggins (who, however, engaged in no scientific work) have, since the time of the early Merchant Adventurers, explored these Arctic regions lying to the south and east of Novaya Zemlya. It has been left to the enterprise of the Swedes, and especially are we indebted to the voyages of the "Vega" and of the "Dijmphna" for information as to the botany of these regions.

There had, however, been overland journeys to the northern shores of Asia, and thence to Novaya Zemlya, the results of which have been incorporated in Sir Joseph Hooker's *Outlines of the Distribution of Arctic Plants* (see *Trans. Linn. Soc.*, vol. xxiii.), and in the works above cited.

The following abbreviations have been made use of:—

× = observed during the voyage of the "Labrador."

D = observed during the voyage of the "Dijmphna" from shores of the Yugor Straits.

V = observed during the voyage of the "Vega," or recorded in Dr Kjellman's summary of plants known from the northern coast of Asia as far as to Cape Tcheluschin.

T = other records from the Taimyr peninsula given in Dr Warming's Summary.

Z = recorded from Novaya Zemlya.

L = observed on the Island of Vardo by Pastor Landmark.

— = known from West Siberia, but more to the south.

Plants marked with the asterisk (*) are British species; those in brackets were not observed by me. Those marked as "indigenous" were collected at the Yugor Straits, and are also native to Lapland, though not observed there by me.

Flora of North Coast of West Siberia and of adjoining Regions.	Siberia. Yugor Straits and West Siberia.	Siberia. North Coast of Siberia.	Novaya Zemlya.	Lapland. Island of Vardø.	Lapland. Vadsø.	Lapland. Kølle.	Lapland. Tromsø.	Yugor Straits and Siberia.	Lapland.
*Thalictrum alpinum, *L.*	×	V	Z	×	.	.	×	Frequent.	Frequent.
Ranunculus—									
Pallasii, *Schl.*	×	.	Z	.	.	.	.	...	Indigenous.
*repens, *L.*	.	.	.	×	.	.	.		
*acris, *L. vars.*	×	V	Z	×	×	×	×	Frequent.	Frequent; often in masses.
,, *sub sp.* borealis, *Trautv.*	.	V	Z	.	.	.	.		
*[auricomus, *L.*]	.	.	.	L	.	.	.	...	Near houses.
affinis, *R. Br.*	×	V	Z	?	.	.	.		
[sulphureus, *Soland.*]	D	V	Z	.	.	.	.	=*altaicus*, Laxm.	
nivalis, *L.*	×	V	Z	.	.	.	.	In peaty bed of river.	Indigenous.
pygmæus, *Wahl.*	×	V	Z	×	×	×	.	...	Common.
hyperboreus, *Rottb.*	×	V	Z	×	.	.	.		
[lapponicus, *L.*]	–	V	Z	.	.	.	.		
*Caltha palustris, *L.*	×	V	Z	×	×	×	×	A reduced form, common; probably var. *minor*.	Both type and var. *minor*.
*Trollius europæus, *L.*	–	.	.	.	×	×	×		
Papaver nudicaule, *L.*	×	V	Z	.	.	.	.	Frequent along shore.	Indigenous.
[Corydalis pauciflora, *Pers.*]	.	V	.	.	.	.	.		
Matthiola nudicaulis, *L.*	×	V	Z	.	.	.	.	...	,,
[Parrya macrocarpa, *R. Br.*]	?	V	.	.	.	.	.		
Arabis—									
*alpina, *L.*	×	.	Z	×	.	.	.	Frequent.	
*[petræa, *L.*]	–	V	Z	.	.	.	.		
Cardamine—									
*pratensis, *L.*	×	V	Z	×	.	×	.		
bellidifolia, *L.*	?	V	Z	.	.	.	.	...	,,
[Shivereckia podolica, *And.*]	.	.	Z	.	.	.	.		
Draba—									
alpina, *L., et vars.*	×	V	Z	.	.	.	.	...	,,
[Wahlenbergii, *Htn.*]	D	V	Z	.	.	.	.	...	,,
[oblongata, *R. Br.*]	.	V	Z	.	.	.	.	...	
repens, *Bieb.*	×	.	Z	.	.	.	.	...	,,
[arctica, *J. Vahl*]	.	.	Z	.	.	.	.		
hirta, *L., et* rupestris, *Htn.*	×	V	Z	.	.	.	.	..	,,
[altaica, *Bunge.*]	–	V	Z	.	.	.	.		
[lactea, *Adams*]	.	.	Z	.	.	.	.		
nivalis, *Lilj.*	×	.	Z	.	.	.	.	...	,,
[corymbosa, *R. Br.*]	.	V	Z	.	.	.	.	...	,,
*incana, *L.*	×	.	.	×	×	.	×	Doubtful.	
Cochlearia—									
*officinalis, *L.*	–	.	.	×	.	.	?		
,, *alpina, *Bab.*	.	.	×	.	.	.	.		
*anglica, *L.*	.	.	.	×	.	×	×	...	Common at Vardø.
,, *sub sp.* arctica, *Schl.*	×	V	.	×	.	.	.		
fenestrata, *R. Br.*	×	V	Z	.	.	.	.	Common.	
[Sisymbrium—									
*Sophia, *L.*]	.	V	.	.	.	.	.		
[pygmæum, *Trautv.*]	.	.	Z	.	.	.	.		
Eutrema Edwardsii, *R. Br.*	×	V	Z	.	.	.	.		
[Erysimum hieracifolium, *L.*]	–	.	.	L	.	.	.		
Braya—									
alpina (*Koch*), *L.*	×	.	Z	.	.	.	.	East Siberia.	Indigenous.
[glabella, *Richards*]	.	.	Z	.	.	.	.		
*[Camelina sativa, *L.*]	.	.	.	L	.	.	.		
*[Brassica campestris, *L.*]	.	.	.	L	.	.	.		
*Capsella bursa-pastoris, *L.*	–	.	.	×	×	×	×		
*Thlaspi arvense, *L.*]	.	.	.	L	.	.	.		
Viola—									
*sylvatica, *Fr.*	–	.	.	.	.	.	×	...	
*palustris, *L.*	–	.	.	?	×	.	.		Common at Vadsø: *V. suecica*, recorded from Vardø by Landmark.
biflora, *L.*	–	.	Z	×	×	×	.	...	Common.

Flora of North Coast of West Siberia and of adjoining Regions.	Siberia.		Novaya Zemlya.	Lapland.				Yugor Straits and Siberia.	Lapland.
	Yugor Straits and West Siberia.	North Coast of Siberia.		Island of Vardø.	Vadsø.	Kølle.	Tromsø.		
Viola [sp.]	D	.	.	.	.	.	.		
*Silene acaulis, *L.*	×	.	Z	×	.	.	×	Frequent.	Common.
Lychnis—									
*[Githago, *Lam.*]	–	.	.	L	.	.	.	...	Buds only produced.
*diurna, *Sibth.*	–	.	.	×	×	×	×	...	Scarce at Kølle and Vadsø.
(Wahlbergella) apetala, *Fr.*	×	V	Z	.	.	.	.	= *L. apetala*, L.	Indigenous.
,, affinis (*J. Vahl*) *Fr.*	×	V	Z	.	.	.	.	...	,,
Cerastium—									
*alpinum, *L., et vars.*	×	V	Z	×	×	×	×	Scarce.	
*triviale, *Link.*	–	.	.	×	×	×	×	...	Very abundant at Vardø.
,, alpestre, *Lindbl.*	.	.	.	×	.	×	.		
*[glomeratum, *Thuill.*]	–	.	.	L	.	.	.		
*tetrandrum, *Curtis*	.	.	.	×	.	.	.		
*trigynum, *Vill.*	.	.	Z	×	×	×	.	East Siberia.	,,
Stellaria—									
*nemorum, *L.*	.	.	.	?	.	×	.	...	Scarce.
*media, *Cyr., et vars.*	–	.	.	×	.	×	×		
*uliginosa, *Murr.*	–	.	.	×	×	.	.		
[crassifolia, *Ehrh.*]	–	.	Z	L	.	.	.		
[longipes, *Goldie*]	×	V	Z	.	.	.	.	...	Indigenous.
humifusa, *Rottb.*	×	V	Z	×	.	.	.		
Arenaria—									
*ciliata, *L. var.* frigida, *Koch*	.	.	Z	.	.	.	.		
,, norvegica, *Vill.*	×	.	.	.	.	.	.	...	,,
*peploides, *L.*	–	.	Z	×	.	×	×		
,, diffusa, *Hornem.*	×	.	.	.	.	.	.	Scarce.	
*(Alsine) [biflora, *Wahl.*]	–	.	Z	.	.	.	.	...	,,
,, [arctica, *Fz.*]	–	V	.	.	.	.	.		
,, [macrocarpa, *Fz.*]	–	V	.	.	.	.	.	*Arenaria* of Pursh not Horn.	
,, verna, *Bart.*	.	.	.	.	.	.	.		
,, ,, glacialis, *Fz.*	.	.	Z	.	.	.	.		
,, ,, *rubella, *Hk.*	×	V	Z	.	.	.	.	...	,
Sagina—									
*nodosa, *L.*	–	.	.	×	.	.	.		
*subulata, *Wm.*	.	.	.	.	.	.	×		
*nivalis, *Fr.*	–	V	Z	.	.	.	.		
*Linnæi, *Presl*	–	.	Z	×	.	×	.		
*apetala, *L.*	–	.	.	×	.	.	×		
*maritima, *Don*	.	.	.	×	.	.	.		
*procumbens, *L.*	–	.	.	×	×	×	×		
*Montia fontana, *L.*	.	.	.	×	.	×	×	Known from East Siberia.	Common.
*Geranium sylvaticum, *L.*	–	.	.	×	×	×	×	...	Frequent.
*Empetrum nigrum, *L.*	–	T	.	×	×	×	×	...	Common.
Trifolium repens, *L.*	–	.	.	×	.	.	×		
*Lotus corniculatus, *L.*	.	.	.	.	.	.	×	From Altai Mts.	
Astragalus—									
*[alpinus, *L.*]	.	V	Z	.	.	.	.	...	Indigenous.
(*Phaca*) frigida, *L.*	×	.	Z	.	.	.	.	A stunted form. See var. *littoralis*.	,,
[Hedysarum obscurum, *L.*]	.	.	Z	.	.	.	.		
Oxytropis—									
*campestris, *L., var.*	×	V	Z	.	.	.	.		
[Mertensiana, *Turcz.*]	.	V	.	.	.	.	.		
Vicia—									
*hirsuta, *L.*	–	.	.	×	.	×	×		
*Cracca, *L.*	–	.	.	×	.	×	×	...	Very reduced.
*Spiræa Ulmaria, *L.*	–	.	.	×	×	×	×		
Rubus—									
*saxatilis, *L.*	–	.	.	.	×	×	×		
*Chamæmorus, *L.*	×	T	Z	×	×	×	×	Scarce: a very reduced form.	Common.

Flora of North Coast of West Siberia and of adjoining Regions.	Siberia.		Novaya Zemlya.	Lapland.				Yugor Straits and Siberia.	Lapland.
	Yugor Straits and West Siberia.	North Coast of Siberia.		Island of Vardø.	Vadsø.	Kølle.	Tromsø.		
*Dryas octopetala, *L.*	×	V	Z	L	×	×	×	A form with very small leaves; the predominant plant in most of the drier places.	Frequent.
[Sieversia glacialis, *R. Br.*]	.	V	.	.	.	.	.		
*Geum rivale, *L.*	–	.	.	.	×	×	×		
Potentilla—									
*Comarum, *Nestl.*	×	T	Z	×	×	×	×	Common	Common.
*procumbens, *Clairv.*	.	.	.	×	×	×	×		,,
*anserina, *L.*	–	.	.	×	.	.	×		
[norvegica, *L.*]	.	.	.	L	.	.	.		
*Salisburgensis, *Haenke,*	×	.	Z	×	×	.	×	=*maculata*, Pourr: frequent.	=*verna*, *L.*, of Landmark's list; frequent.
*reptans, *L.*	–	.	.	.	.	.	×	...	Indigenous.
[fragiformis, *Willd.*, *var.* parviflora, *Trautv.*]	.	V	Z	.	.	.	.		
[sericea, *L.*, *var.*]	.	.	Z	.	.	.	.		
[emarginata, *Pursh*]	D	V	Z	.	.	.	.		
[nivea, *L.*, *et var.*]	–	V	.	.	.	.	.		
Alchemilla—									
*vulgaris, *L.*	–	.	.	×	×	×	×	...	Very abundant on island of Tromsø.
*alpina, *L.*	–	.	.	.	×	×	×	...	Common.
*Pyrus Aucuparia, *Gaertn.*	–	T	.	.	×	×	×	...	At Vadsø—a tree 5 feet high in a garden; at Kølle, four specimens growing together, not a foot high; at Tromsø 10–20 feet.
Saxifraga—									
*aizoides, *L.*	×	.	Z	.	.	.	×		
*oppositifolia, *L.*	×	V	Z	.	.	.	×	Probably both the older species of *Linnæus* and *decipiens*, Ehrh., which varies but little from it, occur: these names are, however, very differently used by different authors.	
decipiens, *Ehrh.*, et * cæspitosa, *L.*	×	V	Z	×	.	×	×		
*cernua, *L.*	×	V	Z	.	.	.	.	Very abundant.	Indigenous.
*rivularis, *L*	?	V	Z	×	×	×	×	A doubtful specimen from sea shore; is probably the sub. sp.	
,, *sub. sp.* hyperborea, *Br.*	×	.	.	.	.	.	.		
hieraciifolia, *Waldst. et Kit.*	×	V	Z	.	.	.	.	Common.	,,
[punctata, *L.*]	.	V	.	.	.	.	.		
*nivalis, *L.*	×	V	Z	.	.	×	×		
[,, tenuis, *Wahl.*]	.	V	.	.	.	.	.		
*Hirculus, *L.*	×	V	Z	.	.	.	.	Common.	,,
[flagellaris, *Willd.*, *vars.*]	.	V	Z	.	.	.	.		
[serpyllifolia, *Pursh*]	.	V	.	.	.	.	.		
[bronchialis, *L.*]	.	V	.	.	.	.	.		
*stellaris, *L.*	×	V	Z	×	×	×	×	Common: probably the variety *comosa*, Poir.	Common.
*Chrysosplenium alternifolium, *L.*	×	V	Z	×	×	×	×	Common.	The form found at Vardø was named by Landmark, the var. *tetrandrum*, Fr.

Flora of North Coast of West Siberia and of adjoining Regions.	Siberia.			Lapland.				Yugor Straits and Siberia.	Lapland.
	Yugor Straits and West Siberia.	North Coast of Siberia.	Novaya Zemlya.	Island of Vardø.	Vadsø.	Kølle.	Tromsø.		
*Parnassia palustris, *L.*	×	T	Z	×	×	×	×	Probably vars. as well as type.	
Sedum—								Common along shore	Frequent.
*Rhodiola, *DC.*	×	V	Z	×	×	×	×		
*acre, *L.*	–	. .	.	×	.	.	×		
*Hippuris vulgaris, *L.*	×	.	Z	×	.	.	.	...	A much drawn out form.
*Callitriche verna, *L.*	–	.	.	×	.	.	.		
Epilobium—								...	Frequent.
*angustifolium, *L.*	–	T	.	×	×	×	×		
[latifolium, *L.*]	–	.	Z	.	.	.	.	East Siberia.	
*alsinifolium, *Vill.*	.	.	.	?	.	×	×	East Siberia.	Common.
*alpinum, *L.*	.	T	Z	×	×	×	×		
*palustre, *L.*	?	T	Z	×	×	.	×	"et var." (Warming).	
*Carum carui, *L.*	–	.	.	×	.	.	.		
*Anthriscus sylvestris, *Hfm.*	?	.	.	×	.	.	.		
*Archangelica officinalis. *Hfm.*	.	.	.	×	.	×	×	East Siberia.	
Heracleum sibiricum, *L.*	–	.	.	.	.	.	×		
*Ligusticum scoticum, *L.*	.	.	.	?	.	.	.	East Siberia.	
(Conioselenum) Fischeri, *Wm.*	.	.	.	.	×	.	.		
(Pachypleurum) alpinum, *Led.*	×	.	Z	.	.	.	.		
*Adoxa Moschatellina, *L.*	×	.	.	L	.	.	.		
*Sambucus nigra, *L.*	–	.	.	.	.	?	.	...	See note, p. 452.
*Linnæa borealis, *Gronov.*	.	.	.	.	×	.	.		
*Cornus suecica, *L.*	.	.	.	×	×	×	×	East Siberia.	
*Galium boreale, *L.*	.	.	.	.	.	.	×		
Valeriana—									
*officinalis, *L.* *var. sambucifolia	–	.	.	×	×	×	.		
capitata, *Pall.*	×	.	Z	.	.	.	.	On drier banks; Scarce.	
*Solidago Virgaurea, *L.*	–	.	.	×	×	×	×	...	A dwarfed form.
*Erigeron uniflorus, *L.*	?	T	Z	.	?	.	.		
Antennaria—									
*dioica, *R. Br.*	–	.	.	×	×	×	×	...	Common.
alpina, *Rchb.?*	–	.	.	.	.	×	.		
carpathica, *Bl. F.?*	.	.	Z	.	.	×	.		
Gnaphalium—									
*sylvaticum, *L.*	–	.	.	.	.	.	×		
*norvegicum, *Hook.*	–	.	.	×	.	×	.		
*supinum, *L.*	.	.	.	×	×	×	.	Asia Minor only.	
Achillea—									
*[Ptarmica, *L.*]	–	.	.	L	.	.	.	...	An alien.
*Millefolium, *L.*	×	.	.	×	.	×	×	...	In meadows.
Pyrethrum bipinnatum, *Willd.*	×	.	Z	.	.	.	.	A few plants on beach near village.	Indigenous.
*Matricaria inodora, *L. et var.* phæocephala, *Rupr.*	×	V	Z	×	×	×	×	Scarce about village.	Very abundant about village of Vardø.
Artemisia—									
borealis, *Pall.*	×	T	Z	.	.	.	.	Probably also var. *Purshii*, Bess., on sandy beach.	
*vulgaris, *L.*	×	V	Z	.	.	.	.	Probably var. *Tilesii*, Ledeb.	Indigenous.
Petasites frigida, *Fr.*	×	.	Z	.	.	.	.	Leaves only; not common.	
*Carduus heterophyllus, *L.*	.	.	.	×	.	×	.		
Arnica alpina, *Murr.*	×	.	Z	.	.	.	.	...	Indigenous.
Senecio—									
resedæfolius, *Less.*	×	.	Z	.	.	.	.	Common.	
(Cineraria) integrifolia, *L.*	×	V	Z	.	.	.	.	= var. of *C. campestris*; many forms of this exceedingly variable plant; common.	

Flora of North Coast of West Siberia and of adjoining Regions.	Siberia.		Novaya Zemlya.	Lapland.				Yugor Straits and Siberia.	Lapland.
	Yugor Straits and West Siberia.	North Coast of Siberia.		Island of Vardø.	Vadsø.	Kølle.	Tromsø.		
(Cineraria) [frigida, *Richd.*]	D	V	Z	.	.	.	.		
,, [*palustris, *L.*, *var.* congesta, *Hook.*]	.	.	Z	.	.	.	.		
*Saussurea alpina, *L.*	–	V	.	×	×	×	×	...	Very variable.
*Hieracium—									
*lingulatum, *Bach.*	.	.	.	.	.	×	.	...	A variety.
Chrysanthum, *Ledeb.*	.	V	.	.	.	×	.	...	? *Nigrescens*, at Kølle.
*alpinum									
,, *melanocephalum, *Tausch.*	.	.	.	.	.	×	×		
sps?	.	.	.	.	×	×	×		
Leontodon sp.?	.	.	.	.	.	.	×		
Taraxacum—									
*officinale, *Wiggers.*	?	T	Z	×	×	×	×	Of Weber, later.	
*palustre, *DC.*	–	.	.	×	.	×	.		
phymatocarpum, *Vahl*	×	V	Z	.	.	.	.	Once found: not distinguishable from *T. ceratophorum.*	
nivale, *Lange*	.	.	.	.	.	.	×	...	Probably this species. See *Medd. Soc. Fauna et Flora Fennica*, xvi.
*Sonchus alpinus, *L.*	–	.	.	.	.	×	.	...	
Campanula—									
*rotundifolia, *L.*, *et vars.*	–	.	Z	×	×	×	×		
[uniflora, *L.*]	–	.	Z	.	.	.	.	...	Indigenous.
Vaccinium—									
*uliginosum, *L.*, *et vars.*	×	V	Z	×	×	×	×	The single specimen obtained in very poor condition, is probably the var. *microphyllum*, Lge. See *Dijmphna Togtets.*	Very luxuriant form.
*Myrtillus, *L.*	–	.	.	×	×	×	×		
*Vitis-Idæa, *L.*	?	T	Z	×	×	×	×	Var. *pumila*, Horn, recorded in *Dijmphna Togtets.*	Scarce.
*Oxycoccus palustris, *Pers.*	–	.	.	×	?	.	.	...	Not abundant.
*Arctostaphyllos alpina, *Spreng.*	.	.	.	.	×	×	×	...	Common.
[Cassiope—									
hypnoides, *Don.*]	–	.	.	.	.	.	.	...	Indigenous.
[tetragona, *L.*]	–	.	.	.	.	.	.	...	,,
*Andromeda polifolia, *L.*	–	T	.	.	×	×	×	...	Common.
*Calluna vulgaris, *Salisb.*	–	.	.	.	.	.	×	...	Mr Bennett remarks that this is very near what Dr Seeman describes (*Jour. Bot.*, t. liii. p. 305) as *C. atlantica*; his specimens were from Newfoundland.
*Loiseleuria procumbens. *Desv.*	.	.	.	×	×	×	×	East Siberia.	Common.
*Phyllodoce cærulea, *Bab.*	–	.	.	.	×	×	×	...	Frequent in less boggy places.
Ledum palustre, *L.*	–	T	.	.	×	.	.	...	Abundant at Vadsø.
Pyrola—									
*rotundifolia, *L.*	–	T	.	×	.	.	×	...	Abundant.
,, grandiflora, *Raddi.*	.	T	.	.	×		.		
*minor, *L.*	–	.	Z	L	×	×	×		
*secunda, *L.*, *et var.*	–	T	.	.	×	.	×	...	A small form at Vadsø.
[*sp.* sine flore]	D	.	.	.	.	.	.		

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Diapensia lapponica, *L.*	–	.	.	.	×	×	.	Found, according to Kjellman, to the east of Cape Tscheluskin.	Common on exposed slopes.
Armeria sibirica, *Turcz.*	×	.	Z	.	.	.	.		
Primula—									
*farinosa, *L.*	.	.	Z	.	.	.	.		
stricta, *Horn.*	×	.	Z	×	.	.	.	One place on cliffs west of village.	
Androsace—									
septentrionalis, *L.*	×	.	Z	.	.	.	.	On beach. Beside true forms, two plants are regarded by Mr Baker as probably "a non-umbellate var."	Indigenous.
[villosa, *L.*]	.	V	.	.	.	.	.		
chamaejasme, *Willd.*	×	.	Z	.	.	.	.	Frequent among tufts of *Dryas.*	
[triflora, *Adams, var.* pilosa, *Kjell.*]	.	.	Z	.	.	.	.		
[Cortusa Matthioli, *L.*]	.	.	Z	.	.	.	.		
*Trientalis europæa, *L.*	–	.	Z	×	×	×	×	...	Common.
Gentiana—									
*nivalis, *L.*	.	.	.	×	.	.	.		
tenella, *Rottb.*	×	T	.	×	.	.	.	Only once found.	
aurea, *L.*	.	.	.	×	.	.	×	East Siberia.	=*involucata,* Rottb.
Menyanthes trifoliata, *L.*	–	T	Z	×	×	×	.	See Dr Warming's Summary.	
[Lagotis glauca, *Gaertn.*]	.	V	Z	.	.	.	.		
Polemonium—									
*cæruleum, *L., var.* acutiflora, *Willd.*	×	.	Z	.	.	.	.	Common.	
grandiflorum,	.	.	.	.	×	.	.	...	A form between *cæruleum* and *pulchellum;* sent from south of Varanger Fiord.
pulchellum, *Bunge.*	×	V	Z	.	.	.	.	= *humile,* Wild., not so common as *P. cæruleum.*	Indigenous.
Eritrichium villosum, *Bunge.*	×	V	Z	.	.	.	.	Common among *Dryas.*	
*Mertensia maritima, *Don*	–	.	.	×	.	.	.		
Myosotis—									
[lappula, *L.*]	.	.	.	L	.	.	.	...	= *Echinospermum,* Lehm.; not in *Berlin Dist. Scand.* from Lapland.
*sylvatica, *Hoffm.*	.	.	.	L	×	.	×		
*alpestris, *Koch*	×	V	Z	–	.	.	.	...	Indigenous.
(Mimulus luteus, *L.*)	.	.	.	.	.	.	×	...	An escape.
Veronica—									
*officinalis, *L.*	–	.	.	.	.	.	×		
*alpina, *L.*	–	.	.	.	×	×	×		
*serpyllifolia, *L.*	–	.	.	.	.	.	×		
*Euphrasia officinalis, *L., vars.*	–	.	.	×	×	×	×	...	A very considerable difference noticeable between the Vardø and Tromsø specimens.

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*Bartsia alpina, *L.*	.	.	.	.	×	×	×	Asia?	
Pedicularis—									
sceptrum-carolinum, *L.*	.	.	.	.	×	.	.	...	Common in extensive marshes.
[sudetica, *Willd., et vars.*]	.	V	Z	.	.	.	.		
[lanata, *Cham.*]	D	V	Z	.	.	.	.		
[hirsuta, *L.*]	–	V	Z	.	.	.	.		
Œderi, *Vahl*	×	V	Z	.	.	.	.	A very common and variable plant.	
[capitata, *Adams*]	–	T	.	.	.	.	.		
[euphrasioides, *Steph.*]	–	T	.	.	.	.	.		
[villosa, *Ledeb.*]	.	V	.	.	.	.	.		
lapponica, *L.*	.	T	.	.	×	×	.	...	Common.
*palustris?	.	.	.	.	.	.	×		
*Rhinanthus minor, *Ehrb.*	.	.	.	.	.	.	×	...	Meadows.
*Melampyrum pratense, *L. var.*	–	.	.	×	×	×	.	...	Frequent.
*Pinguicula vulgaris, *L.*	–	.	.	×	×	×	×	...	,,
Plantago—									
*major, *L.*	–	.	.	L	.	.	×	...	Sparingly.
*maritima, *L.*	?	.	Z	.	.	.	.	Var *pumila*, Kjell., recorded in *Dijmphna Togtets.*	Indigenous.
*[Galeopsis Tetrahit, *L.*]	–	.	.	L	.	.	.	...	An alien; plentiful in 1858 in cultivated field with *G. versicolor.*
*[Chenopodium album, *L.*]	–	.	.	L	.	.	.		
*Atriplex Babingtonii, *Woods.*	.	.	.	.	.	.	×		
Kœnigia islandica, *L.*	–	.	Z	×	×	.	.		
Polygonum—									
*Bistorta, *L.*	×	V	Z	.	.	.	.	...	Indigenous.
*viviparum, *L.*	×	V	Z	×	×	×	×	A dwarf form.	Very common; often, as at Vardø, luxuriant.
*[amphibium, *L.*]	–	T	.	.	.	.	.	...	Indigenous.
*[lapathifolium, *L.*]	.	.	.	L	.	.	.		
*Aviculare, *L.*	–	.	.	L	×	.	.		
*Oxyria reniformis, *Hook.*	×	V	Z	×	×	×	×	Common.	Common.
Rumex—									
arcticus, *Trautv.*	–	V	Z	?	.	.	.	...	= R. *domesticus*, Hart.; probably specimens were this plant.
*Acetosa, *L.*	?	T	Z	×	×	×	×		
*Acetosella, *L.*	.	T	.	×	×	×	×	...	The most persistent with *Luzula* and *Festuca.*
Urtica—									
*[urens, *L.*]	–	.	.	L	?	.	.		
*dioica, *L.*	–	.	.	×	×	×	×		
Salix—									
*pentandra, *L.*	–	.	.	.	.	.	×		
*Caprea, *L.*	–	.	.	.	.	.	×		
*nigricans, *Sm.*	–	.	.	.	×	.	×		
*phylicifolia, *L.*	–	.	.	.	×	×	.		
hastata, *L.*	–	T	.	.	.	.	?		
*lanata, *L.*	×	T	Z	×	×	×	×		
*lapponum, *L.*	–	.	.	.	×	×	.		
**var.* glauca, *Sm.*	×	.	.	×	×	×	.	non L. = *S. helvetica,* Vill.	
[*var.* glauca, *L.*]	–	V	Z	.	.	.	.		

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Salix—									
*Wichuræ, *And.*	.	.	.	.	?	.	.	= *phylicifolia* × *glauca.* According to Dr White, "very probably:" an imperfect specimen.	
[ovalifolia, *Trautv.*]	.	.	Z	.	.	.	.	Lund, later.	
norvegica (*Fr.*) *And.*, *var.* alpestris, *And.*	?	.	.	.	.	.	.	"Possibly:" specimen without catkins: = *glauca* × *herbacea.*	
[reptans, *Lundst.*]	.	.	Z	.	.	.	.		
[arctica, *Pall.*]	.	T	Z	.	.	.	.		
[,, polaris, *Lundst.*]	.	.	Z	.	.	.	.		
Myrsinitis, *L.*	×	.	Z	L	×	.	.		
polaris, *Wahl.*	×	V	Z	.	.	.	.	...	Indigenous.
,, *var.* herbaceoides, *And.*	×	.	.	.	.	.	.		
[rotundifolia, *Trautv.*]	D	V	Z	.	.	.	.		
*herbacea, *L.*, *et var.*	–	.	Z	×	.	×	×		
[sarmentacea, *Fr.*]	.	.	.	L	.	.	.	= *hastata* × *herbacea.*	
onychiophylla, *And.?*	×	.	.	.	.	.	.	"Very probably;" only a poor specimen: = *herbacea* × *reticulata.*	
*reticulata, *L.*	?	V	Z	×	.	×	×		
[subarctica and Brownei, *Lundst.*, are also recorded from Novaya Zemlya]								At the Yugor Straits the species were found chiefly along the gravelly and sandy slopes above the beach. The species are almost all of wide range.	
Betula—									
tortuosa, *Led.*	–		.	.	×	×	×	...	Probably this species.
*nana, *L.*	×	T	Z	.	×	×	×	Scarce; doubtful if seen.	
*Orchis maculata, *L.*	–	.	.	.	×	×	.	...	Probably a variety ? *O. lapponica*, Læst.
*Habenaria viridis, *R.Br.*	–	.	.	L	×	×	.		
*[Corallorhiza innata, *R.Br.*]	–	T	.	.	.	.	.	...	Indigenous.
Triglochin—									
*palustre, *L.*	–	.	.	×	.	.	×		
*maritimum, *L.*	–	.	.	×	.	.	×		
*Allium Schœnoprasum, *L.* *var.* sibiricum,	×	.	Z	×	.	×	.	Only three plants seen.	Scarce on island of Vardø.
*Lloydia serotina, *Reich.*	×	V	Z	.	.	.	.	Very abundant in drier places.	
*Tofieldia palustris, *Huds.*	–	.	.	.	×	.	.		
Veratrum album,	×	.	.	.	×	×	.	Seen with *Allium* in one place only.	Abundant at Kølle.
Juncus—									
*[filiformis, *L.*]	–	.	.	L	.	.	.		
*alpinus, *Vill.*	–	.	.	.	.	.	×		
*[castaneus, *Sm.*]	D	.	.	.	.	.	.	...	Indigenous.
stygius, *L.*	–	.	.	×	×	.	.		
*triglumis, *L.*	–	.	.	×	×	×	×		
*biglumis, *L.*	×	V	Z	.	?	.	.		
*trifidus, *L*	–	.	.	.	×	×	×		
Luzula—									
parviflora, *Desv.*	×	T	.	×	×	.	.	...	= *spadicea*, DC.

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Luzula—									
Wahlenbergii, *Rupr.*	D	.	Z	×	×	.	.		
*sudetica, *DC.*	.	.	.	×	×	.	.	...	=*nigricans*, Desv.
*pilosa, *Willd.*	–	.	.	.	×	.	×		
*campestris, *Willd.*, *et var.* congesta,	×	T	.	×	×	×	×		
hyperborea, *R. Br.*	–	V	Z	×	.	.	.		
*arcuata, *Hook.*	?	V	Z	×	×	×	×	...	Described as *Juncus arcuatus* by Wahlenberg.
arcuata confusa, *Lindeb.*	.	V	Z	?	×	.	.		
*spicata, *DC.*	×	.	Z	×	×	.	×		
Eriophorum—									
*angustifolium, *Roth*	D	V	Z	×	×	×	×	...	Probably var. *elatius*, Koch.
*vaginatum, *L.*	×	V	Z	×	×	.	.		
capitatum, *Host*	–	T	.	.	×	×	.		
[callithrix, *Cham.*]	.	.	Z	.	.	.	.		
[russeolum, *Fr.*]	.	V	Z	.	.	.	.		
Scheuchzeri, *Hoppe.*	×	V	Z	.	.	.	.	...	Indigenous.
*alpinum, *L.*	–	.	.	?	.	×	.		
*Carex—									
dioica, *L.*, *var.* subtriangularis.	–	.	Z	×	×	.	.	=*C. parallela*, Læst.	
obtusata, *Lilj.*?	.	.	.	.	×	.	.	...	Very doubtful. In Scandinavia the true plant is only known from Oland.
*[rupestris, *All.*]	–	.	Z	.	.	.	.	...	Indigenous.
[ursina, *Desv.*]	–	V	Z	.	.	.	.		
incurva, *Lightf.*	×	.	Z	×	.	.	.		
[pratensis, *Drej.*]	.	.	Z	.	.	.	.	See Dr Warming's Summary.	
*lagopina, *Wahl.*	–	.	Z	×	×	.	.		
glareosa, *Wahl.*	×	.	Z	×	.	×	.	...	Common in most exposed places.
[norvegica, *Willd.*]	.	.	.	L	.	.	.		
*canescens, *L.*	–	.	.	×	×	×	.	...	Common.
,, vitalis, *Fr.*	–	.	.	×	.	×	.		
Sewellii, *Arth. Bennett et C. B. Clarke.*	.	.	.	×	.	.	.		New species; see note, page 456.
*atrata, *L.*	–	.	.	.	×	.	.		
[misandra, *R. Br.*]	?	.	Z	.	.	.	.	...	Indigenous.
*alpina, *Swartz*	–	.	.	L	.	×	.		
*[salina, *Wahl.*, *et var.*]	–	V	Z	.	.	.	.	...	,,
*vulgaris, *Fr.*	–	.	.	×	×	×	.		
[hyperborea, *Drej.*]	.	.	Z	.	.	.	.	See Dr Warming's Summary.	,,
*[acuta, *L.*]	–	.	Z	.	.	.	.	...	,,
*rigida, *Good.*	×	V	Z	.	.	.	.	Var. *longipes*, in Vega records.	Common.
,, infuscata,	×	.	.	.	.	.	.	Commonest var.	
,, inferalpina, *Læst.*	.	V	.	.	×	.	.	There was also a form less than *frigida*, scarcely *C. Fyllae*, Holm (see Lange *Meddelser Grœnl.*, p. 291).	
*aquatilis, *Wahl.*	×	V	Z	.	×	×	.	Common.	
,, epigeios, *Læst.*	.	T	Z	.	.	.	.		
*pulla, *Good.*	×	.	Z	.	×	×	.		
rotundata, *Wahl.*	×	.	Z	×	×	.	.	Common.	Apparently common.
fuliginosa, *Sch.*	×	.	.	.	.	.	.	...	Indigenous.
*rariflora, *Sm.*	D	.	Z	×	.	×	.		

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Carex—									
cæspitosa (*L.*) *Fr.*	.	.	.	.	.	×	.		
*irrigua, *Sm.*	–	.	.	.	×	×	.	...	=*magellanica*, Lam. (*fide* Boeck).
*capillaris, *L.*	–	.	.	×	×	.	×		
*[vaginata, *Tausch.*]	.	T	.	.	.	.	.	...	Indigenous.
*panicea, *L.*	–	.	.	.	.	.	×		
*Scirpus cæspitosus, *L.*	.	.	.	×		×	.		
*Anthoxanthum odoratum, *L.*	–	.	.	×	.	×	.		
Hierochloe—									
*borealis, *R.* and *S.*	–	.	.	.	.	×	.		
[pauciflora, *R. Br.*]	.	V	Z	.	.	.	.		
[alpina, *R.* and *S.*]	–	V	.	.	.	.	.	...	,,
Alopecurus—									
*pratensis, *L.*, *et var.*	–	.	Z	×	.	×	×		
ruthenicus, *Wein.*	.	.	Z	.	.	.	.		
*alpinus, *Sm.*	×	V	Z	.	.	.	.		
Phleum—									
*pratense, *L.*	–	.	Z	.	.	.	.		
*alpinum, *L.*	–	.	.	×	.	×	.		
*[Agrostis alba, *L.*]	–	.	.	L	.	.	.	...	Probably an alien.
Calamagrostis—									
Hartmaniana, *Fr.*	.	.	.	×	.	.	?		
[lapponica, *Trin.*]	–	V	.	L	.	.	.	...	= sp. q. Wahl.
*lanceolata, *Roth*	–	.	.	L	.	.	×		
[Holmii, *Lge.*]	D	.	.	.	.	.	.		
*[Apera spica-venti, *Beauv.*]	–	.	.	L	.	.	.	...	Probably an alien.
Deyeuxia—									
*neglecta, *Kunth*	.	.	.	×	.	.	×	Altai Mts.	=*Calamagrostis stricta*, Nutt.
*strigosa, *Kunth*	–	.	Z	.	×	.	.	...	= *C. strigosa*, Bunge.
*[Aira alpina, *L.*]	.	.	Z	.	.	.	.	...	Indigenous.
Deschampsia—									
*cæspitosa. *Beauv.*, *et vars.*	–	V	Z	×	×	×	×		
*flexuosa, *Beauv.*	–	.	.	×	.	.	×		
[Koeleria hirsuta, *Gaud.*]	.	V	.	.	.	.	.		
Trisetum—									
*flavescens, *P. B.*	.	V	.	.	.	.	.		
borealis, *Trautv.*	.	.	Z	.	.	.			
sub-spicatum, *Trin.*	–	.	Z	.	.	.	.	...	,,
*Fluminia arundinacea, *Fr.*	×	.	.	.	.	.	.	...	,,
[Dupontia Fischeri, *R. Br.*]	.	V	Z	.	.	.	.		
Colpodium—									
[latifolium, *R. Br.*]	D	V	Z	.	.	.	.	...	,,
[humile, *Lge.*]	.	.	Z	.	.	.	.		
[Pleuropogon Sabinii, *R. Br.*]	.	V	Z	.	.	.	.		
Catabrosa—									
*aquatica, *Beauv.*	–	.	.	×	.	.	×		
,, subtilis,	.	.	.	×	.	.	.		
[concinna, *Th. Fr.*]	.	V	Z	.	.	.	.		
[algida, *Fr.*]	.	V	Z	.	.	.	.		
Poa—									
*pratensis, *L.*, *et vars.*	×	V	Z	×	×	×	×	Var. *paupera*, Lge., in Vega records.	
*[palustris, *Roth*]	.	.	.	L	.	.	.	...	Probably an alien.
*nemoralis, *L.*, *et vars.*	–	.	.	×	×	×	.	...	Probably *glaucantha* and *Parnelii* amongst the varieties.
*laxa,	×	.	.	.	×	.	.		
*alpina, *L.*, *et var.*	×	.	Z	×	.	×	.		
[cenisia, *All.*]	.	V	.	.	.	.	.		
arctica, *R. Br.*	×	V	Z	.	.	.	.	*Poa arctica* and *P. laxa* were commonest in tundra swamps.	

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Poa—									
*annua, *L.*	×	.	.	×	.	×	.		
sp.?	.	.	.	×	.	×	×		
Glyceria—									
[Vahliana, *Th. Fr.*]	.	.	Z	.	.	.	.		
[angustata, *R. Br.*]	.	V	.	.	.	.	.		
[vaginata, *Lge.*]	.	.	Z	.	.	.	.	Var. *contracta.*	
*maritima, *Wahl.*	×	.	.	×	.	.	×	...	Indigenous.
vilfoidea, *Th. Fr.*	–	V	Z	.	.	.	.		
Kjellmanni, *Lge.*	–	V	Z	.	.	.	.		
tenella, *Lge.*	.	.	Z	.	.	.	.	Var. *pumila.*	
Arctophila—									
effusa, *Lge.*	D	V	Z	.	.	.	.		
pendulina, *Ands.*	.	V	.	.	.	.	.		
fulva,	.	V	.	.	.	.	.		
Festuca—									
ovina, *L., et vars.*	×	V	Z	×	×	×	×	Vars. *violacea* and *vivipara*, from Novaya Zemlya, and on north coast Asia.	Vars. *vivipara sylvatica* and *villosa.*
brevifolia, *R. Br.*	.	.	Z	.	.	.	.	= *ovina*, sub. sp. *borealis*, Lange.	
*rubra, *L.*	×	V	Z	.	.	.	.		
sp.?	.	.	.	.	×	×	.		
*[Agropyrum caninum, *Beauv.*]	–	.	.	L	.	.	.	...	Var. *villosus*, also at Tromsø.
*Elymus arenarius, *L.*	×	.	Z	×	.	.	×		
*Juniperus communis, *L.*, **var.* nana.	–	T	.	.	×	×	×		
*Athyrium alpestre, *Nyl.*	–	.	.	×	×	×	.		
* ,, Filix-fœmina, *Bernh.*	.	.	.	.	.	.	×		
Aspidium—									
*dilatatum, *Sw.*	–	.	.	×	×	×	×	...	Luxuriant on one island of group at Vardø.
*Filix-mas,	.	.	.	.	.	.	×		
*Cystopteris fragilis, *Bernh.*	–	.	N	.	×	×	×		
Polypodium—									
*Phegopteris, *L.*	–	.	.	.	×	×	×		
*Dryopteris, *L.*	–	.	.	.	×	×	×		
*[Woodsia ilvensis]	–	.	?	.	.	.	.	...	Indigenous.
*Botrychium Lunaria, *Sw.*	–	.	.	×	.	.	.	...	A very starved form.
Equisetum—									
*arvense, *L.*	×	.	Z	×	×	×	×	Scarce; reduced.	A peculiar form.
*sylvaticum, *L.*	–	.	.	.	×	×	×		
*limosum, *L.*	–	.	.	.	.	×	.		
*variegatum, *Schl.*	×	.	.	.	.	.	.	Only a single poor specimen obtained.	
scirpoides, *Michx.*	–	.	N	.	.	.	.		
Lycopodium—									
*clavatum, *L.*	–	.	.	.	×	.	.		
*annotinum, *L.*	–	.	.	.	×	.	.		
*alpinum, *L.*	–	.	.	.	×	.	.		
*Selago, *L.*	D	.	Z	.	×	.	×		
*Selaginella selaginoides, *Gray.*	–	.	.	×	×	×	×		
*Isoetes lacustris, *L.*	.		.	.	.	×	.		

Galls of Norway. By Prof. J. W. H. TRAIL, A.M., M.D., F.L.S.

(Read 13th June 1889.)

While my paper upon the "Galls of Norway" was in the press last year, a valuable contribution to the same subject, by Dr Franz Loew, was read before the Viennese "Zoologisch-botanisch Gesellschaft" on 2nd May 1888, and was published in the *Verhandlungen* in the course of the summer (vol. xxxviii. pp. 537–48). It bears the title *Norwegische Phytopto- und Entomo-cecidien* (Norwegian Mite- and Insect-Galls), and is based upon materials collected in middle and northern Norway, from 8th July to 3rd August 1886, by Dr Joh. Lütkemüller.

With the view of completing the record in this Society's *Transactions* of what has been published upon the "Galls of Norway," it seems desirable to add a summary of this valuable paper to what has been published by myself last year. The latter included everything that was known to myself upon the subject up to the date at which my paper was written; and Herr Schøyen has recently informed me that, so far as he knows, it was virtually complete up to date, as Herr Brunchorst's work (to which reference was made in a note added to my paper just before publication) contains nothing additional upon the Norwegian galls.

Dr Loew's paper adds largely to mine as regards the localities (the Hardanger Fiord and Trondhjem being the only localities common to both), and also in the kinds of galls found, Dr Lütkemüller having fallen in with a number that were not observed by me, while not a few of mine had escaped his notice,—the result, perhaps, of botanising in different parts of Norway.

The localities referred to in Dr Loew's paper are as follows, the figures after each denoting latitude N.:—

Ulvik, on the Hardangerfjord (60° 35′); Stalheim (60° 51′); Falejde, on the Nordfjord (60° 54′); Merok, on the Geirangerfjord (62° 7′); Molde, on the Moldefjord (62° 44′); Trondhjem, on Trondhjem Fjord (63° 25′); Svartisen, on Holandfjord (66° 45′); Bodö (67° 17′); Lyngseidet, on Lyngenfjord (69° 34′); Tromsö (69° 38′); Hammerfest (70° 37′); North Cape (71° 7′).

The gall-makers, host-plants, and localities are quoted below in full, those not already recorded as Norwegian by myself being indicated by an asterisk.

For convenience of reference, the gall-makers are grouped under the food-plants, as in my paper; but in the original they are arranged into larger groups by the nature of the gall-makers (Mites, Hemiptera, Diptera, Coleoptera, Hymenoptera), the host-plants supplying the arrangements only for subordinate groups.

Cerastium triviale, Link.—Galls of *Trioza Cerastii* (*Trans. Edin. Bot. Soc.*, p. 201). Near Ulvik, Falejde, Merok, Molde, Trondhjem, terminal moraine of Svartisen glacier, Bodö.

Lotus corniculatus, L.—*Galls of *Phytoptus*, consisting of pinnæ rolled and folded upwards, with a white felted coat of hairs below. Near Falejde and Molde.

**Phaca astragalina*, DC.—Galls of a *Cecidomyia*, in the form of pod-like involute leaflets, which are yellowish-green and somewhat thickened, and are smooth inside. On the moraine of the Svartisen glacier.

Vicia Craeca, L.—Galls of a *Cecidomyia*, probably of *C. Viciæ* (*loc. cit.*, p. 205). Near Lyngseidet.

Prunus Padus, L.—Galls of a *Phytoptus*, called *Ceratoneon attenuatum*, Bremi (*loc. cit.*, p. 205). Near Ulvik, Merok, Molde, and Trondhjem.

Spiræa Ulmaria, L.—Galls of *Cecidomyia Ulmariæ*, Bremi (*loc. cit.*, p. 205). Near Trondhjem and Lyngseidet.

**Rubus saxatilis*, L.—Galls of *Phytoptus*, in the form of a *Cephaloneon*. Were common on the Kristiansten, east of Trondhjem.

**Geum rivale*, L.—Galls of *Phytoptus* (*Phyllerium gei*, Fr., or *Erineum gei*, similar to those recorded by myself (*loc. cit.*, p. 206) from *Geum urbanum*, near the Buarbræ), on one plant near Trondhjem.

* *Alchemilla vulgaris*, L.—Galls of *Phytoptus*, producing a radial folding and consequent constriction of the leaves. At Tromsö, and on the North Cape.

**Rosa carelica*, Fr.—Galls of *Cecidomyia rosarum*, Hardy, in the form of inflated conduplicated dark purple-red pinnæ. Near Ulvik and Trondhjem.

**Cratægus Oxyacantha*, L.—Galls of an aphis, *Myzus oxyacanthæ*, Koch, formed tumour-like outgrowths of a purple-red colour on the leaves. Near Tromsö.

**Sorbus aucuparia*, L.—(1) Galls of a *Phytoptus*, known as *Erineum sorbeum*, Pers., on both surfaces of the pinnæ, on which they form a whitish or yellowish-white or rusty brown coat. On the Gjetfjeld, near Trondhjem.

(2) The middle of the lower surface of each pinna is covered with a coat of very long and very slender colourless hairs, which shelter a few small greyish gall-mites. Near Trondhjem.

Sedum Rhodiola, DC.—Galls of a *Phytoptus* recorded by myself (*loc. cit.*, p. 206). On the morraine of the Svartisen glacier and on the North Cape.

**Saxifraga aizoides*, L.—Galls of *Phytoptus*, deforming the tips of the shoots. On the moraine of the Svartisen glacier.

**S. oppositifolia*, L.—Galls of *Phytoptus*, changing the flowering shoots into pale green rosettes of wrinkled leaves, among which there live orange-yellow mites.

Galium boreale, L.—*(1) Galls of *Cecidomyia Galii*, H. Loew, in the form of ob-pyriform swellings of stems and peduncles just above the leaf-whorls, varying in size from a hemp-seed to a pea. On the Gjetfjeld, near Trondhjem. This gall has been recorded from Scotland by myself (*Trans. N. H. Soc. Aberd.*, 1878, p. 63A).

(2) *Galls of *Cecidomyia galiicola*, F. Loew, consisting of the clustered leaves of the whorls close to the tips of the shoots, the leaves being broader and shorter than usual. Near Bodö. Dr Loew believes that galls recorded by Mr F. Binnie and by myself from Scotland belong to this insect.

(3) Galls of *Phytoptus* on the leaves. Near Trondhjem, and at Bodö. Recorded by myself (*loc. cit.*, p. 208) from near Eide, and on Deeside in Scotland.

Campanula rotundifolia, L.—Ovaries galled by *Miarus* or *Gymnetron Campanulæ*. Common near Ulvik and at Falejde; recorded by myself (*loc. cit.*, p. 210) from Odde.

* *Veronica officinalis*, L.—Virescence of the flowers, caused by *Phytoptus*. The axis of the flower may be shortened, and the colour may be entirely greenish or dark purple-red, with reddish-green stamens.

Populus tremula, L.—*(1) Galls of the midge *Diplosis tremulæ*, Winnertz, on the leaf-blades, leaf-stalks, or twigs. Near Trondhjem. They appear on the leaves as rounded sessile galls of a yellow or red colour, and about as large as a small pea, but on the twigs they are hemispherical, and resemble the latter in colour. Dr Loew points out that these galls were reported by Herr Frauenfeld from Levanger on the Trondhjem Fiord (*Verh. Z. B. Ges. Wien*, 1863, p. 1169).

*(2) On leaves, as hempseed-sized, roundish, compact, one-chambered, dark purple-brown galls, on the upper surface of the leaf, the galls opening below. Found near Trondhjem. This is most likely the work of a gall-midge.

*(3) Galls of *Phytoptus* (*Erineum populinum*, Pers.), on the lower surface of the leaves of *Populus tremula*, in the form of patches of short hairs. Near Molde.

**Salix pentandra*. L.—Galls of *Phytoptus*, as outgrowths from the surface of the leaves, rather warty, and purple-red or yellowish on the upper surface, all parts hairless, but the walls of the cavity lined with warty, naked excrescences. At Lyngseidet.

**S. purpurea*, L.—Galls on leaves formed by *Nematus ischnocerus*, Thoms. Near Lyngseidet. I recorded the galls of this species from *S. ? phylicifolia* (L.) from the Simodal (*loc. cit.*, p. 212).

**S. hastata*, L.—*(1) Galls of *Nematus salicis-cinereæ*, Retz. From the moraine of the Svartisen glacier; the gall was recorded by me on *S. nigricans*, Sm., near Vik, and in the Simodal (*loc. cit.*, p. 212).

*(2) Globular galls (5–8 mm. diam.) on lower surface of the leaf; probably the work of *Nematus bellus*, Zadd. At Lyngseidet and near Tromsö.

*(3) Swellings (8–20 by 6–8 mm.) of the twigs; the work of *Cecidomyia salicis*, Schrk. Near Tromsö.

*(4) Galls of *Phytoptus* on leaves, of the size of a hempseed or poppy-seed, and belonging to type known as *Cephaloneon;* they project from the lower surface of the leaf. Moraine of the Svartisen glacier.

S. caprea, L.—*(1) Galls of *Nematus gallicola*, Westw., in the leaves. At Stalheim, near Gudvangen; and at Merok. This insect is recorded in Siebke's *Enumeratio Insectorum Norvegicorum*.

(2) Leaf-galls of *Nematus bellus*, Zadd. Once near Lyngseidet.

(3) Leaf-galls of *Hormomyia capreæ*, Winn. Near Tromsö.

Recorded by myself (*loc. cit.*, p. 210) from Christiania and Odde.

**S. herbacea*, L.—*(1) Leaf-galls of *Nematus herbaceæ*, Cam., in the form of irregularly rounded deep red or dark green pea-sized outgrowths. On a hill at Hammerfest. Common on Scotch mountains.

*(2) Densely-haired clubbed tips of twigs, tenanted by *Phytoptus*. Along with the last gall.

**Betula pubescens*, Ehrh., bore *Erineum tortuosum*, Grev., the work of *Phytoptus*, in the form of clusters of yellowish-white felted hairs on both surfaces of the leaves. Near Lyngseidet, and near Tromso.

B. verrucosa, Ehrh.—(1) Galls of *Phytoptus*, known as *Erineum betulinum*, Schum, on leaves. Near Falejde. Recorded by myself (*loc. cit.*, p. 213) from Eide, Trondhjem, and Christiania.

(2) Galls of *Phytoptus* in form of small warts in the leaves. Near Falejde. Recorded by myself with the last.

Alnus glutinosa, L.—Galls of *Phytoptus* (*Cephaloneon pustulatum*, Bremi). On a hill near Falejde.

A. incana, DC.—(1) Galls of *Phytoptus* (*Cephaloneon pustulatum*, Bremi) on leaves. Near Falejde and Merok. Recorded by myself (*loc. cit.*, p. 214) from near Eide and Christiania.

(2) *Erineum alnigenum*, Link, on leaves. Near Falejde, Merok, Trondhjem, and Lyngseidet. Recorded by me (*loc. cit.*, p. 213) from Eide and Christiania.

Juniperus communis, L.—Galls of *Hormomyia juniperina*, L., on the twigs. Near Ulvik and Falejde. Recorded by me (*loc. cit.*, p. 214) from Oifiord in Hardanger.

NOTE.—In the *Berliner Entomol. Zeitschrift*, 1889, vol. xxxiii. pp. 55–57, Herr Rübsaamen describes, under the name of *Cecidomyia tiliamvolvens*, sp. n., a midge reared from galled leaf margins of *Tilia parvifolia*, found by him at Siegen; and (*loc. cit.*, p. 57) he attributes to the same insect the similar galls described by me from Eide (*Trans. Bot. Soc. Edin.*, 1888, p. 203).

Enumeration of Fungi collected in Hardanger in 1887. By Prof. JAMES W. H. TRAIL, A.M., M.D., F.L.S.

(Read 9th May 1889.)

In the subjoined list are enumerated all the species of microscopic fungi collected by myself in the Hardanger district of Bergen, in Norway, during the excursion to that district of the Scottish Alpine Botanical Club in the month of August 1887. The lists of Phanerogams collected by the members who took part in the excursion has been already published in the *Transactions*, followed by a paper by myself on the Galls of Norway; but I found it impossible to work out a list of the fungi in time to accompany these papers, as the specimens have required careful, and often continued study, to permit of satisfactory determination. Even yet certain species remain undetermined (and are not at present referred to), owing to imperfect or unsatisfactory specimens alone having been found. Not being aware of the existence of any complete list of Norwegian fungi, it has seemed to me the better course to mention each species met with by me. It will be observed that I venture to regard a few as new discoveries, and to name and describe them under this belief. The localities are the same as those mentioned in the lists above referred to, viz.—(1) From Odde up the Jordal to the Buarbræ glacier; (2) near Eide and Graven; (3) around Vik, and from Ojfjord to the Vøringfos; (4) the Simodal; (5) a small marsh at the head of the Skjervet, on the way from Eide to Vossevangen.

I have to express my obligations to Mr W. Phillips, who, with his usual kindness, named for me the Discomycetes. In general aspect the assemblage of forms is very much like what one might find under similar conditions in Scotland; though including species not met with in Scotland, as is to be expected from the presence in Norway of host plants either unknown or very rare as natives of Britain.

MYXOMYCETES.

Lycogala epidendrum, Buxb., on rotten wood. Vik.

MUCEDINEÆ.

Mucor Mucedo, L., var. **caninus**, Pers., on dog's dung. Jordal.

PERONOSPOREÆ.

Peronospora Alsinearum, Casp., on *Stellaria media*. Near Vik.

P. Trifoliorum, De Bary, on *Lotus corniculatus*. Graven.

Physoderma Menyanthidis (De Bary), Schr., on *Menyanthes trifoliata*. The Skjervet, near Graven.

Protomyces macrosporus, Unger, on *Angelica sylvestris*, Jordal; and *A. Archangelica*, Simodal.

Entorrhiza Aschersoniana, Magn. (= *E. cypericola*, Magn., *p.p.*), in tumours on roots of *Juncus bufonius*. Jordal.

USTILAGINEÆ.

Entyloma Calendulæ, Oud., in leaves of *Hieracium* (?) *vulgatum*, at Odde and Vik, and in the Simodal.

Ustilago segetum (Bull.), Dittm., abundant on *Avena sativa*, *Hordeum distichum*, and *H. hexastichum*, at Odde, &c.

U. vinosa (Berk.), Tul., in flowers of *Oxyria digyna*. Simodal.

U. violacea (Pers.), Fckl., in flowers of *Silene rupestris*. Jordal.

UREDINÆ.

Uromyces Trifolii (Hedw.), Lev., on leaves of *Trifolium repens*. Jordal.

U. Geranii (DC.), Otth. and Wartm., on leaves of *Geranium sylvaticum*. Jordal and Simodal.

U. Valerianæ (Schum.), Fckl. (as *uredospores* on *Valeriana officinalis*). Graven and Simodal.

U. Acetosæ, Schrœt., on leaves of *Rumex Acetosa*. Simodal.

U. Aconiti-Lycoctoni (DC.), Winter, on leaves of *Aconitum septentrionale*, between Ojfjord and the Vøringfos.

U. Alchemillæ (Pers.), Fckl. (= *U. intrusa*, Lev.), on leaves of *Alchemilla vulgaris*. Common.

Puccinia Violæ (Schum.), DC., on leaves of *Viola* (?) *sylvatica*. Common.

P. Menthæ, Pers., on *Calamintha Clinopodium*. Graven.

P. Galii (Pers.), Schw., on *Galium verum*. Near Vik.

P. Prenanthis (Pers.), Winter, on leaves of *Lactuca alpina*. Between Ojfjord and the Vøringfos.

P. Hieracii (Schum.), Mart., on leaves of *Cirsium heterophyllum*, generally distributed; and of *Hieracium*, in Jordal.

P. variabilis, Grev., on leaves of *Taraxacum officinale*. Odde.

P. Pimpinellæ (Strauss), Lk., on leaves of *Anthriscus sylvestris*. Simodal.

P. Poarum, Niels., on *Poa trivialis*, and Æcidium Tussilaginis on *Tussilago Farfara*. Simodal.

P. Bistortæ (Strauss), DC., on *Polygonum viviparum*. Jordal.

P. Oxyriæ, Fckl., on leaves of *Oxyria digyna.* Simodal.

P. Acetosæ (Schum.), Winter, on *Rumex Acetosa.* Jordal and Simodal.

P. Morthieri, Körn, on leaves of *Geranium sylvaticum.* Simodal.

P. Arenariæ (Schum.), Schr., on *Lychnis diurna* in the Simodal, and on *Stellaria nemorum* at Graven.

P. gigantea, Karst., on leaves of *Epilobium angustifolium.* Simodal.

Gymnosporangium juniperinum (L.), Fr., as **Rœstelia cornuta**, Fr., on leaves of *Pyrus Aucuparia.* Simodal.

Phragmidium Rubi (Pers.), Winter, on *Rubus saxatilis.* Ojfjord.

P. subcorticium (Schr.), Winter, on *Rosa canina.* Eide, Vik, Simodal.

P. Rubi-Idæi (DC.), Karst., on *Rubus Idæus.* Simodal.

Melampsora farinosa (Pers.), Schr., as **Uredo**, on *Salix caprea.* Abundant.

M. betulina (Pers.), Tul., as **Uredo**, on *Betula alba.* Jordal.

M. Vacciniorum (Lk.), Schrœt., on **Uredo**, as *Vaccinium Myrtillus* and *V. uliginosum.* Odde and Simodal.

Coleosporium Campanulæ (Pers.), Lev., on *Campanula rotundifolia.* Odde, Eide.

Uredo Polypodii (Pers.), DC., on *Polypodium Dryopteris.* Jordal, Eide, Simodal. On *Cystopteris fragilis.* Simodal.

Exoasceæ.

Exoascus Potentillæ (Farlow), on *Potentilla Tormentilla.* Jordal.

Pezizeæ.

Peziza Oocardii, Kalchbr., on rotten wood. Vik.

Chlorosplenium æruginosum (Fl. Dan.), Tul., in branch of *Corylus Avellana.* Graven.

Hymenoscypha coronata (Bull.), on dead stems of *Lactuca alpina.* Between Ojfjord and the Vøringfos.

H. scutula (Pers.), on dead stems of *Spiræa Ulmaria.* Graven.

H. cyathoidea (Bull.), on dead stems of *Lychnis diurna*, *Anthriscus sylvestris*, *Angelica Archangelica*, and *Rumex Acetosa.* Simodal.

Mollisia cinerea (Batsch), on dead bark and wood. Graven and Vik.

M. atrata (Pers.), *f.* **Ranunculi**, on dead stems of *Ranunculus aconitifolius.* Simodal.

M. Trifolii (Bernh.), on living leaves of *Trifolium pratense.* Jordal.

Lachnella relicina (Fr.), on dead stems of *Lactuca alpina.* Between Ojfjord and the Vøringfos.

Lachnella *sp.*, on dead stems of *Epilobium angustifolium.* Simodal.

[Mr Phillips is inclined to regard this as probably a new species, and suggests for it the name of L. Epilobii.]

Ascobolus immersus (Pers.), on dung. Simodal.

Ascophanus ciliatus (B. and Br.), with the last, on dung.

PHACIDIACEÆ.

Rhytisma salicinum (Pers.), Fr., on leaves of *Salix.* Near Vik.

R. Andromedæ (Pers.), Fr., on leaves of *Andromeda polifolia.* The Skjervet.

R. (?) Pedicularis, DC. On leaves of *Bartsia alpina*, in the Simodal, there occurred plentifully dark spots of the usual Rhytismoid type, but barren. They agreed well with De Candolle's brief description of *R. Pedicularis* from Mont Cenis.

HYSTERIACEÆ.

Hysterographium Fraxini (Pers.), De Not., on twigs of *Fraxinus excelsior.* Graven.

Lophodermium arundinaceum (Schrad.), Chev., on *Calamagrostis Epigeios.* Vik.

L. Epimedii (Ces.), Sacc. On dead herbaceous stems, which I believe belong to *Origanum vulgare*, I found a *Lophodermium* that agrees so well with the description of *L. Epimedii* in the "Sylloge" (ii. p. 796), and with the figure in "Fungi Italici" (124), that I cannot but refer it to this species.

Hypoderma virgultorum, DC., on stems of *Rubus Idæus.*

HYPOCREACEÆ.

Polystigma ochraceum (Wahlb.), Sacc., on leaves of *Prunus Padus.* Abundant.

Claviceps purpurea (Fr.), Tul. The sclerotium was large and plentiful on rye and barley at Ojfjord and in the Simodal.

Epichloe typhina (Pers.), Tul., on a grass. Graven.

LOPHIOSTOMACEÆ.

Lophiostoma vagans, Fabré, on dead stems of *Lactuca alpina.* Between Ojfjord and the Vøringfos.

SPHÆRIACEÆ.

Phomatospora Berkeleyi, Sacc., on dead stems of *Campanula latifolia* and of *Lychnis diurna*, in the Simodal.

Bombardia fasciculata, Fr., on dead wood. Graven.

Hypoxylon fuscum, Fr., on dead branch of *Corylus Avellana*. Vik.

Sphaerella recutita (Fr.), C. and De Not., on dead leaves of *Deschampsia cæspitosa*. Jordal.

S. Asplenii, Awd., in dead fronds of *Asplenium septentrionale*. Graven.

Venturia Alchemillæ (Grev.), B. and Br., on leaves of *Alchemilla vulgaris*. Jordal.

Leptosphæria Dumetorum, Niessl, var. **Galii-borealis**. On dead stems of *Galium boreale*, at Vik. This differs from Niessl's type chiefly in its smaller size. *Perithecia* about 140 μ in diameter; *asci* 40–50 by 6–8 μ, clavate, or cylindrical with a short stalk; *sporidia* 2- or 3-rowed, each measuring 12–15 by $2\frac{1}{2}$–3 μ, pale brown, 3-septate, second cell slightly or not at all larger than the neighbouring cells. In other respects this agrees with the type.

L. quadriseptata, *sp. n.* On dead stems of *Thalictrum minus*, *Valeriana officinalis*, *Lactuca muralis*, and *Rumex Acetosa*. Jordal and Vik. *Perithecia* scattered, covered by the epiderm, globose $\frac{1}{4}$–$\frac{1}{3}$ mm. in diameter, ostiole short; *asci* 8-spored, sub-clavate, stalked, 60–80 μ by 8–9 μ; *sporidia* distichous or tristichous, fusiform, often inequilateral and curved, always 4-septate, second cell protuberant, 23–32 μ by 4–5 μ, pale brown; sometimes each cell is guttulate; *paraphyses* numerous, slender, hyaline, pluriguttulate, longer than the asci. Seems to approach nearest to *L. fœniculacea*, Fabré; but is remarkably constant in its characters on all the above food plants.

L. dolioloides (Awd.), Karst., on dead stems of *Achillea Millefolium*. Vik.

L. Silenes-acaulis, De Not., on *Silene acaulis*. Simodal.

L. culmicola (Fr.), Karst., on a dead grass. Vik.

L. culmifraga (Fr.), Ces. and De Not., on *Deschampsia cæspitosa*. Jordal.

Sphærulina intermixta (B. and Br.), Sacc., on twigs of *Rosa canina*. Jordal.

Metasphæria Empetri (Fr.), Sacc., on *Empetrum nigrum*. Odde and Vik.

Pleospora Andropogonis, Niessl, var. **Actææ**, an *sp. nova*. On dead stems of *Actæa spicata*, in Jordal, I found a *Pleospora*, which comes so near *P. Andropogonis*, Niessl, that, despite the difference of host plants, I can find no sufficient specific distinction; though, as both asci and sporidia are smaller, it may deserve a varietal name as above. It differs from Niessl's description thus:—*Perithecia* × 220 μ; *asci* 75–85 × 14–15 μ, with a short stalk; sporidia ellipsoid with rounded ends, 15–16 × 7–8 μ, brown, triseptate, usually one or both of the middle loculi show a longitudinal septum, as in type.

P. media, Niessl, on dead phyllaries of *Cirsium heterophyllum*, and on dead stems of *Oxyria digyna*. Jordal.

P. dura, Niessl, on dead stems of *Lychnis diurna*. Simodal.

P. rubicunda, Niessl, on dead stems of *Ranunculus aconitifolius*. Simodal.

Pryenophora hispida (Niessl), Sacc., on dead stems of *Sedum annuum*. Odde.

Ophiobolus porphyrogonus (Tode), Sacc., on dead stems of *Aconitum septentrionale* and of *Lactuca alpina*. Between Ojfjord and the Vøringfos.

O. immersus, Trail, sp. n., on dead stems of *Campanula latifolia*, in the Simodal. *Perithecia* scattered, immersed in fuliginous patches in the woody tissues, only a short ostiole appearing; *asci* 8-spored, cylindrical, 70 × 6 μ; *sporidia* 50–60 × 2 μ, pluriguttulate (sometimes appearing pluriseptate), hyaline. *O. immersus* was found in stems of *Urtica dioica* in September 1888.

PERISPORIACEÆ.

Sphærotheca Castagnaei, Lev., on *Geranium sylvaticum*, *Alchemilla vulgaris*, and *Potentilla Tormentilla*. Jordal and Simodal.

S. Epilobii (Link.), Sacc., on *Epilobium*. Jordal.

Podosphæra tridactyla (Walbr.), De Bary, on *Prunus Padus*. Simodal.

P. Oxyacanthæ (DC.), De Bary, on *Pyrus Aucuparia*. Odde.

P. myrtillina (Schubert), Kze., on *Vaccinium Myrtillus*, and on *V. uliginosum*. Odde.

Erysiphe Martii, Lev., on *Hypericum dubium* and on *Galium Aparine*. Jordal and Vik.

E. communis (Walbr.), Fr., on *Ranunculus aconitifolius*, *R. repens*, and *Centaurea scabiosa*. Odde and Vik.

E. Galeopsidis, DC., on *Galeopsis Tetrahit*. Vik.

E. Cichoracearum, DC., on *Valeriana officinalis* and *Verbascum nigrum*. Simodal and Ojfjord.

Microsphæra divaricata (Walbr.), Lev., on *Rhamnus Frangula*. Graven.

M. Alni (DC.), Winter, on *Alnus incana*. Odde.

HYMENOMYCETES.

Corticium incarnatum (Pers.), Fr., on dead branches of *Corylus Avellana*. Vik.

Pistillaria ovata, Fr. On dead stems of *Lactuca alpina*, near the Vøringfos, I found what appears to be this species, though not quite typical in form.

Exobasidium Vaccinii, Wor., on *Vaccinium Myrtillus*, at Odde, and on *V. uliginosum*, in the Simodal.

Sclerotium semen, Tode, on dead stems of *Oxyria digyna*. Jordal.

HYPHOMYCETES.

Ovularia haplospora, Speg. (*O. pusilla*, Sacc., nec *Ramularia pusilla*, Unger), on *Alchemilla vulgaris*. Jordal.

O. obliqua (Cooke), Oud., on *Rumex*. Skjervet.

Ramularia agrestis, Sacc., on *Viola tricolor*. Vik.

R. didyma, Unger, on leaves of *Ranunculus repens*. Skjervet.

R. gibba, Fckl., on leaves of *Ranunculus repens* and *R. acris*. Simodal (conidia $20–40 \times 1\frac{1}{2}–2\frac{1}{2}\ \mu$).

R. Valerianæ (Speg.), Sacc., on *Valeriana officinalis*. Graven and Vik.

R. Taraxaci, Karst., on *Taraxacum officinale*. Jordal.

R. variabilis, Fckl., *Digitalis purpurea*. Near Odde.

R. Urticæ, Ces., on *Urtica urens*. Vik.

R. Oxyriæ, sp. n., on leaves of *Oxyria digyna*, in the Simodal. Spots amphigenous, circular or oval, 2–3 mm. across, pale or nearly white, surrounded by a broad border, which is at first dull green, then red-brown, conidia hyaline, cylindrical, slightly curved or bent, ends obtuse, 70–90 by $2–2\frac{1}{2}\ \mu$, 3–4-septate, on slender hyphæ.

Bostrichonema alpestre, Ces., on *Polygonum viviparum*. Vik and Simodal.

B. modestum (B. and B. White), Sacc., on *Alchemilla alpina*. Jordal and Skjervet.

Acrothecium parvisporum (Pr.), Sacc., on dead stems of *Campanula latifolia*. Simodal.

Fusicladium depressum (B. and Br.), Sacc., on *Angelica sylvestris*. Vik and Simodal.

Coniothecium complanatum (Nees), Sacc., on dead stems of *Ranunculus aconitifolius*. Simodal.

Isariopsis Stellariæ, Trail, on *Stellaria nemorum*. Graven.

SPHÆROPSIDEÆ.

Phyllosticta Geranii, sp. n. On leaves of *Geranium sylvaticum*, in the Simodal. Spots hypophyllous, effused, brown; *perithecia* spherical, sub-dermal, scarcely papillate, 60–80 μ in diameter, very thin, pale brown; sporules ellipsoid, $2–2\frac{1}{2}\ \mu \times \frac{3}{4}–1\ \mu$, hyaline.

P. Tiliæ, Sacc. and Speg., on *Tilia parvifolia.* Eide.

Phoma herbarum, West., on *Alchemilla alpina.* Vik.

P. complanata (Tode), Desm., on *Angelica sylvestris.* Simodal.

P. cylindrospora (Desm.), Sacc., on dead leaves and stems of *Linnæa borealis.* Vik. (Pycnidia 100 μ in diameter; sporules 13–17 × 2–2½ μ.)

Vermicularia liliacearum, West., on *Smilacina bifolia.* Skjervet.

Cytispora rhodophila, Sacc., on twigs of *Rosa canina.* Jordal.

Coniothyrium Fuckelii, Sacc., on twigs of *Rosa canina.* Jordal.

Septoria Hyperici, Desm., on *Hypericum dubium.* Graven. (Sporules 28–30 × 2μ, hyaline, 4–6-septate.)

S. cerasina, Peck. On dying leaves of *Prunus Padus*, at Graven, there occurred a *Septoria* so entirely agreeing in its characters with Peck's description that I do not venture to regard it as distinct from his species, though that occurred on *Prunus serotina* in New York State. The sporules of the Norwegian examples measure 50 × 2½ μ, are curved and obtuse, and show no septa.

S. Tormentillæ, Desm., on *Potentilla Tormentilla.* Jordal.

S. Fuckelii, Sacc., on *Tussilago Farfara.* Jordal.

S. Menyanthes, Desm., on *Menyanthes trifoliata.* Skjervet.

S. Lysimachiæ, West., on *Lysimachia vulgaris.* Graven.

S. Galeopsidis, West., on *Galeopsis Tetrahit.* Odde.

S. Stachydis, R. and D., on *Stachys sylvatica.* Graven.

S. Prunellæ, Trail, on *Prunella vulgaris.* Jordal.

S. Rumicis, sp. n. On leaves of *Rumex Acetosa*, near Eide. Spots circular or nearly so, 4–6 mm. across, pale rufous, with a narrow darker border; *pycnidia* epiphyllous, lenticular, opening by a central pore, thin, pale brown, 90–100 μ in diameter; *sporules* cylindrical, somewhat curved, ends obtuse, 24–32 μ × 2½ μ, 1–2-septate, hyaline.

Rhabdospora Artemisiæ, sp. n. On dead stems of *Artemisia vulgaris*, at Graven. *Pycnidia* scattered uniformly but very profusely over the stems, globular, 130–140 μ in diameter, ostiole prominent, piercing the epiderm; *sporules* fusiform-filiform, straight or slightly curved, 8–15 × 1 μ, pluriguttulate, hyaline.

Leptothyrium alneum (Lev.), Sacc., on leaves of *Alnus incana.* Odde.

L. Rubi (Duby), Sacc., on *Rubus Idæus.* Simodal.

Leptostroma Spiraeæ, Fr., on *Spiræa Ulmaria.* Graven.

L. virgultorum, Sacc., on *Rubus saxatilis.* Graven.

MELANCONIEÆ.

Glaeosporium Ribis (Lib.), M. and D., on *Ribes Grossularia.* Simodal.

Melanconium sphæroideum, Lk., on *Alnus incana.* Vik.

Marsonia Potentillæ (Desm.), Fisch., on *Potentilla Tormentilla.* Jordal.

M. Salicis, sp. n. On living leaves of *Salix*, in the Simodal. *Pustules* epiphyllous small, warty, scattered, or massed in smaller or larger groups, dull brown; *conidia* $10–12 \times 2\frac{1}{2}–3\ \mu$, fusiform or clavate, nearly straight, or more often falcate and acute at the tip, hyaline, basal cell much the smaller of the two; basidia minute.

Coryneum microstictum, B. and Br., on twigs of *Rosa canina.* Jordal.

Cylindrosporium niveum, R. and B., on *Caltha palustris.* Simodal.

Note on the Fertilisation of Aspidistra elatior *by Slugs.* By JOHN WILSON, D.Sc., University of St Andrews.

(Read 10th January 1889.)

The flowers of this very common decorative plant rise from subterranean rhizomes, and open immediately above the surface. Their bases are often half sunk in the soil, and they have frequently been mistaken for fungi by the uninitiated. In large plants, under artificial cultivation at least, many of the crowded rhizomes lie above the surface. Protection is afforded the flower by a series of papery bracts (fig. 1, *br*). The hue of the interior of the perianth is brownish-purple, the upper inner edges of the lobes being orange. The outside is freely spotted with purple. The stigma (fig. 1, *r*) roofs over the whole throat of the flower, and is dingy reddish-purple. It is deeply sulcate, the eight sulci (fig. 1, *s*) radiating with considerable regularity from the centre. They terminate near the centre in small hollows or tunnels, which, having usually yellow areas at the endings, are suggestive of having been carved out by slugs. The same remark

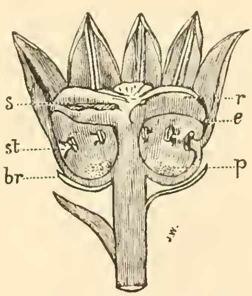

FIG. 1.—Section of Flower of *Aspidistra elatior*, nat. size.

applies to the orange margins of the perianth lobes. The furrows and ridges of the elevated radii (fig. 1, *r*) of the stigma correspond with those on the face of the segments opposite. The epidermis of the sulci is rendered detentive by the papillæ, a few cells high, universally distributed there. The eight stamens (fig. 1, *st*) are situated beneath the radii, that is, opposite the segments, and project nearly horizontally from the wall of the cavity of the flower. The whole stigma is rigid, in the newly-expanded flower, and the incurved margins (fig. 1, *e*) are then so adherent to the adjacent walls that an attempt to separate them leads to rupture, and removal of a small triangular portion of stigmatic tissue. In the flowers examined originally the stigma exhibited no apertures leading into the cavity beneath. The whole superficial tissue of the stigma and inner faces of the perianth lobes is thickly beset with raphides, in all probability to prevent surreptitious entrance by perforation. The walls of the cavity are extremely smooth and glassy, forming such a place as a slug might find pleasure in exploring. At an early stage the pollen, which is very abundant and powdery, is shed, and rolls to the bottom of the cavity (fig. 1, *p*).

Looking at a case in which the stigma is imperforate, the pollen cannot be reached until the stigma becomes flaccid and free at the margins. In a certain time, dependent on success of fertilisation and other causes, this takes place. If a slug now enters, it cannot fail to have the greater part of its body covered with pollen. It has been observed that much pollen remained in even very withered flowers. Finding exit, and proceeding to a fresh flower, the slug will pry about the sulci of the stigma and deposit the carried pollen there, thus performing cross-pollination.

The belief that slugs are the agents employed in the fertilisation of this species was strengthened by the discovery of a few flowers with their small slimy visitants inside. Experiments with the slugs did not demonstrate anything beyond this, that they creep about the grooves in quest of a hole, and when they find it (although small and even artificially formed for them), they descend by it into the cavity of the flower.

Since the above note was brought before the Society, opportunity has been taken of making further observations, and of reading Hildebrand's paper on F. Delpino's "Weitere Beobachtungen über die Dichogamie im Pflanzenreich," in *Bot. Zeit.*, Jahrg. xxviii., 1870, which contains (p. 588) a discourse on our plant. Flowers were met with, having four equidistant apertures at the margins of the fresh stigmas (in front of alternate segments) leading into the pollen-chamber. These vary from a mere pin-hole or slit to an opening capable of admitting a young slug. The presence of these apertures does not necessitate any alteration of the views previously maintained. Slugs are still clearly the best adapted agents in the case. Of course, the possibility of self-pollination is here greatly increased during the exit of the slug. The pollen, however, first deposited on the stigma is in many cases likely to be that brought from another flower. Delpino describes a flower having the four little openings by which small *Mücken* (gnats or craneflies), "probably the pollinating insects," pass. He did not actually find them in the cavities, but noticed what he considered traces of their visits in flowers three or four days open, not only the margins of the openings being smeared with pollen, but also tracks of it being present in their vicinity. Further, he seems to have observed that a small spider had spun over the stigma a web with threads so fine that they could not be detected unless by means of the pollen grains adhering to them, and he regards this as favouring the view that insects are frequent visitors.

All this may reasonably be demurred to. Insects of the kind indicated are not adapted in any respect whatever for the work ascribed to them. As to the spider's webs, it may be held as certain that the fine threads seen by Delpino correspond to those often seen during the course of the present observations, which were simply very delicate filaments of mucus, with pollen-grains entangled, left by a slug in its peregrinations.

The significance of the heteromorphic condition of the stigma (that is, with or without apertures) is not evident. It may be surmised that the tendency of modification is towards the complete closing in of the pollen chamber by the stigma.

Note on a Sweet Substance called Manna, from a species of Astragalus *growing in Persia, and on the Manna of* Alhagi maurorum. By A. GALLETLY.

(Read 11th April 1889.)

At Ispahan, in Persia, a favourite sweetmeat, called "gez angubeen," is made from a substance which is known by the name of "gez," mixed with sugar, almonds, and pistachio nuts. This sweetmeat is sent all over the country, and is believed to have been in use for a long period of time. The gez is one of the substances known as manna. It is an exudation from a species of *Astragalus* growing in the hilly district of Feridoon, 100 miles west of Ispahan and about 8000 feet above the sea. The gez plant is found over a considerable area in Persia, but it is only in this district where the gez or manna is gathered in quantity, and only at Ispahan where this particular sweetmeat is made.

The so-called manna or gez is a honey-like substance, but remarkably viscid and sticky, so that it cannot be easily transferred from one vessel to another. It consists chiefly of uncrystallisable glucose or fruit sugar and contains no mannite, at least it can contain little more than a trace of this substance. There is also present a considerable quantity of what appears to be gum or mucilage, and it contains 8 per cent. of water. The sawdust of the stem of the dried plant contains about 10 per cent. of matter soluble in water. This has the marked taste of liquorice, so that it is probably liquorice sugar. The gathered gez or manna has not the same flavour as the sweet matter from the sawdust.

A branch of the gez plant is on the table. It was sent to Sir R. Murdoch Smith by a friend at Ispahan, but unfortunately it has neither leaves nor flowers, so that only the genus can be made out. It is probably either *Astragalus florulentus* or *A. adscendens*, from both of which "manna" is obtained in Persia.

The manna from the widely-spread shrub *Alhagi maurorum* is well known. The plant occurs in Greece, Asia Minor, Persia, India, and Egypt, extending far south into Africa. This sweet substance is often called Persian manna and also camel-thorn manna. It is obtained in dry, brittle tears. Some botanical books state that it possesses the same properties as the officinal manna from *Fraxinus Ornus*. But the Alhagi manna is plainly a quite different substance. It dissolves in alcohol, giving crystals of cane sugar, and it appears to consist largely of this sugar. There is, however, mannite present in it also, as shown by the violet colour of the solution obtained by dissolving the manna in water, then adding a few drops of sulphate of copper and a little caustic potash. But the mannite is evidently small in quantity, whereas this substance forms from 40 to 60 per cent. of officinal manna.

Report on Temperatures and Open-Air Vegetation at the Royal Botanic Garden, Edinburgh, from July 1888 *to June* 1889. By ROBERT LINDSAY, *Curator of the Garden.*

July 1888.—This was one of the most inclement summer months we have had any experience of. From the beginning of the month until its close there was an almost entire absence of real summer weather. A long spell of cloudy skies, with frequent heavy falls of rain and thunderstorms, completed the record of the month. The lowest night temperature was 35°, which occurred on the 1st and 31st of the month; and the highest was 52°, on the 14th. The lowest day temperature was 54°, on the 15th; and the highest 75°, on the 19th. On the rock-garden 276 species and well-marked varieties came into flower, amongst which were *Campanula Raineri, C. Waldsteiniana, Cyananthus lobatus, Decaspora thymifolia, Dianthus carthusianorum, Edraianthus dalmaticus, Epilobium obcordatum, Galax aphylla, Gentiana arvernensis, Kniphofia caulescens, Lewisia rediviva, Lilium Krameri, Lithospermum graminifolium, Mazus pumilio, Orobanche elatior, O. rubra, Primula Warei, Saxifraga fimbriata, Spraguea umbellata, Statice Suwarowi, Tropæolum polyphyllum, Veronica Bidwilli, V. cupressoides, V. glauco-cærulea.*

August.—The weather during August was slightly better than that of the previous month; still it was cold and unsettled. The lowest night temperature was 36°, which occurred on the 19th; and the highest 58°, on the 1st.

The lowest day temperature was 55°, on the 11th; and the highest 78°, on the 9th. The show of Roses was very inferior, owing to cold and wet; many buds never opened at all, but rotted on the bushes. One hundred and forty species of plants came into flower in the rock-garden, the best of which were *Adonis pyrenaica, Astragalus alopecuroides, Campanula isophylla alba, Dianthus Atkinsoni, D. Seguieri, Erythræa diffusa, Erica stricta, E. ramulosa, Gentiana ornata, G. tibetica, Galium rubrum, Linum monogynum, Lilium auratum, Omphalodes Lucilliæ, Spiræa astilboides, S. cæspitosa, S. bullata, Ruta patavina, Yucca gloriosa.*

September.—This month was a most favourable one, and out-door operations had but little interruption. No frost occurred; there was a fair amount of sunshine, and there were only eight wet days during the month. Late-flowering herbaceous plants and annuals now reached their best, but were much behind the average in quality of blossom. Many trees and shrubs, particularly Oaks, made a second growth. The lowest night temperature was 34°, on the 9th; and the highest 51°, on the 2nd. The lowest day temperature was 51°, on the 30th; and the highest 77°, on the 22nd. On the rock-garden forty-eight species came into flower during September, amongst which were *Aster spectabilis, Campanula fragilis, Colchicum speciosum maximum, Cyclamen europæum, Gladiolus Saundersii, Gentiana asclepiadea alba, Helleborus altifolius, Ligularia Hodgsoni, Lobelia fulgens, Spiræa Bumaldæ, Veronica longifolia subsessilis.* Seeds of herbaceous and alpine plants have not ripened well, and a poor crop has been gathered.

October.—Remarkably fine and dry weather characterised this month. Frost set in at the beginning of it, later than usual, and not very severe. The thermometer was at or below the freezing-point on six nights, indicating collectively only 9° of frost as against 31° during October 1887. The lowest readings were on the 2nd, 29°; 3rd, 31°; 5th, 29°; 7th, 32°; 14th, 30°. The lowest day temperature was 48°, on the 6th; and the highest 68°, on the 27th. Dahlias, Pelargoniums, and other tender plants were injured by frost on the 2nd, but not sufficiently so to prevent them flowering, which they are still doing in the open ground. Autumnal tints on deciduous trees and shrubs were late in showing;

very few had their leaves coloured, and, with the exception of *Pavia flava, Pyrus latifolia, Cornus mas,* and *Azalea pontica,* they have been much less interesting than usual. Rhododendrons, Azaleas, and other ericaceous plants are more sparsely set with flower-buds than I ever remember having seen at this time of year. Want of heat and sunshine during the growing period has doubtless brought about this result. Hollies have produced an exceptional crop of berries this season; most other trees and shrubs are rather deficient in fruit. On the rock-garden nineteen species of plants came into flower during the month, the handsomest being various species of *Kniphofia, Helleborus,* and *Crocus.* In consequence of the fine dry weather experienced, a large number of plants which came into flower during previous months are still in good condition, among which *Yucca gloriosa* may be mentioned. There were twenty-one dry days during the month, and very rarely has the ground been so thoroughly dry at the end of October.

November.—The past month has been remarkable for the extreme atmospheric mildness which prevailed; very seldom has there been so little frost to record during November. As a set-off, storms of wind and rain have been unusually frequent, which proved much more harmful than any seasonable amount of frost could have been. The severe gale on the 16th fortunately passed over without doing any very serious damage to the garden, further than the loss of one or two common trees. Broken branches were scattered about in all directions, until it became rather alarming.

The thermometer was at or below the freezing-point on nine mornings, indicating collectively 20° of frost, as against 49° for the corresponding month last year. The lowest readings occurred on the 1st, 30°; 16th, 29°; 21st, 29°; 27th, 25°; 29th, 30°. The lowest day temperature was 36°, on the 20th; and the highest 57°, on the 25th. Rain fell on seventeen days.

Owing to the abnormal mildness, early spring-flowering bulbous plants, such as species of *Scilla, Narcissus, Iris,* and the like, are already far advanced in growth. Buds are also starting into growth on *Ribes, Syringa, Pyrus,* and other shrubs. At the close of the month fairly good summer Roses were in flower, in conjunction with Christmas

Roses and Primroses. The Holly is the most conspicuous plant in fruit out-of-doors, the berries being abundant and well coloured.

On the rock-garden a good many plants are still in flower, but eight species only began to flower during November, viz., *Gynerium argenteum*, *Schizostylis coccinea*, *Parochætus communis*, *Tricyrtis hirta*, *Gypsophila Rokojécka*, *Kniphofia Saundersi*, and *Aster* species.

December.—Like the preceding month, December has been remarkable for the extreme mildness of weather which prevailed. The thermometer was at or below the freezing-point on thirteen occasions, the aggregate of frost registered being 57° only, as against 132° for the same month of 1887, and not since 1883 has this period of the year been so mild. The lowest readings occurred on the 11th, 24°; 19th, 26°; 27th, 26°; 30th, 17°; 31st, 24°. The lowest day temperature was 32°, on the 30th; and the highest 57°, on the 3rd. No snow and comparatively little rain fell. Not a single plant came into flower on the rock-garden during December, other than those previously recorded. The total number of species and marked varieties of alpine and dwarf-growing herbaceous plants which have flowered in the rock-garden during the entire year amounts to 1542, being 134 more than during 1887. This result has been attained by the addition of new plants to the collection from various sources, more than from any favourable circumstances connected with the weather of the past year. The largest number of species came into flower during May and June. The number of species which flowered each month during 1888 was as follows:—January, 24; February, 29; March, 64; April, 137; May, 367; June, 430; July, 276; August, 140; September, 48; October, 19; November, 8; December, 0; total, 1542.

January 1889.—The weather throughout the month was again unusually mild for the season. Rain fell more or less on nine days only, no snow fell, and out-door work suffered no interruption during the month. The thermometer was at or below the freezing-point on fourteen occasions, the aggregate amount of frost registered being 57°, as against 67° for the corresponding month last year. The lowest readings occurred on the 1st, 28°; 2nd, 21°; 7th, 24°; 22nd, 25°; 27th, 21°. The lowest day temperature was 36°, on the 2nd; and the highest 56°, on the 18th. On the rock-garden twenty species and varieties came into flower, amongst which were *Andromeda floribunda, Crocus Imperati, C. byzantinus, Hepatica angulosa, H. triloba, Helleborus angustifolius, H. purpurascens, Polygala Chamæbuxus,* and its variety *purpurea,* &c. Considering the mild weather which has prevailed, not so many plants are in flower as might have been expected. Those which have flowered are below the average in quality. This is particularly noticeable on various species of *Helleborus.* The coldness of the past summer seems to have had an injurious effect on herbaceous plants. Of the forty plants whose dates of flowering are annually recorded to the Society, the following came into flower during the month, viz.:—*Dondia Epipactis* on January 3rd; *Tussilago fragrans,* 11th; *Rhododendron atrovirens,* 17th; *Daphne Mezereum,* 26th; *Galanthus plicatus,* 26th; *Leucoium vernum,* 30th; *Galanthus nivalis,* 31st.

February.—During the month the thermometer was at or below the freezing-point on twenty mornings, indicating collectively 103° of frost, as against 121° for the corresponding month last year. The lowest readings were on the 10th, 18°; 11th, 18°; 12th, 20°; 16th, 24°; and 24th, 24°. The lowest day temperature was 33° on the 9th, and the highest 55° on the 1st of the month. Slight falls of snow occurred on seven days and rain on four days. A good many spring plants have come into blossom, but vegetation generally is making slow progress. There is no perceptible change on the buds of deciduous trees. A few hardy shrubs are fairly well advanced, such as species of *Ribes, Cratægus,* and *Nuttallia.* Flowers of *Rhododendron præcox* and *Nobleanum* were injured by the frost on the 10th, but, so far, extremely little injury has been done by frost this winter; many half hardy plants are still quite safe in the open borders without protection of any kind having been afforded them. The following spring plants, annually recorded, came into flower, viz.:—*Scilla præcox,* on February 1; *S. sibirica* on Feb. 3; *Eranthis hyemalis,* on Feb. 3; *Rhododendron Nobleanum,* on Feb. 6; *Tussilago alba,* on Feb. 14; *Crocus Susianus,* on Feb. 14; *Bulbocodium vernum,* on Feb. 18; *Sisyrinchium grandiflorum,* on Feb. 20; *Corylus Avellana,* on Feb. 22; *Symplocarpus fœtidus,* on Feb. 22; *Crocus vernus,* on Feb. 23; *Iris reticulata,* on Feb. 25; *Sisyrinchium grandiflorum album,* on Feb. 26; *Tussilago nivea,* on Feb. 27. On the rock-garden twenty-seven species came into flower during the month, amongst which were *Corbularia nivalis, Corydalis angustifolia, Cyclamen Atkinsi, Crocus annulatus, C. Olivieri, C. suaveolens, Galanthus Elwesii, Leucoium carpaticum, Narcissus minimus, Ranunculus anemonoides, Saxifraga Burseriana.*

March.—During March vegetation made only moderate progress; the weather during the month was exceedingly variable. Very severe frost occurred during the first week, but the total amount for the month was rather below the average. Rain, sleet, or snow fell more or less on fourteen days, but the ground was in such a dry condition that little impression was made thereby. Spring-flowering bulbs are fully up to the average in richness and quantity of blossom, but it is evident that many herbaceous and shrubby plants have suffered severely this winter, not so much from excess of cold as from the insufficient ripening they received during the past cold summer. The thermometer was at or below the freezing-point on sixteen mornings, indicating collectively 90 degrees of frost, as against 131 degrees for the corresponding month last year. The lowest readings occurred on the 2nd, 24°; 3rd, 22°; 4th, 16°; 14th, 29°; 27th, 23°. The lowest day temperature was 39°, on the 1st; and the highest 59°, on the 13th of the month. Of the forty spring-flowering plants whose dates of flowering are annually recorded, the following fourteen came into flower, viz.:—

	March		March
Nordmannia cordifolia, .	4	Draba aizoides, . .	22
Scilla bifolia, . .	6	Corydalis solida, . .	23
„ alba, ...	12	Narcissus pumilus, . .	25
Mandragora officinalis, .	12	Orobus vernus, . .	26
Scilla bifolia taurica, .	14	Hyoscyamus Scopolia, .	29
Omphalodes verna, . .	16	Ribes sanguineum, .	30
Arabis albida, . .	18	Erythronium Dens-canis,	30

On the rock-garden sixty species came into flower, being four less than for last March. Amongst the most conspicuous were *Chionodoxa Luciliæ* and *sardensis, Coptis brachypetala, Dentaria pentaphylla, Draba Mawii* and *bruniæfolia,* *Daphne Blagayana, Hyacinthus azureus, Korolkowia Sewerzowi, Primula marginata* and *Cashmeriana, Pulmonaria arvernensis, Saxifraga imbricata, juniperina, oppositifolia,* and *sancta, Soldanella montana, Tecophyllea cyanocrocus.*

April.—During the month of April vegetation made very good progress, and seldom has there been so little frost. Rain fell on twenty-two days, and such an excess, before the leaves of deciduous plants have become expanded, is gener-

Register of Spring-Flowering Plants, showing Dates of Flowering at the Royal Botanic Garden, Edinburgh, during the years 1888 *and* 1889.

No.	Names of Plants.	First Flowers opened.	
		1888.	1889.
1	Adonis vernalis, ...	April 16	April 6
2	Arabis albida, ...	Feb. 6	March 18
3	Aubrietia grandiflora, . . .	April 14	April 16
4	Bulbocodium vernum, . . .	Feb. 22	Feb. 18
5	Corydalis solida, . . .	April 6	March 23
6	Corylus Avellana, . . .	Jan. 25	Feb. 22
7	Crocus Susianus, . . .	Jan. 26	Feb. 14
8	,, vernus, ...	Feb. 23	Feb. 23
9	Daphne Mezereum, . . .	Feb. 22	Jan. 26
10	Dondia Epipactis, . . .	Jan. 5	Jan. 3
11	Draba aizoides, ...	March 30	March 22
12	Eranthis hyemalis, . . .	Feb. 8	Feb. 3
13	Erythronium Dens-canis, . .	March 31	March 30
14	Fritillaria imperialis, . . .	April 29	April 30
15	Galanthus nivalis, . . .	Jan. 26	Jan. 31
16	,, plicatus, . . .	Jan. 26	Jan. 26
17	Hyoscyamus Scopolia, . . .	April 13	March 29
18	Iris reticulata, ...	Feb. 23	Feb. 25
19	Leucoium vernum, . . .	Feb. 4	Jan. 30
20	Mandragora officinalis, . . .	March 8	March 12
21	Narcissus Pseudo-Narcissus, . .	April 3	April 7
22	,, pumilus, . . .	March 17	March 25
23	Nordmannia cordifolia, . . .	Feb. 11	March 4
24	Omphalodes verna, . . .	March 23	March 16
25	Orobus vernus, ...	March 31	March 26
26	Rhododendron atrovirens, . .	Feb. 3	Jan. 17
27	,, Nobleanum, . .	April 13	Feb. 6
28	Ribes sanguineum, . . .	April 10	March 30
29	Scilla bifolia, ...	March 19	March 6
30	,, ,, alba, . . .	March 8	March 12
31	,, præcox, ...	Jan. 26	Feb. 1
32	,, sibirica, ...	Jan. 30	Feb. 3
33	,, taurica, ...	March 8	March 14
34	Sisyrinchium grand . . .	March 8	Feb. 20
35	,, album, . . .	March 13	Feb. 26
36	Symphytum caucasicum, . .	April 18	April 16
37	Symplocarpus fœtidus, . . .	Feb. 8	Feb. 22
38	Tussilago alba, ...	Feb. 9	Feb. 14
39	,, fragrans, . . .	Dec. 28 1887.	Jan. 11
40	,, nivea, ...	April 10	Feb. 27

ally beneficial. For newly-transplanted trees and shrubs the weather has been all that could be desired.

The thermometer was at or below the freezing-point on six mornings; the total amount of frost registered was 6°, as against 58° for April 1888. The lowest readings were, on the 2nd, 30°; 3rd, 29°; 15th, 31°; and on the 4th, 9th, and 15th, 32° respectively. The lowest day temperature was 41°, on the 4th; and the highest 67°, on the 17th.

The collective amount of frost registered this season up to the end of April is 342°, as against 589° for the same period last year. The following is the distributions for each month:—October, 9° of frost; November, 20°; December, 57°; January, 57°; February, 103°; March, 90°; April, 6°; total, 342°. The lowest point reached this season was 16° Fahr., which occurred on March 4.

On the rock-garden 134 species and varieties of plants came into flower during the month.

Of the forty spring-flowering plants, annually recorded to show their periods of flowering, five came into flower, thus completing the list, viz.:—*Adonis vernalis* on April 6, *Narcissus Pseudo-Narcissus* on April 7, *Aubrietia grandiflora* on April 16, *Symphytum caucasicum* on April 16, *Fritillaria imperialis* on April 30.

May.—This month was one of the most favourable experienced for many years, and no frost occurred during the month. This seldom happens in May, as frost has been registered more or less every year since 1882. Vegetation made rapid progress, and in the absence of frost or severe winds has gone on advancing without check of any kind. The foliage of deciduous trees has rarely been seen in such luxuriant condition, the heavy rains which fell during April having assisted in their development. The flowering of the ordinary ornamental trees and shrubs is considerably behind the average. Hawthorn and Holly are almost destitute of flowers, in remarkable contrast to the profuse manner in which they blossomed last year. Rhododendrons and most hard-wooded plants are developing fine, strong growths. Rapid growth is the most notable feature of the month. Herbaceous plants are flowering freely, but those which flowered early in the season have set very little fruit; *Orobus*, Cowslips, *Cynoglossum*, &c., grown here in quantity for class purposes, cannot this season be had in fruit in anything like sufficient quantity. Very little frost occurred when the plants were in blossom to render them so barren, and I can only attribute their present condition to weakness induced by the cold, dull summer of last year. The lowest night temperature recorded at the Garden was 35°, which took place on the 3rd of the month; other low readings were registered—on the 1st, 40°; 2nd, 37°; 26th, 38°; 30th, 37°; all the other readings were above 40°. The lowest day temperature was 52°, on the 5th; and the highest 77°, on the 22nd.

The rock-garden was very attractive during the month, from the large number of plants in blossom; 380 species and varieties opened their first flowers in May.

June.—This month has been one of the finest recorded, the beneficial effects of which will probably be felt even more next season than this. Just as many of our garden plants are still suffering from the bad effects of the previous cold summer, so we may not expect to reap the full benefit of the splendid weather of the last two months till next season. The foliage of all forest and ornamental trees is now complete, and remarkably fine. Aphides, caterpillar, and other insect pests have been very abundant, owing to the prolonged drought, and in many parts of the country the leaves of Beech, Oak, and Lime trees have been very much injured by their ravages; here no serious damage has been done as yet.

Nearly all variegated plants have developed richly coloured leaves, Conifers being particularly bright. Generally speaking, flowers are less abundant on most plants than usual; Elder seems to be an exception here. A very large number of plants came into flower in the rock-garden during June, no fewer than 444 species and varieties having been counted, many of which went quickly out of flower. The lowest night temperature was 35°, which was recorded on the 11th of the month. Other low readings were—on the 5th, 40°; 6th, 42°; 8th, 39°; 13th, 42°. The lowest day temperature was 56°, on the 2nd; and the highest 85°, on the 26th of the month. Rain fell on five days only. A few of the more interesting plants in flower on the rock-garden were—

Androsace foliosa
,, lanuginosa
,, ,, Leichtlini
Aquilegia pyrenaica
Cyananthus lobatus
Cypripedium parviflorum
Campanula Allioni
Edraianthus caudatus
,, pumiliorum
Dianthus neglectus
,, superbus
Eriophorum alpinum
Exarrhena Lyallii
Gentiana lutea
Gillenia trifoliata
Leontopodium alpinum
Linaria origanifolia
Mulgedium alpinum
Nardostachys Jatamansi
Orchis maculata superba
,, foliosa
Oxalis braziliensis
Pentstemon pubescens
,, secundiflorus
Primula capitata
Rosa pyrenaica
Rhododendron ferrugineum album
Ranunculus parnassifolius
Saxifraga odontophylla
,, valdensis
Saponaria cæspitosa
Senecio laxiflorus
Vella spinosa, &c.

OBITUARY NOTICES OF DECEASED FELLOWS.

Professor ALEXANDER DICKSON. By Professor Thomas R. Fraser.

(Read 11th July 1889.)

Botanical science sustained a great loss by the death of Alexander Dickson. During a life which extended over only fifty-one years, Dr Dickson had for nearly thirty years given his best thoughts and energies to the teaching and advancement of botany. His success in both directions has been recorded in an enduring form in contemporaneous botanical publications, and in the large number of students of botany trained by him during a quarter of a century.

Alexander Dickson was born at Edinburgh on the 21st of February 1836. He sprang from a family which at various times has given members to the legal and medical professions; one of the earliest of whom any special records exist having been John Dickson of Kilbucho and Hartree, a lawyer, who in 1649 was appointed a Senator of the College of Justice, taking the title of Lord Hartree.

Alexander Dickson received his early education at home. In 1855, he entered the University of Edinburgh as a student of medicine; and soon engaged with enthusiasm in those preliminary scientific studies which have so frequently been the occasion of the first awakenings of latent scientific impulses. In him they appear to have served this purpose. He became an enthusiastic biologist; and a warm admirer and disciple of Goodsir, in whose philosophical tendencies he found, like many of his friends, the inspiring direction that soon became so marked and characteristic a feature of his scientific work and aims. Engrossed in natural science, he took, it would seem, comparatively little interest in the purely professional or technical departments of the medical curriculum. He, however, appreciated differentiation as a means of promoting advancement in the art as well as in the science of medicine. In his inaugural address, delivered in 1859, as a President of the Royal Medical Society, he supposes the questions, "Of what use is it for . . . . . a student of medicine to know that the cranium is composed of vertebral elements—that such and such bones of the face correspond to costal arches; and that certain bones and muscles of the upper extremities correspond to other bones and muscles in the lower? Why should" . . . . . his "memory be burdened with apophysis and epiphysis, when" there is "so much else to be learned of more direct importance?" And he goes on,—"To such objections it may be answered, that although morphological anatomy in its present state may be of little practical importance to the medical man, yet this is no reason why he should not study it. It must be at once apparent that, from the nature of homological anatomy, one of the great ends which it is destined to accomplish is a simplified teaching of descriptive anatomy, by a logical and intelligible arrangement and generalisation of the enormous mass of facts with which the anatomical student has to contend; and this can only be attained to by the development and perfecting of homological anatomy, by which alone a philosophical classification of anatomical details can be rendered possible. Such being the case, all doubt as to the utility of homological anatomy must be thrown aside. Its study must surely be of importance, if it enables anyone to assist, however slightly, in promoting so good an end. The medical man, while he performs his duties to his suffering fellow-creatures, ought never to forget at the same time what he owes to medical science and to posterity."

Dr Dickson graduated as doctor of medicine in August

1860, having previously, in accordance with his biological proclivities, studied under Kölliker in Würzburg and Virchow in Berlin.

His career as a teacher of botany began in the summer of 1862, when he conducted the class of botany in the University of Aberdeen for Professor Dickie, who was at the time incapacitated by bad health. He thus obtained an opportunity for displaying his merits as a teacher; and his success proved of much value in securing for him in 1866 the chair of Botany in the University of Dublin. Two years afterwards he was appointed Professor of Botany in the University of Glasgow, where he confirmed his early reputation as a clear and painstaking teacher and an enthusiastic worker in structural and morphological botany.

Dr Dickson remained in Glasgow from 1866 till 1879. In the latter year, the professorship of botany in the University of Edinburgh became vacant, on the resignation, caused by failing health, of the renowned and veteran Professor Balfour; and to this great botanical position, Dr Dickson was promoted by the Curators. In the following year, he received from the Crown also the appointment of *Regius* Professor of Botany to the University of Edinburgh, as well as that of Regius Keeper of the Royal Botanic Garden.

It is with his work as a professor in Edinburgh that the members of this Society are most familiar. The recollection of that work is still so vividly present among us, that, but for the requirement of a historical record, it would be needless to dwell on it. We find him entering on his duties imbued with the same conception of the far-reaching affinities between science and art or practice as was recognised in the early developments of his biological career. In his inaugural address he adopted for his subject the consideration of some remarkable parallels between the animal and vegetable kingdoms as regards specialisation of form for the performance of different functions. For this purpose he compared a flowering plant with a zoophyte, and showed how unity of organisation is manifest throughout nature. The same lesson was indicated as, twenty years before, he had taught in his inaugural address to the Royal Medical Society, that the cultivation of every department of biological science increases the knowledge of that human anatomy which is the foundation of the art of medicine and surgery.

His relations with the students of the university soon became of the most cordial description. His painstaking earnestness as a teacher, his obvious desire to further their botanical studies, the knowledge that soon spread of the hours spent in preparation for his class, and especially in the preparation of the wonderfully skilful and instructive illustrations that from day to day appeared on the blackboard, and the numberless evidences of his courteous and generous disposition, gained for him, not only respect, but also warm and grateful affection.

Professor Dickson's first botanical paper was published in 1857, while he was yet a student of medicine. During the following twenty-nine years his activity as a worker was shown by the publication of upwards of fifty papers. Many of them rank as masterpieces of accurate and elaborate description, and of philosophical conceptions of structure. A glance over the appended list shows his great partiality for subjects bearing on development and morphology, in which departments of botany he acquired the position of an eminent authority. In confirmation of these statements, it is sufficient to cite his graduation thesis, for which he obtained a gold medal, "On the Development of the Flower, and especially the Pistil, in the *Caryophyllaceæ*," and his papers on the Morphology of the Reproductive Organs of the *Coniferæ*, on the Embryo and its Appendages in *Tropæolum*, on the Embryology and Development of the Flower of *Pinguicula*, on the Spiral Arrangements of the Cones of *Pinus pinaster*, and on the Morphology and Structure of the Pitchers in *Cephalotus* and *Nepenthes*.

On account of his eminence as a botanist and teacher, he was made honorary M.D. of the University of Dublin, LL.D. of the University of Glasgow, Fellow of the Linnæan Society, and President of the Botanical Society of Edinburgh.

Professor Dickson took much interest in matters outside of his immediate professorial duties and scientific pursuits. He was a Conservative in State and Church politics. On various occasions he actively supported candidates for parliamentary representation. A consistent Free Churchman, he remained true to the original position of that Church, and opposed publicly the policy which an influential majority had adopted, of reversing its traditions on the question of a State-recognised and supported Church. He strenuously opposed the legislative attempts, which fortunately proved abortive, to modify the special characters of medical education and graduation in the Scottish universities, for the mere sake of bringing them into harmony with the systems prevailing in the southern division of the United Kingdom. He looked with much distrust on the schemes, embodied in the various Bills introduced into Parliament during the last seven years, for effecting fundamental changes in the constitution and character of the Scottish universities; considering them prompted more by political, social, and selfish aims, than by a real and disinterested desire for educational reform. If it were possible for one so charitable and generous to entertain any feeling of resentment, that feeling was approached in the indignation with which he regarded many of the statements of the extreme section of agitators for university legislation. Even when he found himself in a hopeless minority,—as occasionally happened in the discussions on this question,—few men could be more courageous in maintaining or expressing the views he had deliberately adopted.

Polemical discussion, however, was not congenial to his fair and candid disposition. When not engaged in teaching or in the botanical investigations to which he was so ardently attached, his occupations as proprietor of Hartree and Kilbucho, and social intercourse with his friends, were more in accordance with his tastes.

It has been well said that, as a country laird, "his one aim in life was to make others happy." And the same characteristics made him also a general favourite in society; where he used to delight his friends by the exquisite taste and feeling with which he played on the piano the works of Beethoven and Bach, and the national airs of Scotland.

His social charms were never more pleasantly exhibited than when he was entertaining his friends at his country house. They were made to feel as if the place belonged to them, and not to him; except that every now and then the host was recognised by his kindly interpositions to increase the comfort and enjoyment of his guests. *His* delight was to know that they had been gratified with the day's shooting or curling, or with the ramble over hills or through the woods, where some matter of botanical interest was invariably brought under notice; *their* delight was the companionship and conversation of an acute and widely-informed man, genial and destitute of envy, self-denying and careful to avoid wounding susceptibilities, and appreciating heartily what was good in others, because desirous of doing so.

No one could have guessed that beneath this never-ceasing genial and amiable placidity and kindliness, a consciousness existed of a physical ailment, whose course and effect could not with certainty be anticipated for a day, nor even for an hour. It is characteristic of the man, that he courageously and considerately concealed all knowledge of the existence of this "thorn in the flesh," in order to avoid causing anxiety and pain to those nearest and dearest to him. He succeeded in his purpose; and when, on the 30th of December 1887, he suddenly expired on the curling pond at Hartree, no forebodings or anxieties had occurred to increase the bitter grief of his departure.

In concluding this record of a dear friend, I would remind the Society how warmly he was attached to its interests. He constantly attended its meetings, served it as President and in some of its other offices, and communicated to it the greater number of his botanical papers.

Chronological List of Scientific Papers.

On a Monstrosity in the Fruit of *Silene inflata*, with some Remarks on Placentation. *Trans. Bot. Soc. Edin.*, v., 1857.

On the Compound Nature of the Cormophyte. *Trans. Bot. Soc. Edin.*, vi., 1858; *Edin. New Phil. Jour.*, 1858.

Remarks on the Development of the Seed-Vessel of Caryophyllaceæ. *Trans. Bot. Soc. Edin.*, vi., 1859. (The substance of this paper forms part of the author's graduation thesis, "On the Development of the Flower, and especially the Pistil, in the *Caryophyllaceæ*.")

Observations on some Bisexual Cones occurring in the Spruce Fir (*Abies excelsa*). *Trans. Bot. Soc. Edin.*, vi., 1860; *Edin. New Phil. Jour.*, 1860; *Adansonia*, ii.

Translation of Baillon's Organogenic Researches on the Female Flower of the Coniferæ. *Trans. Bot. Soc. Edin.*, vii., 1861.

Note upon the preceding Translation, with Observations upon the Morphological Constitution of certain Abietineous Cones. *Trans. Bot. Soc. Edin.*, vii., 1861 ; *Edin. New Phil. Jour.*, 1861 ; *Adansonia*, ii.

On some of the Stages of Development in the Female Flowers of *Dammara australis*. *Ibid.*

Observations on the Embryogeny of *Tropæolum majus*. *Trans. Bot. Soc. Edin.*, vii., 1862 ; *Edin. New Phil. Jour.*, 1863.

On Diplostemenous Flowers, with some Remarks upon the Position of the Carpels in the Malvaceæ. *Trans. Bot. Soc. Edin.*, viii., 1864; *Edin. New Phil. Jour.*, 1864 ; *Adansonia*, iv.

Note on the Position of the Carpellary Groups in *Malope* and *Kitaibelia*. *Trans. Bot. Soc. Edin.*, viii., 1864.

On the Morphological Constitution of the Andrœcium of *Mentzelia*, and its analogy with that of certain Rosaceæ. *Trans. Bot. Soc. Edin.*, viii., 1865 ; *Seeman's Jour. of Bot.*, iii., 1865.

Opening Address to the Botanical Society of Edinburgh for Session 1865–6. *Trans. Bot. Soc. Edin.*, viii., 1865.

On the Phylloid Shoots of *Sciadopitys verticillata*, Sieb. and Zucc. (Read before the Botanical Congress, London, 1866.) *Seeman's Jour. of Bot.*, iv., 1866.

On the Staminal Arrangements in some Species of *Potentilla* and in *Nuttallia cerasiformis*. *Trans. Bot. Soc. Edin.*, viii., 1866 ; *Jour. of Bot.*, iv., 1866.

On Abnormal Flowers in *Tropæolum majus*. *Trans. Bot. Soc. Edin.*, ix., 1866.

Notice of an Abnormal Leaf of *Prunus Laurocerasus*. *Jour. of Bot.*, v., 1867.

On some of the Principal Modifications of the Receptacle, and their Relation to the "Insertion" of the Leaf-organs of the Flower. *Report Brit. Assoc.*, 1868.

On the Development of the Flower of *Pinguicula vulgaris*, L., with Remarks on the Embryos of *P. vulgaris*, *P. grandiflora*, *P. lusitanica*, *P. caudata*, and *Utricularia minor*. *Trans. Roy. Soc. Edin.*, xxv., 1869; *Proc. Roy. Soc. Edin.*, vi., 1869.

Note on the Embryo of *Ruscus aculeatus*. *Jour. of Bot.*, viii., 1870; *Trans. Bot. Soc. Edin.*, x., 1870.

Note on the Embryo of *Zostera*. *Ibid.*

Note on the Embryo of the Date Palm. *Ibid.*

On the Phyllotaxis of *Lepidodendron* and *Knorria*. *Jour. of Bot.*, ix., 1871; *Trans. Bot. Soc. Edin.*, xi., 1871.

Notice of Exhibition of Vegetable Spirals (chiefly Fir Cones and Cacti). *Proc. Roy. Soc. Edin.*, vii., 1871.

On some Abnormal Cones of *Pinus Pinaster. Trans. Roy. Soc. Edin.*, xxvi., 1871.

Suggestions on Fruit-classification. *Jour. of Bot.*, ix., 1871.

Note on Germination of *Delphinium. Ibid.*, x., 1872.

On Consanguineous Marriages viewed in the light of Comparative Physiology, &c. Introductory Lecture delivered at the Opening of the Medical Session, 1871–2, in the University of Glasgow. *Glasg. Med. Jour.*, N.S. iv., 1872.

Note on *Stigmariæ* from the Fossiliferous Strata at Auchentorlie. *Report Brit. Assoc.*, 1872.

Note on an Abnormality of *Chrysanthemum Leucanthemum. Nature*, x.; *Report Brit. Assoc.*, 1874.

Note on an Abnormality of *Primula vulgaris*, with Interpetaline Lobes. *Report Brit. Assoc.*, 1875; *Trans. Bot. Soc. Edin.*, xii., 1875.

Note on a Monstrosity of *Saxifraga stellaris. Ibid.*

On the Embryogeny of *Tropæolum peregrinum*, L., and *Tropæolum speciosum*, Endl. and Pœp. *Trans. Roy. Soc. Edin.*, xxvii., 1875.

Note on Two Monstrosities of *Matricaria inodora. Report Brit. Assoc.*, 1876.

Note on Laticiferous Canals in Fruit of *Limnocharis Plumieri. Ibid.*

Note of Exhibition of Specimen of *Pogonatum alpinum* with two Capsules under one Calyptra. *Ibid.*

On the Structure of the Pitcher of *Cephalotus follicularis. Jour. of Bot.*, xvi., 1878.

Note on the Stipules of *Spergularia marina. Report Brit. Assoc.*, 1878; *Jour. of Bot.*, xvi., 1878.

Note on the Inflorescence of *Senebiera didyma. Ibid.*

Note on the Six-celled Glands of *Cephalotus*, and their Similarity to the Glands of *Sarracenia purpurea. Ibid.*

Note on Exhibition of Specimens of *Isoëtes echinospora. Report Brit. Assoc.*, 1878.

On Functional Specialisation of Individuals in Animals and Plants, with particular reference to Analogies between the Sertularian Zoophyte and the Flowering Plant. *Trans. Bot. Soc. Edin* xiii., 1879.

On the Morphology of the Pitcher of *Cephalotus follicularis. Jour. of Bot.*, xix., 1881; *Gardeners' Chronicle*, 1881.

On the Septa across the Ducts in *Bougainvillea glabra* and *Testudinaria elephantipes. Trans. Bot. Soc. Edin.*, xiv., 1879.

On the Germination of *Podophyllum Emodi. Trans. Bot. Soc. Edin.*, xvi., 1882; *Gardeners' Chronicle*, 1882.

On a Plant of *Primula vulgaris* with a Green Corolla. *Trans. Bot. Soc. Edin.*, xiv., 1882.

On a Monstrosity in the Flower of *Iris Pseudacorus*. *Ibid.*; *Gardeners' Chronicle*, 1882, pt. 2.

On the Germination of *Streptocarpus caulescens*. *Trans. Bot. Soc. Edin.*, xiv., 1882.

On the Structure of the Pitcher in the Seedling of *Nepenthes*, as compared with that in the Adult Plant. *Gardeners' Chronicle*, xx., 1883; *Proc. Roy. Soc. Edin.*, xii., 1883–4.

Note on Hybrid Hedychiums. *Ibid.*, xxii., 1884.

On the Æstivation of the Floral Envelopes of *Helianthemum vulgare*. *Trans. Bot. Soc. Edin.*, xiv., 1883.

On the Occurrence of Foliage-leaves in *Ruscus* (*Semele*) *androgynus*; with some Structural and Morphological Observations. *Gardeners' Chronicle*, 1883; *Trans. Bot. Soc. Edin.*, xvi., 1883.

On the Development of Bifoliar Spurs into Ordinary Buds in *Pinus sylvestris*. *Trans. Bot. Soc. Edin.*, xvi., 1885; *Gardeners' Chronicle*, 1885.

On Certain Points in the Morphology of *Frullania* and some other Leafy Jungermanniceæ. *Trans. Bot. Soc. Edin.*, xvi., 1886.

Dr Boswell of Balmuto. By Hugh Cleghorn, LL.D.

(Read 5th March 1889.)

John Thomas Irvine Boswell, *né* Syme and afterwards Boswell Syme, was born in 4 Queen Street, Edinburgh (now the Philosophical Institution), in 1822. His father was Patrick Syme, a well-known artist, who afterwards became drawing master at the Dollar Academy, where our friend received his early education. His mother was Miss Boswell, daughter of Lord Balmuto, for many years Sheriff of Fife, and afterwards a Lord of Session.

Both parents were artists, and the son from early years showed a decided taste for collecting plants, insects, and shells. He served an apprenticeship with the Stevensons of Edinburgh, attended the University, and was qualified as civil engineer. For some years he was engaged by Messrs Wyllie and Peddie in various surveys connected with the construction of railways and other great undertakings. Whilst travelling on duty, he seized every opportunity of prosecuting his favourite researches. The result of his early botanical explorations is recorded in Mr H. C. Watson's *Topographical*

Botany. He checked the lists of Fife, West Perth, Kincardine, and Orkney.

He became a member of this Society in 1843, and in 1850 undertook the Curatorship of the Herbarium, then located in the upper story of the University.

In February 1850, he read his first paper, on the plants collected during a visit to his relatives in Orkney in the summer of 1849. It is recorded in our *Transactions* (iv. p. 29), and attracted the attention of Hewett Watson, and a friendship began which led to his being offered the curatorship of the Botanical Society of London in 1851. Syme then gave up his profession, removed to town, and devoted all his energies to his favourite studies. He lived in Adelaide Road, Haverstock Hill, and his house was a rendezvous for metropolitan field botanists.

In 1852 and 1854 he explored the vicinity of London, and found many South England plants he had never seen before. Two papers on his Middlesex excursions will be found in the *Phytologist*, vol. iv. Mr Baker of Kew states (*Jour. Bot.*, xxvi. 83) that the parcels which the members of the London Botanical Society at this period received consisted largely of London and Scotch plants gathered by Watson and Syme. The London Botanical Society was broken up in 1857. The early editions of the "London Catalogue" were mainly the work of Mr Watson. Mr Syme shared the preparation of the 5th, 6th, and 7th editions.

In 1854 Mr Syme was elected a Fellow of the Linnean Society, and in the same year was appointed lecturer on botany in the Charing Cross School of Medicine, and also at Westminster Hospital, where he did duty for many years.

In 1860 he lectured on natural history at the New College, Edinburgh, after the death of Professor Fleming, and before the appointment of Professor Duns.

In 1863 the third edition of *English Botany* was began, and upon this Syme's botanical reputation mainly rests The eleven volumes appeared between 1863 and 1872.

The accuracy and carefulness of his descriptions are too well known to members of this Society and to British botanists from daily experience of their usefulness to need any commendation here.

Mr Baker has well observed (*loc. cit.*), "the power which Syme shows in grasping the relationship of the types and the acute sense of proportion shown in their arrangement. I never cease when I use the book to admire the skill which is shown in dividing out the types into species, sub-species, and varieties, a task done so thoroughly well, that when Sir J. D. Hooker, with all his wide experience, went over the same ground in his *Student's Flora*, he found extremely little to change" (*Jour. Bot.*, xxvi. 83).

Boswell's very large British herbarium was purchased by Mr F. J. Hanbury, F.L.S., Upper Clapton, London, who generously allows any botanist to have access to it by applying to him. The collection contains many critical notes and some unique specimens, and is kept entirely distinct (*Jour. of Bot.*, xxvi. 157). Mr J. C. Melvill possesses the Foreign Collection, marked with distinctive labels, at Alkersal Cottage, Prestwich, Manchester.

From 1868 till his death (28th January 1888) Boswell lived at his ancestral home, Balmuto, near Kinghorn, a much respected country gentleman. He seldom appeared as a magistrate, but for many years arranged the distributions of the Botanical Exchange Club, and drew up the Annual Reports, which are all printed in the *Journal of Botany*.

In 1875 the University of St Andrews conferred on him the degree of LL.D., in recognition of his valuable contributions to science, and in 1884 he was elected an Honorary Fellow of our Society.

He is survived by his widow and by two sons, the elder of whom is at the Scottish Bar, and an only daughter.

A portrait will be found in *Illustrated London News*, 11th Feb. 1888.

Chronological List of Scientific Papers.

1. Syme, John T. Boswell. Notice of some of the rarer Plants observed in Orkney during the Summer of 1849, *Ann. Nat. Hist.*, v., 1850, pp. 266–269; *Edin. Bot. Soc. Trans.*, iv., 1853, pp. 47–50.
2. Notice of the Occurrence of *Eleocharis uniglumis*, Link, near Blackness Castle, Linlithgowshire, *Ann. Nat. Hist.*, vi., 1850, pp. 145–146.
3. On the *Sparganium natans*, L. Henfrey, *Bot. Gaz.*, iii., 1851, pp. 157–159.

4. Localities for Plants near London, in 1852, *Phytologist*, iv., 1853, pp. 859–862.
5. Remarks on *Gladiolus illyricus*, Koch, and its allies, Seeman, *Jour. Bot.*, i., 1863, pp. 130–134.
6. Observations on the Larva of *Deilephila*, *Entom. Month. Mag.*, ii., 1865–66, pp. 5–8.
7. Entomological Notes from Fifeshire, *Entomologist*, iv., 1868–69, pp. 115–117.
8. Note on the Fertilisation of Cereals, *Jour. of Bot.*, ix., 1871, pp. 373, 374.
9. *Acentropus niveus* in Scotland [1870], *Scottish Naturalist*, i., 1871–72, p. 20.
10. Notes on certain Scottish Plants [1871], *Scottish Naturalist*, i., 1871–72, pp. 92–93.
11. Fertilisation of Grasses, *Jour. of Bot.*, i., 1872, pp. 153, 154.
12. Sowerby's *English Botany*, 3rd edit., 1863–72, 11 vols.

The Rev. Churchill Babington, D.D., and John Percy, M.D., F.R.S. By Andrew Taylor.

(Read 11th July 1889.)

The late Rev. Churchill Babington, D.D., was induced to join our fellowship through the influence of Professor Cardale Babington, his near relative. He for many years acted with great assiduity as one of our local Secretaries.

Churchill Babington was descended from a family for a long time well known in the counties of Derby and Leicester. His father, the Rev. Matthew Drake Babington, incumbent of Thringstone in Leicestershire, was a graduate of Trinity College, and an excellent scholar. He was, therefore, capable of directing the home education of the son, who gave early promise of future success, alike in classical study and in natural history, especially in botany and ornithology.

From the obituary contributed to the magazine of St John's College, Cambridge, the *Eagle*, by Professor Babington, and through whose courtesy I am privileged to quote this and most of the following particulars regarding our deceased Fellow, we learn that he joined that institution in 1839, and graduated as a Senior Optime and seventh in the first class of the Classical Tripos in 1843. He was elected a member of our Society in the same year, about the same time presenting to our Herbarium a large collection, principally of lichens and mosses. In 1846 he published his successful Hulsean Prize Essay entitled, *The Influence of Christianity in Promoting the Abolition of Slavery in Europe.* In the same year he was elected a Fellow of St John's College. Immediately after this he started on a south of Europe tour of several months, for the purpose of visiting his parents at Messina, whither ill health had driven his father. He also visited his uncle, Dr Strange, at Naples. During these journeyings he made large botanical collections, and spent much study on the Roman antiquities of Italy. On his return to Cambridge as a resident Fellow of St John's, he simultaneously prosecuted literary and scientific investigations. In 1849 he published *Macaulay's Character of the Clergy Considered,* in which he demonstrated the unfairness of the picture of them drawn by the eminent English historian. He also published a careful *facsimile* of the original edition of *Trattato utilissimo del beneficio di Giesu Christo crucifisso verso i Christiani,* attributed to Paleario, and published at Venice in 1543, but the edition of which was nearly destroyed by the Inquisition. Again, some fragments on papyrus of the Orations of Hyperides were carefully edited; and as a result of this labour, he issued three books on the subject, much esteemed by classical scholars, namely, *The Oration of Hyperides against Demosthenes* (1851), and *For Lycophron and Euxenippus* (1853), and *The Funeral Oration of Hyperides over Leosthenes* (1858). By appointment of the Master of the Rolls, he edited Reginald Pecock's *Repressor of Overmuch Blaming of the Clergy,* and two volumes of Higden's *Polychronicon.* He held the office of Disney Professor of Archaeology from 1865 for fifteen years, demonstrating the value of the study of Greek and Roman coinage and fictile art for the elucidation of history. During this period of his life he catalogued the Greek and English coins of the Fitzwilliam Museum, as well as the classical manuscripts in the University Library. He was also a frequent contributor to Hooker's *Journal of Botany,* the *Numismatic Chronicle,* the *Cambridge Journal of Classical and Sacred Philology,* and the *Proceedings of the Suffolk Institute.* He also described the lichens for Seeman's *Botany of the Herald,* and Hooker's *Flora of New Zealand.*

In 1866 he removed his residence to the Rectory of

Cockfield in Suffolk, where he abode till his death on January 3, 1889. By practising habits of early rising, it is said, Babington carried on his varied studies as enthusiastically as during his Cambridge residence, at the same time gaining a reputation as a model parish priest, and obtaining the warm affection of his scattered flock. He was known as one of the most zealous and tasteful of archæological church-restorers. His grounds gave many tokens of his botanical studies, whilst the library showed itself as the home of one who was at once a classic, scientist, and archæologist. He recently published a valuable work entitled, "The Birds of Suffolk," in the *Transactions of the Suffolk Institute*, and largely contributed to the Rev. Dr Hind's work on *The Flora of Suffolk*, which is shortly to appear. The Rev. John MacMurtrie informs me that he had correspondence with Babington on conchological matters, which also he studied minutely.

Churchill Babington took the degree of D.D. in 1879, and was elected an Honorary Fellow of St John's College in 1880. He was a Fellow of the Linnean Society, V.-P.R. Society of Literature, Member of the Numismatic Society, Hon. Member of the Historico-Theological Society of Leipzic, &c.

He died of rheumatic fever in the 68th year of his age, leaving a widow to mourn his loss.

John Percy, M.D., F.R.S., the renowned metallurgist, was a very active member of our Society during his pregraduate student days, from 1836 to 1842, when, along with Edward Forbes, Carpenter, and other eminent scientists, he took a leading part at our monthly meetings. In our *First Report*, pp. 43–45, Mr Percy succeeded Mr Edward Forbes in the programme of a meeting in 1836, when he gave an account of an excursion in the south-east of France, made with the express purpose of examining the vegetation of that part of the Continent. Again, at the meeting of January 1837, Mr Percy minutely described his plant-finds in the Jardin de la Mer de Glace; and in 1841 he presented a specimen of Phytelephas or Tagna plant of South America, known by the name of Vegetable Ivory. Percy contributed very largely to the University Herbarium fine plant specimens collected by him in Southern Europe. Indeed, the present writer, when arranging the Herbarium, became so impressed by the richness, completeness, and taste of the collection as to form a decided opinion that Percy might have gained as great *éclat* in this favourite study of his youth, as he subsequently did in the special branch entered during manhood.

Percy was the son of a Nottingham solicitor, and was born in 1817. When in Edinburgh, where he took his degree of M.D., he was a favourite pupil of Sir Charles Bell. He settled for some years as a physician in Birmingham, the while pursuing toxicological and chemico-biological research. In 1851, at the request of Sir Henry de la Beche, Percy forsook his medical practice to become the first occupant of the Chair of Metallurgy in the newly founded School of Mines. How his name became associated with the rise of this "Age of Steel," how far his researches during the last twenty-eight years led on that surprising advance in engineering so peculiar to this age, is not the province of this notice to narrate. But to the last Percy was regarded as a many-sided man of general culture, as well as the leader in his own specialty, of which his great work, *On Metallurgy*, will be the literary monument.

John Percy joined us in 1837, becoming a Non-Resident Fellow in 1840. He died in June 1889.

James Smith Crichton, M.D., Arbroath. By George Bell.

(Read 14th March 1889.)

Dr Crichton, who was elected a Resident Fellow of this Society so recently as 9th December 1886, was the second son of the late Rev. Dr Crichton, long the revered pastor of Free Inverbrothock Church, Arbroath. He was born at Gayfield, Arbroath, on 2nd April 1841. He received his early education in his native town, and preparatory to entering on the medical curriculum at Edinburgh University, served an apprenticeship with a local chemist. He passed through his classes with distinction, graduated in 1864, and commenced the active work of his profession as assistant to a doctor in Burnley. He did not stay long there, but returned to Arbroath as coadjutor to Dr Key, who eventually removed to Montrose, where he still practises. After Dr Key left, Dr Crichton succeeded to his practice.

On 18th January 1887, while on his way to visit a patient in the country, the doctor slipped on the ice, and received injuries which aggravated, if they did not engender, the illness which resulted in his death on 28th June of same year. In all schemes for the intellectual, social, moral, and religious welfare of the community, Dr Crichton, from his youth up, took an active and prominent part.

The Natural History Association (of which he was the president, and which included a vigorous botanical section) owed its formation to his energy, and he contributed largely to its prosperity, activity, and usefulness. Among the papers read by him may be mentioned "The Medicinal Properties of some Common Plants," "Marine Algæ of the Forfarshire Coast," "Some Poisonous Plants," "The Male Fern," "John Ray, his Life and Work," "Aims and Objects of a Local Naturalists' Society" (afterwards published), &c. He was one of the most active members of the Committee to whose labours we owe "The Flora of Arbroath and its Neighbourhood," which was published in 1882.* He was also a member of council of the East of Scotland Union of Naturalists' Societies, and prepared and read the report (since printed) on "Marine Algæ" at the annual general meeting of the Union in Dundee, 1884. The doctor, as a member of the meteorological section of the Arbroath Natural History Association, was largely instrumental, along with Dr Alexander Brown, the astronomer, in getting the new observing station, with a complete set of instruments, placed at the New Cemetery, Arbroath, under the charge of the present careful observer, Mr John Nicoll. It was his earnest desire to see the herbarium and natural history collections in the Arbroath Museum completed, especially as regards local specimens, and scientifically arranged, so that they might be of some educational value to the youth of the town. A committee was formed under his direction to undertake this work, which is still in the hands of the Arbroath Natural History Association. At the time of his death he was collecting data and memoranda relating to the antiquities and natural history of "Kelly Den" and the "Cliffs," two

* This committee included, among others, Alexander Hutton, F.L.S., now of Dundee; James Brebner, Dundee, and John Stewart, Arbroath, both Fellows of this Society; and John Nicoll, of "Champion" potato fame.

popular and pleasant public resorts near Arbroath. His townsmen have testified their admiration of his character by erecting a public monument to his memory.

JOHN ALLAN. By Dr Macfarlane.

John Allan, of Tanhill and Middlehouse, was born at Carluke on 12th July 1845, and died at Easter Middleton on 2nd December 1888.

From childhood he evinced a great taste for natural science, and though in later years he chose law as his profession, his early proclivities became more and more pronounced.

He joined our Society on 11th December 1884, and on two occasions he was a member of the Botanical Camp, first at Applecross in 1886, and again at Glenure in 1887. He contributed the report of the former to our *Transactions*, and during that excursion he interested himself greatly in the algæ of that rich locality, so that his list, forming part of the report, will help future workers.

Note respecting paper on certain Woods, p. 381.

The result of the examination of some British-grown woods, made since this paper was written, has shown that in their case only a portion of the alcohohc extract is resinous. Some of these extracts, mentioned in a general way as resinous in this paper, may not be wholly so. The matter will be referred to more fully in a future communication.

MISCELLANEOUS CONTRIBUTIONS AND EXHIBITIONS.

SESSION 1888–89.

November 8, 1888.

Professor Balfour intimated valuable donations of plants from the director of Kew Gardens, and from Mr Scott Elliot. He also stated that Mr Jenner of Duddingston Lodge had presented a complete set of the *Botanical Magazine* to the Library of the Royal Botanic Garden.

Professor Balfour described and exhibited a gynantherous condition of the Foxglove, obtained by his predecessor, Professor Dickson.

December 13.

Dr Cleghorn exhibited and described a set of coloured drawings of Indian plants, made by native artists, and presented to the Society for the Library at the Royal Botanic Garden, by the late Mr Gorrie of Rait Lodge.

A report on Temperature and Vegetation at Glasgow Botanic Institute was read from Mr Bullen.

Mr Lindsay exhibited and made some remarks on *Veronica Hectori*, *V. Loganioides*, *V. pinguifolia*, var., and *Olearia nummularifolia*. These plants formed part of a collection received lately from New Zealand by Mr M. Dunn, Dalkeith Palace Gardens. They were in a healthy, thriving condition after their long journey, and being of great botanical interest, Mr Dunn had kindly presented them to the Royal Botanic Garden.

Living plants were also exhibited of *Diapensia lapponica*, *Cassiope hypnoides*, and *Tofieldia borealis*, collected on the Dovrefjeld, Norway, by Mr G. Bird; and a number of interesting Alpine plants, collected by Mr P. Sewell on the desolate "tundra" regions to the extreme north of the Urals, during the expedition of the "Labrador," amongst which were *Eritrichium nanum*, *Diapensia lapponica*, *Papaver nudicaule*, *Artemisia borealis* var., *Wormskioldii*, *Polemonium cœruleum* var., *Pedicularis* sp., &c.

Mr Campbell of Ledaig sent blossoms of plants then flowering in his garden.

March 14, 1889.

Mr Lindsay exhibited, from the Botanic Garden, cut specimens of *Brownea coccinea*, *Grevillea biternata*, *Sparmannia africana* fl. pl., in flower; also a pot of *Galanthus Sharlockii*.

Mr Hole of Quorndon Lodge, Loughborough, sent flowers of Snowdrop, Snowflake, Cineraria, Lily of the Valley, and Tobacco, coloured in a beautiful way from absorption of aniline dyes.

April 11.

Mr Dunn of Dalkeith Palace Gardens exhibited cut branches of *Lapageria rosea*, and *Philesia buxifolia*, with their hybrid offspring *Philageria Veitchii*.

Mr Potts of Fettes Mount showed a large series of seedling Saxifrages, raised by him, amongst which was a pretty variegated variety of the "hypnoides" section.

Mr Lindsay exhibited flowering plants of *Trollius acaulis* and *Trillium erectum*, from the Botanic Garden.

May 9.

Professor Balfour showed a flower branch of *Megacarpæa bifida*, which was then blossoming on the rock-garden; and a fine plant of the rare *Roridula dentata*, a shrubby Drosera which had been raised from seeds received by Dr Macfarlane from Dr Reinecke, Witsenberg, Cape Colony.

Mr Lindsay exhibited the following plants, in flower, from the Garden:—

Androsace villosa	Primula integrifolia
,, lactea	,, mistassinica
Bryanthus erectus	,, rosea
Corydalis nobilis	,, Sieboldi *vars.*
Narcissus calathinus	,, Reidi
,, juncifolius	Pinguicula caudata
,, muticus × juncifolius	,, alpina
Primula auriculata	,, elatior
,, farinosa	Saxifraga pallida

June 13.

Mr Turnbull gave a microscopic demonstration of the Absorption of Mercury by the Wood vessels of the Plane Tree as the result of transpiration suction.

Mr Lindsay drew attention to a fine flowering specimen of *Amorphophallus campanulatus*, the corm of which had been received from Kew. He also showed—

Arum palæstinum	Erinus alpinus albus
Xanthosia rotundifolia	Saxifraga cæsia
Dianthus neglectus	Raoullia eximia, &c.
,, neglectus, *seedling vars.*	

Mr Boyd of Faldonside exhibited a large number of cut blooms of rare Alpine and herbaceous plants; and the President referred to a set of specimens from Cyprus, belonging to Miss Laing.

July 11.

A large number of insectivorous plants were exhibited by Mr Lindsay, from the Botanic Garden, amongst which were—

Nepenthes Khasyana
,, sanguinea
,, × Mastersiana*
,, Rafflesiana
,, Veitchii
,, × Dicksoniana*
,, Chelsoni
,, × Edinensis*
,, Curtisii
,, distillatoria
,, ampullaria
,, × cylindrica
,, × Dormanniana
,, × hybrida maculata
Sarracenia purpurea
,, Drummondi
,, flava
,, ,, ornata
,, crispata
,, rubra
,, variolaris
Sarracenia × Chelsoni
,, × Maddisoniana
,, × Mesoniana
,, × Patersoni
,, × Flambeau
,, × Illustrata
Darlingtonia californica
Roridula dentata
Drosera binata
,, Burkei
,, capillaris
,, dichotoma
,, longifolia
,, capensis
,, rotundifolia
,, spathulata
Drosophyllum lusitanicum
Dionæa muscipula
Cephalotus follicularis
Pinguicula caudata

* A hybrid form of the parents immediately preceding.

OFFICE-BEARERS.

At the General Meeting held on Thursday, 8th November 1888, the following Office-Bearers for 1888–89 were elected:—

PRESIDENT.

William Craig, M.D., C.M., F.R.S.E., F.R.C.S.E.

VICE-PRESIDENTS.

Symington Grieve.
Andrew Taylor, F.R.P.S.
William Watson, M.D.
William B. Boyd of Faldonside.

COUNCILLORS.

Thomas A. G. Balfour, M.D., F.R.S.E., F.R.C.P.E.
Malcolm Dunn, Dalkeith Palace Gardens.
Alexander Galletly.
David Christison, M.D.
Professor F. O. Bower, M.A., F.R.S.E., F.L.S.
Alexander Buchan, M.A., LL.D., F.R.S.E.
Hugh Cleghorn, M.D., LL.D., F.R.S.E.
Robert Lindsay.
George Bird.
John Methven.

Honorary Secretary—Professor Sir Douglas Maclagan, M.D., F.R.S.E.
Honorary Curator—The Professor of Botany.
Foreign Secretary—Andrew P. Aitken, M.A., D.Sc., F.R.S.E.
Treasurer—Patrick Neill Fraser.
Assistant-Secretary—John M. Macfarlane, D.Sc., F.R.S.E.

LOCAL SECRETARIES.

Aberdeen—Stephen A. Wilson of North Kinmundy.
,, Professor J. W. H. Trail, M.A., M.D.
Berwick—Philip W. Maclagan, M.D.
,, Francis M. Norman, R.N.
Birmingham—George A. Panton, F.L.S., 73 Westfield Road.
Bridge of Allan—Alexander Paterson, M.D.
Calcutta—George King, M.D., Botanic Garden.
Cambridge—Charles C. Babington, M.A., F.R.S., Professor of Botany.
,, Arthur Evans, M.A.
Chirnside—Charles Stuart, M.D.
Croydon—A. Bennett, F.L.S.
Dublin—W. R. M'Nab, M.D., F.L.S., Professor of Botany, Royal College of Science.
Glasgow—Professor F. O. Bower, M.A., D.Sc.
Greenock—Donald M'Raild, M.D.
Kelso—Rev. David Paul, M.A., Roxburgh Manse.
Kilbarchan—Rev. G. Alison.
Leicester—John Archibald, M.D.

London—William Carruthers, F.R.S., F.L.S., British Museum.
,, E. M. Holmes, F.L.S., F.R.H.S.
Manchester—Benjamin Carrington, M.D., Eccles.
Melbourne, Australia—Baron Ferdinand von Mueller, M.D.
Nairn—William Alex. Stables.
Norfolk—John Lowe, M.D., King's Lynn.
Nova Scotia—George Lawson, LL.D., Dalhousie.
Ottawa, Ontario—W. R. Riddell, B.Sc., B.A., Prov. Normal School.
Perth—F. Buchanan White, M.D., F.L.S.
Saharunpore, India—J. F. Duthie, B.A., F.L.S., Botanic Garden.
Shrewsbury—Rev. W. A. Leighton, B.A., F.L.S.
Silloth—John Leitch, M.B., C.M.
Wellington, New Zealand—Sir James Hector, K.C.M.G., M.D., F.R.S.L. & E.
Wolverhampton—John Fraser, M.A., M.D.

Fellows elected, Session 1888–89.

1888.
Nov. 8. George Ure, Broughty Ferry—*Res. Fellow.*
W. T. Thiselton Dyer, M.A., C.M.G., F.R.S. —*Hon. Fellow.*
W. C. Sully and W. Tyson, Cape Town—*Corr. Fellows.*
Dec. 13. Robert Turnbull, Edinburgh—*Res. Fellow.*
Henry E. Hole, Loughborough—*Res. Fellow.*
J. E. T. Aitchison, M.D., C.I.E., F.R.S,—*Res. Fellow.*
Rev. A. B. Morris, Edinburgh—*Res. Fellow.*
Colonel Frederick Bailey, R.E.—*Non-Res. Fellow.*
John Mooney, Manchester—*Non-Res. Fellow.*
1889.
Jan. 10. Ernest Dent, Edinburgh—*Res. Fellow.*
A. Mackenzie, Edinburgh—*Res. Fellow.*
James Grieve, Edinburgh—*Res. Fellow.*
Mar. 14. W. S. Blackstock, Kirkcaldy—*Res. Fellow.*
May 9. Mrs Bayley Balfour—*Lady Associate.*
June 13. William Loudon, Edinburgh—*Res. Fellow.*
July 11. William Paxton, Edinburgh—*Res. Fellow.*
P. Hill Normand, Aberdour—*Res. Fellow.*

THE LIBRARY AT THE ROYAL BOTANIC GARDEN.

The following additions have been made to the Library at the Royal Botanic Garden, Edinburgh, during the year from 1st October 1888 to 1st October 1889:—

BOOKS, PAMPHLETS, &c.

AGARDH, C. A. Systema Algarum. 1824. 1 vol.—*From the Royal Gardens, Kew.*

ALLEN, J. F. Victoria Regia.—*From the Royal Gardens, Kew.*

ATKINS, Mrs A. Cyanotype Photographs of British Algæ. 1 vol.—*From the Royal Gardens, Kew.*

BACKHOUSE & SON, Messrs, York.—Catalogues of *Hymenophyllum* and of *Trichomanes*, 1861–71.—*From the Royal Gardens, Kew.*

BARRELIERO, A. R. P. J. Plantæ per Galliam Hispaniam et Italiam observatæ, &c., 1714. 1 vol.—*From the Royal Gardens, Kew.*

BEJERINCK, M. W. Beobachtungen und Betrachtungen ueber Wurzelknospen und Nebenwurzeln.—*From the Author.*

BLACKSTONE. Fasciculus Plantarum circa Harefield. 1737. 1 vol.—*From the Royal Gardens, Kew.*

BONORDEN, H. F. Handbuch der Allgemeinen Mykologie, &c. 1851. 1 vol.—*From the Royal Gardens, Kew.*

BORNET, ED. Note sur une nouvelle espèce de Laminaire.

——— Note sur deux nouveaux genres d'Algues perforantes.—*From the Author.*

BRONGNIART, Ad., et allii. Annales des Sciences Naturelles. 7 vols.—*From Thomas Walker.*

BUCHANAN WHITE, Dr F. Note on Zoology and Botany of Glen Tilt.—*From the Royal Gardens, Kew.*

BUHSE, F. Aufzæhlung der auf einer reise durch Transkaukasien und Persien, &c. 1860. 1 vol.—*From the Royal Gardens, Kew.*

BUSER, R. Flora Orientalis, auctore E. Boissier, Supplementum.—*From M. Buser.*

COLLA, A. Illustratio Generis Dysodii. 1 vol.—*From the Royal Gardens, Kew.*

COLUMNA, F. Stirpium rariorum Ecphrasis, &c. 1616. 1 vol.—*From the Royal Gardens, Kew.*

COMOLLI, G. Flora Comense. 1834. 1 vol.—*From the Royal Gardens, Kew.*

COULTER, J. M., and ROSE, J. N. Revision of N. American Umbelliferæ.—*From the Authors.*

CUTANDA, P. D. V.—Flora Compendiada de Madrid, &c. 1861. 1 vol.—*From the Royal Gardens, Kew.*

DARLINGTON, W. Flora Cestrica (U.S.A.). 1837. 1 vol.—*From the Royal Gardens, Kew.*

DECAISNE, J. Herbarii Timorensis Descriptio. 1835.—*From the Royal Gardens, Kew.*

DECANDOLLE, A. P. Recueil de Mémoires sur la Botanique. 1813.—*From the Royal Gardens, Kew.*

DE SERRES, M. Mémoires (sur fossiles). 1 vol.—*From the Royal Gardens, Kew.*

Duchartre, P. Organisation de les fleurs des *Delphinium*.
——— Notice sur Jean-Antonie Scopoli.
——— Quelques Observations sur la floraison du *Tigridia pavonica*.
——— Observations sur le sous-genre *Lemonia*.
——— Note sur l'enracinement de l'Albumen d'un Cycas.
——— Note sur un cas d'abolition du Géotropisme.
——— Note sur des fleurs hermaphrodite de *Begonia*.
——— Fleurs proliferes de Bégonias tubereux.—*From the Author.*

Durande. Flore de Bourgogne. 1782. 2 vols.—*From the Royal Gardens, Kew.*

Eaton, D. C. Filices Wrightianæ et Fendlerianæ.—*From the Royal Gardens, Kew.*

Elliott, S. A Sketch of the Botany of South Carolina and Georgia. 2 vols.—*From the Royal Gardens, Kew.*

Endlicher, S. Flora Posoniensis. 1830. 1 vol.—*From the Royal Gardens, Kew.*

Ernst, Dr A. On the Etymology of the word Tobacco.—*From the Author.*

Fries, E. Systema Mycologicum. 1821–23. 2 vols.
——— Summa Vegetabilium Scandinaviæ. 1846–49. 1 vol.
——— Novitiarum Floræ Suecicæ Mantissa. Parts 1, 2 (imperfect).—*From the Royal Gardens, Kew.*

Fritsch, A. Principien der Organisation der Naturhistorischen Abtheilung des neuen Museums zu Prag.—*From the Royal Gardens, Kew.*

Gerard, L. Flora Gallo-provincialis. 1761. 1 vol.—*From the Royal Gardens, Kew.*

Goeppert, H. R. Ueber ein zur Erläuterung der Steinkohlen-Formation im hiesigen königlichen botanischen Garten errichtetes Profil. Zur Erläuterung des bildes der Steinkohlenflora.—*From the Royal Gardens, Kew.*

Gonan, A. Flora Monspeliaca. 1765. 1 vol.—*From the Royal Gardens, Kew.*

Gosse, P. H. Omphalos.—*From Thomas Walker.*

Grisebach, A. Spicilegium Floræ Rumelicæ et Bithynicæ. 1843–44.
——— Plantae Wrightianae. Part 2.—*From the Royal Gardens, Kew.*

Gronovius, J. F. Flora Virginica. 1762. 1 vol.—*From the Royal Gardens, Kew.*

Guillemin, J. A., Perrottet, S., Richard, A. Floræ Senegambiæ Tentamen. 1830–33. 1 vol.

Hart, H. C. The Flora of Howth. 1887. 1 vol.

Hildebrand, Prof. H. Ueber einige Pflanzenbastardierungen.—*From the Author.*

Hooker, W. J. British Flora. 2nd Ed. 1831. 1 vol.—*From the Royal Gardens, Kew.*

Hooker, J. D. Flora of British India. Part 15.—*From the India Office.*

Howie, C. The Moss Flora of Fife and Kinross.—*From the Author.*

Janczewski, Prof. E. Les Hybrides du genre *Anemone*, 1 and 2.—*From the Author.*

Koerber, G. W. Systema Lichenum Germaniæ. 1855. 1 vol.

Labillardière. Atlas pour servir à la relation du Voyage à la recherche de La Pérouse. 1 vol.—*From the Royal Gardens, Kew.*

LAWSON, Prof. G. Presidential Address to Royal Society of Canada.—*From the Author.*

L'HÉRITIER, C. L. Sertum Anglicum. 1788. 1 vol.

——— Geraniologia. 1787–88. 1 vol. fol.—*From the Royal Gardens, Kew.*

LEERS, J. D. Flora Herbornensis. 1789. 1 vol.—*From the Royal Gardens, Kew.*

LEHMAN, J. G. C. Memoir of A. G. Ainsinck, &c. 1833.—*From the Royal Gardens, Kew.*

LINDLEY, J. Observations upon the Effects produced on Plants by the Frost, &c., 1837–38. 1839.—*From the Royal Gardens, Kew.*

LINNÉ, C. von. Genera Plantarum. Viennæ, 1767. 1 vol.

——— Prælectiones in Ordinibus Naturalibus Plantarium Edit. Giseke. P. D., 1792. 1 vol.—*From the Royal Gardens, Kew.*

LOUDON, J. C. Magazine of Natural History. Vols. I.–IX.—*From Thomas Walker.*

MAPPI, M. Historia Plantarum Alsaticarum. 1742. 1 vol.—*From the Royal Gardens, Kew.*

MEYER, G. F. W. Flora des Königreichs Hannover. 1822. 1 vol.—*From the Royal Gardens, Kew.*

MORISON, R. Plantarum Historiæ Univers. Oxoniensis, Pars 2 et 3. 2 vols. 1680–99.—*From the Royal Gardens, Kew.*

MUELLER, Baron F. VON. On New Australian Plants.

——— On a New *Casuarina.*

——— Definition of some New Australian Plants.

——— Vegetable Fossils of Victoria.—*From the Royal Gardens, Kew.*

——— Iconography of Australian Species of *Acacia.* Decades 12, 13.

——— Select Extra Tropical Plants. 7th Ed.—*From the Government of Victoria.*

MULLER, O. F. Flora Fridrichsdalina, &c. Daniæ. 1767. 1 vol.—*From the Royal Gardens, Kew.*

NOTARIS, J. D. Musci Italici. 1 vol.—*From the Royal Gardens, Kew.*

OUDEMANS, C. A. J. A. Flora von Nederland. 1859–62. 4 vols.—*From the Royal Gardens, Kew.*

PALLAS, P. S. Flora Rossica. 1 vol.—*From the Royal Gardens, Kew.*

PAXTON, J. Magazine of Botany. Vols. I.–VII.—*From Charles Jenner, Esq.*

RAUWENHOFF, N. W. P. Onderzoekimgen over *Sphaeroplea annulina,* Ag.—*From the Author.*

REBENTISCH, J. F. Prodromus Floræ Neomarchicæ. 1804. 1 vol.—*From the Royal Gardens, Kew.*

REGEL, ED. Descriptiones et Emendationes plantarum in Horto Imperiali Botanico Petropolitano cultarum.—*From the Author.*

RODRIGUEZ, J. B. Genera et Species Orchidarum novarum. 1 vol.—*From the Royal Gardens, Kew.*

SAUNDERS, W. W. Refugium Botanicum. Vol. I.—*From Charles Jenner, Esq.*

SAVI, G. Trattato degli Alberi della Toscana. 1811. 1 vol.—*From the Royal Gardens, Kew.*

SCHILLING, Dr W. Hand- und Lehrbuch für angehende Naturforscher.—*From Thomas Walker.*

SCHUMACHER, C. F. Enumeratio Plantarum in partibus Sællandiae septalis et Orientalis. 1801–3. 2 vols.—*From the Royal Gardens, Kew*

SCHWENDENER, Prof. S. Die Spaltöffnungen der Gramineen und Cyperaceen.

——— Zur Doppelbrechung vegetabilischer Objecte.—*From the Author.*

SEEMAN, B. et W. E. G. Bonplandia. Vol. I.—*From Thomas Walker.*

SMITH, ANDREW. A Contribution to South African Materia Medica.—*From Robert Young, Esq.*

SMITH, J. E. Tracts relating to Natural History. 1798. 1 vol.—*From the Royal Gardens, Kew.*

SOLE, W. Menthæ Britannicæ. 1798. 1 vol.—*From the Royal Gardens, Kew.*

SOLLY, ED. Experiments on the Inorganic Constituents of Plants. On the Exhaustion of Soils. 1845.—*From the Royal Gardens, Kew.*

SPRENGEL, C. Floræ Halensis. 1806. 1 vol.—*From the Royal Gardens, Kew.*

SWEET, R. British Flower Garden. 1st Series, Vols. I.–III.; 2nd Series, Vol. I.—*From Charles Jenner, Esq.*

THURM, E. F. IM. Visit of the Governor to the Pomeroon District.—*From the Royal Gardens, Kew.*

TRAILL, G. W. The Marine Algæ of Elie (co. Fife).—*From the Author.*

TREVELYAN, W. C. On the Vegetation and Temperature of the Färoe Islands.—*From the Royal Gardens, Kew.*

TURNER, CHR., and SPENCER, JOHN. The Florist for 1856, 57, 58, 59, and 60.—*From Charles Jenner, Esq.*

TURNER, DAWSON. Synopsis of the British Fuci.—*From George Murray, Esq.*

VISIANI, R. DE. Flora Dalmatica, &c. 1842. 1 vol.—*From the Royal Gardens, Kew.*

WIKSTROM, J. E. Stockholms Flora. 1840. 1 vol.—*From the Royal Gardens, Kew.*

WILLKOMM, M., et LANGE, J. Prodromus Floræ Hispanicæ. 1861. 1 vol.—*From the Royal Gardens, Kew.*

WINCH, N. J. Contribution to the Flora of Cumberland.—*From the Royal Gardens, Kew.*

GOVERNMENT PAPERS, REPORTS AND PUBLICATIONS OF CORPORATIONS, SOCIETIES, &c.

ADELAIDE.—Botanic Garden.

Annual Report for 1888.—*From the Director.*

AMSTERDAM.—Koninkliijke Akademie.

Verslagen en Mededeelingen. Vol. III. Parts 3 and 4.—*From the Academy.*

BELFAST.—Naturalists' Field Club.

Annual Report and Proceedings. Series II. Vol. III. Part 1.—*From the Club.*

Natural History and Philosophical Society.

Report and Proceedings for Session 1887–88.—*From the Society.*

BERLIN.—Botanischer Verein für die Provinz Bradenburg.

Verhandlungen. Jahrgang XXIX.—*From the Society.*

BERNE.—Société Helvétique des Sciences Naturelles.
Verhandlungen. 1887–88.—*From the Society.*
Naturforschende Gesellschaft.
Mittheilungen. Nos. 1195–1214.—*From the Society.*
BERWICK.—Berwickshire Naturalists' Club.
Proceedings, Vol. XII. No. 1.—*From the Club.*
BONN.—Naturhistorischer Verein der Preussischen Rheinlande, Westfalens, und Reg.-Bezirks Osnabruck.
Verhandlungen Jahrg., XLIII. 2; XLIV. 1 and 2; XLV. 1 and 2; XLVI. 1.—*From the Society.*
BOSTON.—Boston Society of Natural History.
Proceedings. Vol. XXIII. Parts 3, 4.—*From the Society.*
Massachusetts Horticultural Society.
Transactions, 1888, Part 1; 1878, Part 2.—*From the Society.*
BREMEN.—Naturwissenschaftlicher Verein.
Abhandlungen. Bd. II. Hft. 2, 3; III.; IV. Hft. 4; X. Hft. 3.
Beilage. Nos. 1, 2, 6, 7, 8.—*From the Society.*
BRESLAU.—Schlesischen Gesellschaft fur vaterlandische Cultur. Botanischen Section, 1888.
Berichte.—*From the Society.*
BRISBANE.—Royal Society of Queensland.
Proceedings. Vol. V. Parts 1, 2, 3; Vol. VI. Parts 1–4.—*From the Society.*
BRISTOL.—Bristol Naturalists' Society.
Proceedings. Vol. V. Part 3. List of Officers, &c.—*From the Society.*
BRUSSELS.—Société Royale de Botanique de Belgique.
Bulletin. Tome XXVI. Fasc. 2; Tome XXVII.—*From the Society.*
Académie Royale des Sciences de Belgique.
Bulletin. Série 3, Tom. XIV.–XVII.
Annuaire, 1888–89.—*From the Society.*
Federation des Sociétés d'Horticulture de Belgiques.
Bulletin, 1886.—*From the Federation.*
BUITENZORG.—Jardin de Botanique.
Annales. Vol. VII. Pa. 1.
CAMBRIDGE.—Botanic Garden.
Syndicate Reports.—*From the Royal Gardens, Kew.*
CHERBOURG.—Société Nationale des Sciences.
Mémoires. Tome XXV.—*From the Society.*
CINCINNATI.—Society of Natural History.
Journal. Vol. XI. Nos. 2, 3, and 4; Vol. XII. No. 1.—*From the Society.*
COPENHAGEN.—Botaniske Forening.
Botaniske Tidsskrift. Vol. XVII. Parts 1, 2.—*From the Society.*
COSTA RICA.—Museo Nacional.
Anales, Tome I.—*From the Museum.*
COURRENSAN.—Société française de Botanique.
Journal de Botanique. Tome VI. Nos. 61–72.—*From the Society.*
CRACOW.—Academija Umiejetnósci.
Comptes Rendus. 1889. Nos. 4–7.—*From the Society.*

DUBLIN.—Royal Society.
Transactions. Vol. IV. Parts 2–5.
Proceedings. Vols. I., II.; Vol. VI. Parts 3–6.—*From the Society.*

DUMFRIES.—Dumfriesshire and Galloway Natural History and Antiquarian Society.
Transactions, Journal, and Proceedings. Session 1886–87.—*From the Society.*

EDINBURGH.—Botanical Society.
Transactions and Proceedings. Vol. XVII. Part 2, 1888.—*From the Society.*
Royal College of Physicians.
Reports from the Laboratory. Vol. I.—*From the College.*
Royal Society.
Proceedings, Vols. XIII., XIV.—*From the Society.*
Royal Physical Society.
Proceedings. Session 1887–88.—*From the Society.*
Royal Scottish Society of Arts.
Transactions. Vol. XII. Part 2.—*From the Society.*

ESSEX.—Naturalists' Field Club.
The Essex Naturalist. Vol. II. Nos. 9, 12; Vol. III. Nos. 1–6.—*From the Club.*

ERLANGEN.—Physikalisch-Medicinische Societät.
Sitzungsberichte. Heft 20. 1887–88.—*From the Society.*

GIESSEN.—Oberhessische Gesellschaft für Natur- und Heilkunde.
Berichte, XXIV.—*From the Society.*

GLASGOW.—Philosophical Society.
Proceedings. Vol. XIX. Session 1887–88.—*From the Society.*

HAARLEM.—Nederlandische Maatschappij ter Bevordering van Nijverheid.
Tijdschrift. 4e Reeks, Deel XIII., Jan. to Aug. 1889.
Koloniaal Museum. Reports 3 and 4.—*From the Society.*
Musée Teyler.
Archives. Series II. Vol. III. Parts 2, 3.
Catalogue de la Bibliothèque, Parts 7 and 8.—*From the Corporation.*

HALIFAX.—University.
Calendar of Dalhousie College and University.—*From Prof. G. Lawson.*
Nova Scotia Institute of Natural Science.
Proceedings and Transactions. Vol. VII. Part 2.—*From the Institute*
Government of Nova Scotia.
Annual Report of the Central Board of Agriculture, 1888.
Provincial Government Crop Report.
Journal of the House of Assembly.—*From Dr G. Lawson.*

HALLE.—Kaiserliche Leopoldinisch Carolinische Deutsche Akademie der Naturforscher.
Nova Acta. Band LIII. No. 4.
Leopoldina. 1888.—*From the Academy.*

HERTFORDSHIRE.—Natural History Society.
Transactions. Vol. V. Parts 2, 3, 5.—*From the Society.*

KÖNIGSBERG.—Physicalisch-Oekonomische Gesellschaft.
Schriften, XXIX., 1888.—*From the Society.*
LISBON.—Academia Real das Sciencias.
Journal. No. 45.—*From the Academy.*
LONDON.—Linnean Society.
Journal. Nos. 156, 162, 165–171, 173.
General Index to Volumes I.–XX.
Transactions. 2nd Series. Vol. II. Part 16.—*From the Society.*
Pharmaceutical Society.
Journal. Nos. 948–980.
Calendar, 1888, 1889:—*From the Society.*
Quekett Microscopical Club.
Journal. Ser. 2, Vol. III. Nos. 23–25.—*From the Club.*
Royal Horticultural Society.
Journal. Vol. X.; Vol. XI. Parts 1, 2.—*From the Society.*
India Office.
Annual Administration Report for 1887–88.—*From the India Office.*
LUND.—Universitas Lundensis.
Acta. Tome XXIV.—*From the University.*
LYONS.—Société Botanique.
Bulletin Trimestriel. Nos. 1–4, 1889.
Annales, 1888, 1889.—*From the Society.*
MANCHESTER.—Botanical Record Club.
Phanerogamic and Cryptogamic Report for the Year 1888.—*From the Club.*
MELBOURNE.—Royal Society of Victoria.
Transactions, New Ser., Vol. I. Part 1.
Proceedings, Vol. I. Part 1.—*From the Society.*
MILAN.—Instituto Botanico di Roma.
Annuario. Vol. III. Fasc. 1.—*From the Institute.*
MONTREAL.—Geological and Natural History Survey of Canada.
Catalogue of Canadian Plants. Part IV.
List of Publications.
Annual Report. Vol. II., 1886, with Maps.—*From the Survey.*
MOSCOW.—Société Impériale des Naturalistes.
Bulletin. 1888, Nos. 3 and 4. 1889, No. 1.
Beilage. Nos. 1, 2, 1888.—*From the Society.*
NEWCASTLE-ON-TYNE.—Tyneside Naturalists' Field Club.
Transactions. Vol. X. Part 1.—*From the Club.*
NEW YORK.—American Museum of Natural History.
Bulletin. Vol. II. No. 2.
Annual Reports, 1887–88, 1888–89.—*From the Museum.*
Torrey Botanical Club.
Bulletin. Vol. XV. Parts 10–12; Vol. XVI. Parts 1–8.—*From the Club.*
Academy of Sciences.
Transactions. Vol. VII. Nos. 3–8; Vol. VIII. Nos. 1–4.—*From the Academy.*

Palermo.—Hortus Botanicus Panormitanus. Tome II. Fasc. 5.—*From Prof. Todaro.*

Paris.—Société Botanique de France.

Bulletin. Revue Bibliographique.

Comptes Rendus. Tome XXXV. Parts 4 and 5; Tome XXXVI. Parts 1–4.—*From the Society.*

Société Linnéenne de Paris.

Bulletin Mensuel. Nos. 95–97.—*From the Society.*

Petersburg, St.—Hortus Imperialis Botanicus Petropolitanus.

Acta. Tome X. Fasc. 2.—*From the Garden.*

Philadelphia.—Academy of Natural Science.

Proceedings. 1888. Parts 2 and 3.—*From the Academy.*

San Francisco.—California State Board.

Second Biennial Report of Board of Forestry, 1887–88.—*From the Board.*

Sydney.—Royal Society of New South Wales.

Journal and Proceedings. Vol. XXII. Parts 1, 2.—*From the Society.*

Toronto.—Canadian Institute.

Proceedings. Vol. VI. Fasc. 1 and 2.—*From the Institute.*

Upsala.—Societas regia Scientiarum Upsaliensis.

Nova Acta. Series 3, Vol. XIII. Fasc. 1.—*From the Society.*

Vienna.—Königlich-kaiserliche Naturhistorische Hofmuseum.

Annals. Band I. Nos. 1, 2.—*From the Museum.*

Washington.—Smithsonian Institution.

Report of Board of Regents, 1885. Part 2.—*From the Institute.*

United States Geological and Geographical Survey of the Territories.

Monograph XII. with Atlas.

Geology of Leadville.

Mineral Resources of United States. 1887.—*From the Survey.*

Wellington.—New Zealand Institute.

Transactions and Proceedings. Vol. XXI.—*From the Institute.*

Colonial Museum and Geological Survey Department.

23rd Annual Report.

Meteorological Report.

Phormium tenax, 2nd Edition.—*From the Director.*

PERIODICALS.

Annals of Botany. Vol. I. Nos. 1, 3, 4.—*From Professor Bayley Balfour.*

The Botanical Gazette. Vol. XIII. Nos. 10–12; Vol. XIV. Nos. 1–8.—*From the Editor.*

The Botanical Magazine. Vol. CXIV.—*From Charles Jenner, Esq.*

The Garden. 1888–89.—*From R. Lindsay, Esq.*

The Garden and Forest. Nos. 1–83.—*From Professor Bayley Balfour.*

The Gardeners' Chronicle. 1888–89.—*From the Editor.*

Nature. Nos. 989–1038.—*From the Editor.*

Botanische Jaarboek, 1889.—*From Professor Macleod.*

THE HERBARIUM AT THE ROYAL BOTANIC GARDEN.

The following additions have been made to the Herbarium of the Royal Botanic Garden, Edinburgh, during the year from 1st October 1888 to 1st October 1889:—

BENNETT, A., Esq. *Calamagrostis stricta*, Nutt., var. *borealis*, Hunter.

BOLUS, H., Esq. South African Plants, 1 bundle (259).

CARLIER, E. W. A small collection of Belgian Plants.

CRAIG, Dr. *Leocarpus vermicosus*.

DICKSON, Dr ARCHIBALD.. Swiss and other Plants, 11 bundles.

GRUNOW, A. 14 specimens of Australian and Japanese Algæ.

LEIBIUS, Madam E. O. *Solidago arguta*, L., 1 specimen.

MUELLER, Baron F. von. Specimens of Stylidieæ (25).

ROYAL GARDENS, KEW.—Plants from Ichang, China, collected by D. Henry.

Plants of the Greek Archipelago; collected by Barbey, Major, and others, 3 bundles.

Mougeot's Stripes Cryptogamæ. Fasc. 1–15.

Bohler and Wagner's Lichens, 1 vol.

Dicksons' Fasciculi Plantarum Cryptogamicarum Britanniæ. 1 vol.

Leefe's Salicetum Britannicum Exsiccatum.

Leefe's general Herbarium, 4 bundles.

Haussknecht's Greek Plants, 6 bundles.

Buysman's Egyptian Plants, 4 sheets.

French Plants, 3 bundles.

Thomson's Maroccan Plants, a few.

Wight's Indian Plants, 1 bundle.

South African Plants, 1 bundle.

Schomburgk's Plants, 1 bundle.

Miscellaneous Ferns, 1 bundle.

Miscellaneous Grasses, 1 bundle.

Miscellaneous Flowering Plants, 13 bundles.

Miscellaneous Algæ, 6 bundles.

Plants collected by the British North American Commission, one set.

Rothery's Cayenne Plants, 1 bundle.

Lojocono's Italica Plants, 1 bundle.

Palmer's Mexican Plants, 1 bundle.

Sullivant's Musci Alleghanienses. 1846. 1 vol.

Kuntze's Herbarium Plants, 1 bundle.

Fijari's Egyptian and Arabian Plants, 2 bundles.

SCOTT ELLIOT, G. F. Five bundles of South African Plants.

THRELLFALL, WILLIAM, Representatives of. Persian Plants collected by Mr Threllfall, 12 bundles.

TRAILL, G. M. 29 Specimens of Algæ.

TYSON, W. South African Plants, 1 bundle.

WOOD, J. M. South African Plants, 1 bundle.

WOODROW, G. MARSHALL, Esq., Poonah. Acacia from Socotra—3 specimens.

THE MUSEUM OF THE ROYAL BOTANIC GARDEN.

The following additions have been made to the Museum of the Royal Botanic Garden, Edinburgh, during the year from 1st October 1888 to 1st October 1889:—

AITCHISON, Dr J. E. T. Specimens of Orchid Salep.
——— Sapucaia and Butter Nuts.
BARCLAY, G. M. Lake Balls of *Cladophora œgagropila*, from S. Uist.
BELL, R. (through the Scottish Horticultural Association). Twin Cucumber.
BOWER, Prof. F. O. Male Cone of *Ceratozamia*.
——— Specimens of *Pilularia globulifera*.
BROCKLEHURST, GEORGE. Abnormal Grape.
CUMMING, Miss A. W. *Orobanche Hederœ*.
DONALDSON, W. Two Fruits of *Nelumbium*.
DOYNE, Miss BERTA. Specimens of *Cyathus striatus* and *Geoglossum*.
DUNN, MALCOLM. Flower Branches of *Lapageria* and *Philageria*.
——— *Monstera*, Pine-Apple, and other Fruits.
——— Apple-Grafts.
ELLIOT, SAMUEL, Galashiels. Hypertrophied Pear.
ELLIOT, G. F. SCOTT. Sugar-canes attacked by borer insects.
FRASER, Miss LILIAS. Salmon infested with *Saprolegnia ferax*.
GORDON, J. British Grasses attacked by Ergot.
GRAY, A. *Lecidea pulchella*, from Ben Nevis.
HUTTON, G. H. Semi-double *Nigella damascena*.
KNIGHT, Dr. Fruits of *Avena* from Plants grown from Grain taken out of a Mummy.
LAIRD, Messrs R. B. Specimens of *Æcidium Grossularieœ*.
LAWSON, Sir W. Two female Cones of *Zamia*.
MACDONALD, Mrs, Largie Castle. Specimens of *Merulius lacrymans*.
MACFARLANE, G. L. Cinchona Bark, from Ceylon.
M'INTOSH, C., Dunkeld. Specimens of Fungi and Musci.
MUNICH SCHOOL OF FORESTRY. Collection of Pathological Specimens.
OWEN, Miss C. M. Leaf-Fungi, Seeds, &c.
PURVIS, Dr. Proliferated Poppy.
ROBERTSON, W. W. Specimens of Dry-Rot.
ROYAL GARDENS, KEW. Collection of Gums, Leaves, Fruits, Seeds, and Fibres.
——— Stems of Cycads—Cases of Cocoons.
——— Nineteen Fasciculi of Reinsch's preparation of Microscopic Algæ.
THOMSON, C., Londonderry. Proliferated Rose.
TURNBULL, R., B.Sc. *Splachnum mnioides*, from Ben Nevis.
WATSON C. Grafted Cherry.
WYTSON, W., M.D. *Bulgaria inquinans*.

The Society exchanges Publications with—

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Montreal, . . Geological and Natural History Survey of Canada.—Alfred R. C. Selwyn, Director.
Natural History Society.
Toronto, . . Canadian Institute.

Nova Scotia.

Halifax, . . Agricultural Department.—Prof. G. Lawson, Secretary.

United States.

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Boston Society of Natural History.
Cincinnati, . Cincinnati Society of Natural History.
Crawfordsville, Editor of *Botanical Gazette*.
New Haven, . Connecticut Academy of Arts and Sciences.
New York, . . New York Academy of Sciences.
Torrey Botanical Club.
American Museum of Natural History.
Philadelphia, . Academy of Natural Sciences.
San Francisco, California Academy of Sciences.
Topeka, . . Kansas Academy of Science.
Washington, . United States Geological and Geographical Survey of Territories.—J. V. Hayden, Director.
United States Geological Survey.—T. W. Powell, Director.
Smithsonian Institution.
United States Department of Agriculture, Section of Vegetable Pathology.—B. T. Galloway, Chief.

South America.

Rio-de-Janeiro, Museu Nacional.

AUSTRALASIA.

New South Wales.

Sydney, . . . Royal Society of New South Wales.

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Brisbane, . . Royal Society of Queensland.

Victoria.

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EUROPE.

Austria.

Cracow, . . . Academija Umiejetnósci.
Graz, . . . Naturwissenschaftlicher Verein für Steiermark.
Vienna, . . . Kaiserlich-Königliche Zoologisch-botanische Gesellschaft.

Belgium.

Brussels, . . . Académie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique.
Société Royale de botanique de Belgique.
Ghent, . . . Editor of *Botanische Jaarboek.*

Denmark.

Copenhagen, . Botaniske forening.

France.

Cherbourg, . . . Société Nationale des Sciences Naturelles et Mathematiques.
Courrensan, . Société Française de Botanique.
Lyons, . . . Société Botanique.
Paris, . . . Société Botanique de France.

Germany.

Berlin, . . . Botanische Verein für die Provinz Brandenburg und die angrenzenden Länder.
Bonn, . . . Naturhistorischer Verein der preussischen Rheinlande, Westfalens, und der Reg.-Bezirks Osnabruck.
Bremen, . . . Naturwissenschaftliche Verein.
Erlangen, . . . Physikalisch-Medicinische Societät.
Giessen, . . . Oberhessische Gesellschaft für Natur- und Heilkunde.
Halle, . . . Kaiserlich Leopoldinisch-Carolinische deutsche Akademie der Naturforscher.
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Glasgow, . . . Natural History Society.
Philosophical Society.

Hertford, . . Hertfordshire Natural History Society and Field Club.
Liverpool, . . Literary and Philosophical Society.
London, . . Editor of *Gardeners' Chronicle.*
Linnean Society.
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Pharmaceutical Society of Great Britain.
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Royal Horticultural Society.
Manchester, . Manchester Literary and Philosophical Society.
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Perth, . . . Perthshire Society of Natural Science.
Plymouth, . . Plymouth Institution.

HOLLAND.

Amsterdam, . Koninklijke Akademie van Wettenschappen.
Haarlem, . . Musée Teyler.
Nederlandische Maatschappij ter Bevordering van Nijverheid.
Luxembourg, . Société Botanique du Grand-duché de Luxembourg.

ITALY.

Rome, . . . Reale Instituto Botanico.

PORTUGAL.

Lisbon, . . . Academia real das Sciencias.

SCANDINAVIA.

Lund, . . . Universitas Lundensis.
Upsala, . . Societas regia Scientiarum Upsaliensis.

SWITZERLAND.

Berne, . . . Naturforschende Gesellschaft.

RUSSIA.

Kieff, . . . Société des Naturalistes.
Moscow, . . Société impériale des Naturalistes.

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Corrected to October 1889.

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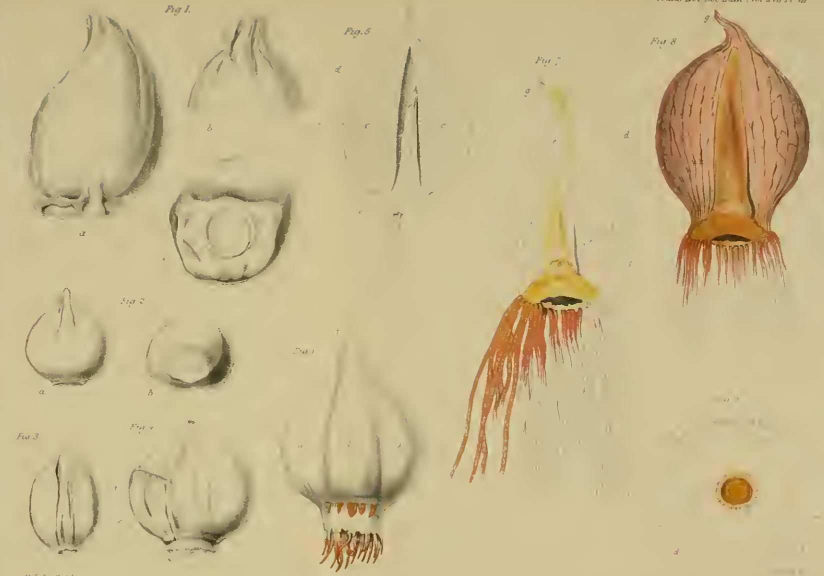
Fig. 8.

Fig. 9.

F Huth, Lithr Edinr



M. F. Smith del

AITCHISON — ON BADSHA OR ROYAL SALEP

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CAREX SEWELLII, Benn. et C.B. Clarke.

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