TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY.

VOLUME XIV.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY.

MDCCCLXXXIII

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BOTANICAL SOCIETY.

VOL. XIV.—PART I.

EDINBURGH:
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TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

SESSION XLIV.

13*th November* 1879.—Dr T. A. G. Balfour, President, in the Chair.

The Chairman delivered the following valedictory address :—

Gentlemen,—In resigning this chair, to which you did me the honour of electing me two years ago, I intend to deliver no formal address, but, as our obituary list during the past year has, I am sorry to say, been unusually large, to confine myself almost exclusively to giving a sketch of the lives of the deceased, especially as some of these have held the foremost ranks in botanical science. I cannot, however, omit taking some notice of a lecture delivered in this city about three weeks ago, in which botany as a part of medical education was virtually declared to be worse than useless. It would be preposterous in me, in addressing you, gentlemen, who know the value of that science so well, to occupy much time in replying to such a charge ; but a few remarks seem called for on the present occasion.

I always thought that the grand feature of medical education in our day was the raising of its standard; and that the preliminary examinations recently introduced were for this very purpose, viz., to secure that no imperfectly educated person should find admission into the medical profession. On the same principle the wisdom of our forefathers prescribed for the students of medicine the subjects of botany and zoology. The university, to its honour be it said, has maintained this programme in all its integrity; I regret, however, to say that the former subject has been ignored by the two colleges, but I certainly was not prepared to find that, not content with the colleges having dropped it, the university was to be attacked for having retained it, and that the very complete education which has been the glory of our *alma mater* was to be turned to her discredit. That botany may be studied as a part of general education was indeed conceded; but that, as regards its bearing on medicine it was (if the speaker's words were correctly reported) of no importance at all,—a mere waste of the medical student's precious time.

Now, gentlemen, such words as these, if uttered on any other occasion than that of an inaugural address, might safely be left to fall into the pit of oblivion, to which their inherent gravity would hasten their descent, but when we find other teachers present, and a vote of thanks unanimously accorded, it is time for us, in defence of our special science, to inquire whether or not botany can be of any use to the student of medicine; and I should say—

1st. He must surely have been asleep during the past few years who does not know and acknowledge the intimate connection between the vegetable and animal worlds. Physiology is, I suppose, regarded by the lecturer as an important part of the medical curriculum; but, I think, it must be generally allowed that no man can be a truly accomplished physiologist who is ignorant of the functions of the vegetable kingdom. So much is this the case, that only a few years ago, from that very same chair, Professor Pettigrew, in treating of the circulation of the blood, began with the consideration of the manifestation of movements in tubes, &c., as exhibited in the vegetable world, devoting at least two of his twelve lectures to that subject. It was one of the grand characteristics of the teaching of Goodsir, that he fixed the anatomical truths which he was communicating in a firm, interesting, and philosophical manner, by the analogous structures revealed by comparative anatomy; and surely no more certain method of conveying physiological truth in an attractive and impressive manner can be found, than by taking a comprehensive view of the functions of organic life. But not to dwell longer upon this topic, I shall pass on to—

2d. That as a very large proportion of the substances of our Materia Medica are derived from the vegetable world, it is surely of importance that we should know something of the characters and relations of the plants which yield them. If any one should say that we can easily prescribe rhubarb without knowing its botanical source, or that it belongs to the *Polygonaceæ*, then I answer that we can with equal facility prescribe Epsom salts without any knowledge of its being sulphate of magnesia; but if the absence of the latter knowledge would imply an ignorance of chemistry which would preclude from the medical profession, on what ground can the gross ignorance of botany be applauded and regarded as a ground of congratulation? Is it asserted that an acquaintance with natural orders can teach us nothing bearing on the medicinal character of the plant? This only betokens the ignorance of the asserter; for does he not know that A. P. de Candolle, as early as 1816, published a work entitled "On the Medicinal Properties of Plants compared with their External Characters and their Natural Classification," thus establishing a law which indeed Linnæus himself suggested, and which was accepted by the majority of the men of science. The researches of Crum Brown and Fraser, Cahours, &c., on ethyl- and methyl-strychnia, have shown how a slight chemical change may entirely alter the physiological actions, and have thus proved how apparent contradictions to the above law, in the case of *Strychnos toxifera* yielding curare, as compared with other species of *Strychnos*, may be explained. But in a recent paper, Professor Herlandt, by a careful, minute, and discriminating process, has fully established the three following propositions:—

(1.) Botanic species and families which are similar in their characters are also similar in the nature and properties of their constituents.

(2.) The species which form the connecting link between similar groups contain constituents belonging to the allied families.

(3.) The botanic and natural classification of the medicaments of vegetable origin is the only scientific and rational one.

Any one who reads Herlandt's paper with care cannot fail to see that the suggestion of Linnæus was essentially correct; and surely that establishes the importance, if not necessity, of the study of botany by the student of medicine. It is not, however, only regarding medicinal plants that botanical knowledge is of service to a medical practitioner. I may illustrate this by a case that occurred in my own practice only a few months ago. A lady and gentleman entered my study, bringing with them their little girl, and exhibiting great anxiety and alarm lest she had poisoned herself, as she had eaten one of some foreign seeds which had been given her to play with. They had brought with them a seed similar to the one which she had eaten, and I was at once enabled to relieve their minds from all anxiety, and to assure them that no injurious consequences would result; for in the seed brought I recognised that of *Coix lachryma*. Now, supposing the child had been taken to the student or medical practitioner trained according to the most recent advice of the lecturer referred to, she would doubtless have been subjected to the misery resulting from the administration of an active emetic, and the grief and painful surmises of the parents would have remained unallayed. But to pass to the province of pathology, I assert—

3d. That even in tracing the history of some diseases, a knowledge of the lower forms of vegetation is of the utmost importance. Who that knows anything of the "germ-theory" is not aware of the fact that the *Bacteria* and *Vibriones* have, by Lister's able researches, been shown to be vegetable organisms?* Again, how is the medical practitioner ignorant of botany to be able to give an opinion as to the cryptogams which either cause or complicate so many diseases of the scalp? It is all very well to say

* Need I refer to the researches of Dr Klein in regard to what he styles "Pneumo-enteritis" in swine, by which he has shown "that the microphyte which accompanies the disease is botanically specific, and that both it and its progeny can be conducted through a series of artificial cultivations apart from the animal body; and that germs thus remotely descended from a first con-

you can get that information from botanists, but I regard everything connected with a disease as a special subject of medical study, to which the practitioner ought to be able to bring a mind well cultured as to phytology. It would be easy for me here to retort that insanity in most cases can without difficulty be proved by the testimony of the friends of the insane, and that, after all, the most skilful alienist physician would in many cases be very helpless without such testimony being afforded him; and that, as it is only the proofs of the existence and not *the kind* of the insanity which require to be scheduled, therefore the study of mental diseases in all their phases is only a needless burden imposed on the medical student who has an eye to general practice. But surely in such a case the reply would be forthcoming that we must train all our faculties and acquire all collateral knowledge, such as psychology, ontology, logic, and deontology, that we may intelligently deal with the disease; and is not a similar answer as valid regarding botany in the above instances.

4th. Were it only as a healthy recreation, botany is a great advantage to the medical student. The lecturer stated that he would select his assistant not from among the students who had obtained gold medals for herbaria, but from among those who could show most names in the dispensary case-book. Now, apart from the gross misrepresentation of botanical science and teaching which is involved in the above statement, it would probably be found that the diligence and energy displayed by the successful competitor for the herbarium medal had also procured for him the largest number of cases in his dispensary book, and these more carefully and accurately diagnosed, just in consequence of the botanical training through which he was passing; and as it is important that an assistant should be possessed of vigorous health, such a condition would be more likely to be found in the botanist than in the other. Besides all this, the physician who has no

tagium will, if living animals be inoculated with them, breed in these animals the specific disease." The splenic fever of farm stock has been proved by other observers to be due also to a microphyte; and the *Spirilla*, which is a distinct botanical species, though not actually proved to be the cause of relapsing fever, is yet found multiplying in the blood of persons affected with that disease (Simon).

interest in natural science studies is apt to have his mind cramped and narrowed, and is thus prepared to fall a victim to morbid ideas; whereas the man whose studies have embraced the natural sciences finds an ennobling and healthy influence in their pursuit. How different from that of the lecturer referred to was the view of such a physician as the late Dr Warburton Begbie, who, on receiving a botanical paper from a medical friend who had written it, expressed the interest which he felt in the subject, and added, "How pleasant it is to have such a study to relieve the tension of your ordinary daily labours." The keen student of botany is not necessarily the less ardent and successful prosecutor of his other medical studies; though, to confine myself to my own fellow students, neither Burdon Sanderson nor Murchison, however they might have aspired, would ever have been admitted to the high office of assistant to Dr Batty Tuke.

It would be easy to enlarge on this theme, and to show the importance of a knowledge of botany from its bearing on hygiene,—*e.g.*, when vegetable organisms in the water-supply render it unsuitable,—malaria,* &c., &c.; but the time at my disposal is already too short for the work that is before us, so that I must at once proceed to the Obituary Notices, which have reference to the following:—

Mr JAMES M'NAB.	Dr DAVID MOORE.
Sir W. C. TREVELYAN.	Mr PETER S. ROBERTSON.
Dr M'BAIN.	Mr WM. MUDD.
Prof. GRISEBACH.	Dr JOHANN F. TH. IRMISCH.
Mr ARTHUR FORBES.	Mr SAMUEL HAY.
Mr A. J. ADIE.	Dr M. A. E. WILKINSON.
Dr JAS. CUMMING.	Rev. W. B. CUNNINGHAM.
Dr KARL KOCH.	Mr E. V. SANDILANDS.
Dr CHARLES MURCHISON.	Mr A. GRAHAM.

* Since the above was written, a most interesting essay on "Contagion," from the pen of Mr Simon, has appeared, in which he quotes the researches of Professors Klebs and Tommasi-Crudeli made at Rome in reference to the ague endemic there, which seem to render it certain that ague-poison is a microphyte of malarious soil; for these professors maintain that they can isolate from malarious soils and their atmospheres definite microphytic forms capable of separate cultivation; and that if this microphyte, which they have named *Bacillus malariæ*, be cultivated through successive generations in successive portions of an indifferent fluid, and a portion of the last fluid in which the *Bacillus* is germinating be injected subcutaneously into rabbits, ague will be produced in these animals.

In my opening address last year I alluded to the deep sorrow which we all felt at the serious illness under which Mr M'Nab was labouring, and I then expressed the earnest hope that his valuable life might yet be prolonged for our sakes, and for that of the science which he loved so well. It has, however, been otherwise ordered, and we have been called to mourn over his sad removal from among us, which has left a blank of no ordinary kind. A special obituary notice of our late esteemed Curator was, as was most befitting, communicated to us during our last session by the Regius Director of the Botanic Garden; but I should think myself chargeable with unkindness and neglect did I, in my present position, even at the risk of repetition, omit all reference to some of the valuable services which he rendered to botanical science, especially to horticulture. As one of the original members of this Society, which was founded in 1836, he was most diligent and assiduous in his attendance, and contributed largely to its "Transactions." A touching incident occurred only a few days before his death, which shows the great interest which, to the very last, he took in this Society, and the conscientious way in which he discharged his duties towards it. One day, when seriously ill and naturally claiming the constant attention of his attached family, none of whom was willing to be absent from him, he remembered that in the evening our opening meeting for the session took place, and turning to his son, he urged him to go to it as his representative; "for," he added, "I have never, till now, been absent from any of the opening addresses." It was always a treat to listen to the very interesting monthly reports on the progress of open-air vegetation in the Botanic Garden, and the various readings of the thermometer, which have proved of the highest value to horticulturists and meteorologists; in connection with the latter, I need only remind you of the very interesting paper by our friend Mr Buchan, "On the Flowering of Spring Plants," and to his acknowledgement of his indebtedness to those observations of Mr M'Nab. To all the cognate subjects of botany, horticulture, arboriculture, landscape gardening, and vegetable climatology he devoted much attention, as his numerous papers scattered through various magazines show; and many a piece of ground, whether it be a square or park in the city, or more extensive domain elsewhere, owes its beauty and attractiveness to the skill and ability of his directing mind.

The Rockery in the Botanic Garden will ever be associated with his name. It has proved a great success, and has added an additional charm to these Gardens which, though dealt with most niggardly by successive Governments, stands second to none but Kew. In 1872 Mr M'Nab was unanimously elected to occupy this presidential chair, and the admirable opening address which in November 1873, in the capacity of President, he delivered, and the animated discussion to which it gave rise, are fresh in the memories of all of us.

I have not alluded to the special advantages which Mr James M'Nab enjoyed in being trained under so distinguished a father, who, for the period of thirty-eight years preceded him as Curator, nor to his own appointment, in 1843, to that honourable and responsible position, which he filled with such credit to himself and benefit to the Gardens; nor have I spoken of his visit in 1834 to the United States and Canada, which he turned to such good account; nor have I alluded to his experiments on the best method of heating greenhouses; nor to his appointment as Superintendent of the Experimental Garden; for we have already had such a full history of the life and work of our departed friend, that only a few words seemed here to be necessary. From my own personal experience, however, I cannot refrain from adding that I always found in Mr M'Nab the greatest willingness to oblige, and readiness to facilitate the carrying out of any experimental researches. And I cannot help saying that, since we have been deprived of his valuable services, it is a matter of no small congratulation that in his successor we have one who enjoyed such constant intercourse with him, and knew his views so well, and who cherishes a warm regard for his memory, and is anxious to carry out the schemes which were so well devised by his predecessor, but which the hand of death prevented him from accomplishing.

Sir Walter Calverley Trevelyan, Bart., died suddenly at Wallington, his seat in Northumberland, on March 23, 1879, in the eighty-second year of his age. He early displayed a strong love of science, for, even when a boy at Harrow, he would rise early in the summer mornings and go great distances in quest of plants, which often necessitated his beating a hasty retreat, that he might be present at prayers at eight o'clock. After leaving Harrow he went to Oxford, and attended the University College, where he was a student in the botanical and geological classes, and took his degree of M.A. in 1820. He then came to Edinburgh to prosecute still further his scientific studies. He lost no time in practically applying the scientific knowledge thus acquired, for in 1821 he visited the Faroe Islands on a botanical and mineralogical expedition, where he spent some time, and proved himself to be a most close, careful, and accurate observer. He read a paper on the "Vegetation and Temperature of the Faroe Islands" in the Natural History Section of the British Association at Edinburgh, in 1834, and published it in a somewhat extended form in vol. xviii. of the "New Philosophical Journal." This article is very interesting and instructive, giving as it does a brief sketch of the appearance of some of the mountains and their elevations, of the kind of soil which generally prevails, of the climate, which is for the most part mild but damp, and of the temperature which, at Morshavn at least, was found to have a mean of 45·399°.

He gives a list of some of the plants found on July 18, 1821, on the south-east side of the mountain, Mallingsfiall, in the Island of Videroe, and here the careful manner in which he made his observations is shown by such remarks as the following:—At 1088 feet, *Salix herbacea* (first plant); at 1098 feet, *Prunella vulgaris* (last plant); at 1382 feet, *Dryas octopetala* (one plant only), but at 1530 feet, it was frequent. One plant only of *Papaver nudicaule* appeared at 1530 feet, but it was of frequent occurrence at 1950 feet; and so on. Here the mention of the particular side of the mountain examined, the date of collecting, the different altitudes at which particular plants first appear and become frequent, &c., prove him to have been at that early period an accurate observer.

He succeeded his father as Sixth Baronet, on May 23, 1846, and greatly improved his extensive landed estates, both at Wallington, in Northumberland, and at Nettlecombe, in Somersetshire. He was a Fellow of the Royal Horticultural Society, which his father had founded; and was also one of the Trustees of the Royal Geographical Society. He did much to advance geology in the comparative infancy of that science, and contributed many papers on that subject to the "Transactions of the Wernerian Society," which were characterised by much skill and ability; and the care with which they were executed is evident from this consideration, that most of, if not all, the facts adduced by him have been confirmed by subsequent investigators. In the last paper on the rocks of Northumberland, published by Messrs Topley & Lebour, the following complimentary reference to Sir Walter occurs: "The earliest paper claiming special notice regarding the intrusive nature of the whin sill of Northumberland was one published by Sir Walter Trevelyan in 1823, in which a careful account is given of the geology of part of the northern coasts of Northumberland; a map and section accompany the paper, showing how unevenly and irregularly the basalt lies among the strata in that district. The limestone lying upon the whinstone is described as being very crystalline towards and at the point of contact." Twelve or more other papers on scientific subjects issued from his pen. But, not only was he ardently attached to science, he was also a lover of literature. He had a refined mind, and was possessed of extensive knowledge. When the Rev. Mr Hodgson was writing his "History of Northumberland," he was much indebted to the subject of our sketch for valuable aid, and the third volume of the "Camden Society's Trevelyan Papers" was edited by him conjointly with his cousin, Sir Charles Trevelyan. He was of a kind and liberal disposition, and hence many museums were recipients of his bounty. To the New Museum in University College, Oxford, he gave largely; but his contributions also extended to the British Museum, and the Museum at Kew, to which he presented his Faroe Island Herbarium and other collections. Several of the specimens collected in these islands were also given to our museum; and in May 1867 we have in our "Proceedings" a notice to the following effect: "Sir W. C. Trevelyan presented a large collection of British, Continental, and

Australian dried plants." For some botanical works in our library we are also indebted to him.

Sir Walter entered heartily into whatever measures he considered likely to promote the wellbeing of society; hence the deep interest which he took in education, and the earnest and persistent efforts which, both by precept and example, he employed to suppress the vice of intemperance; of which efforts the United Kingdom Alliance showed their thorough appreciation by electing him their first president in 1853, and retaining him in that position till he was removed by death.

He was a Non-Resident Fellow of our Society, and his name has been perpetuated in science by being associated with one of the most elegant of all the minute *Gastromysi*, the *Leangium Trevelyani* (Greville).

In Dr James M'Bain science in many of its departments has lost a most able and successful cultivator, and many of us a warm and attached friend, whose absence from our Society, of which he was a Resident Fellow, we sincerely mourn. Dr M'Bain was born at Logie, in the parish of Kirriemuir, Forfarshire, on November 30, 1807.

He began his medical studies in this city in 1823, and passed his examination at the College of Surgeons in March 1826, thus receiving his diploma from that body when little more than nineteen years of age. In the same year he also took the degree of M.D. at the University of St Andrews. In the following year (1827) he passed his examination for assistant-surgeon in the Royal Navy. Not long afterwards he was appointed to H.M.S. "Undaunted," then commissioned at Chatham to take out Lord William Bentinck as Governor-General of India; he served several years, employing his spare time in natural history pursuits. In 1832 he was appointed assistant-surgeon to H.M.S. "Investigator," which was then employed under Captain George Thomas in surveying the Shetland and Orkney Islands. Here M'Bain had his scientific tastes largely gratified, as he carried on dredging along the coast, as well as in deep water, and there accumulated a large amount of material which was afterwards utilised in Forbes' and Hanley's "Mollusca." He also here made fine collections of marine algæ for Dr Harvey's famous work, "Phycologia Britannica." In 1848 the vessel was paid off, and Dr M'Bain returned to *terra firma*, and took up his residence at Elie for four years, before fixing his abode at Trinity. About this time (1853) he became an attendant at our meetings, and continued to be so pretty constantly till his last illness. When he came to Trinity he met in Professor Fleming (who was a relative of his) with a man of a like type with himself—honest, sincere, original, steadily prosecuting science for its own sake, without any view to ulterior advantages, and for him he ever entertained the warmest regard. To geology his thoughts seem to have been specially directed by that very able and accomplished professor, and the cognate science of mineralogy was to him a source of delight. He latterly devoted himself also to anthropological studies, and with his friend Professor Turner was busily engaged in measuring crania, &c. In his many scientific excursions, his vasculum and his geological hammer were his constant companions. In short, it may be truly said of M'Bain, that within his heart were chords which vibrated in unison with Nature in her various domains. When Professor John Fleming was removed by death, Dr M'Bain, who during his life had proved his *fidus Achates*, took his place and maintained his teachings, specially in zoology and geology, at the meetings of our sister Society, "The Royal Physical," where he was no less respected than among ourselves. His generous nature led him ever to encourage any sincere investigator of scientific truth, and his kindly sympathy with his fellow-labourers cheered them in the farther prosecution of their task.

But I should fail in my sketch if I did not view Dr M'Bain in his capacity of faithful custodier of that *Actinea Mesembryanthemum* who, among naturalists, has long borne the honourable appellation of "Granny," and who, though she has entered on her fifty-second, if not her fifty-ninth, year of existence, has not yet ceased to people the waters with her progeny, for, from the 4th March to the 4th of October of this year, on which occasion the last official registry of birth occurs, she has given birth to twenty-seven young ones. This is nothing, however, to her prolific powers in 1857, for then in a single night she gave birth to no less than 240 young, which would have put Priam himself to shame, seriously alarmed Malthus, and taxed the energies of all the accoucheurs in Edinburgh and its surrounding districts. She was gathered from the rocks at North Berwick by Sir John Dalzell, and at his death was handed over to Professor John Fleming, then to Dr M'Bain, who, in prospect of his death, was most solicitous to find a proper guardian for such a treasure. Some to whom he spoke declined to undertake so responsible a duty, till, at last, our excellent friend Mr Sadler was asked and cordially responded to the request, and on March 1st of this year the old lady was duly handed over to his care by Dr M'Bain, and, as most of us know, she receives that kind attention and tender regard to which her years and history entitle her. This last fact regarding our departed friend serves to show the unabated interest which even to the end he took in objects of natural history.

He died at Logie Villa, Trinity, on March 24, 1879.

August Heinrich Rudolph Grisebach was born at Hanover, on the 17th of April 1814, and died on the 9th of May 1879. At a very early period in life he manifested a great love of botany; and an incident is recorded regarding him, when only twelve years of age, which shows at once his ardour and decision of character which enabled him to overcome difficulties that would have arrested the progress of any ordinary boy. He had himself no insignificant collection of plants, for in his botanical excursions he had explored very completely the neighbourhood of Hanover; but so anxious was he to obtain a more extensive supply, that he even summoned the courage to write to Professor Sprengel at Halle, requesting the professor to exchange plants with him; which request, I need not add, was kindly and generously responded to by Sprengel.

At fifteen he was sent to school at Ilfeld, where he remained two years. Here, also, he fully availed himself of the large opportunities which the surrounding country afforded him for his botanical studies.

In 1832, at the age of eighteen, he entered the University of Göttingen, and continued to study there till 1835. His principal teachers were Schrader and Bartling, and among his fellow-students was one who has most deservedly risen to the highest honour, viz., to the Chancellorship of the German Empire, I refer, of course, to Prince Bismarck, and it is much to the credit of the Prince that he did not allow his high position to affect in any way the true friendship of their youthful days.

From 1835 to 1837 Grisebach attended the University of Berlin, where his chief teachers were Kunth and Meyen ; the latter especially captivated him while he expounded vegetable physiology. Among his fellow-students here were Schleiden, the famous author of the "Cellular Theory of Plant Structure," and Schwann, the no less famous applier of that theory to the animal organism. With the former of these Grisebach had frequent and close intercourse, while Schwann was also among the circle of his friends, and for some time lived in the same house with him. In 1836 he took his degree of Doctor of Medicine in that University ; and in the autumn of 1837, in consequence of the death of his father, he removed to Göttingen, and started as a lecturer.

In 1841 Grisebach was chosen Professor Extraordinary of Botany in the University of Göttingen. In 1844 he pursued the sensible course of entering into a matrimonial alliance with Miss Evelina Reinbold, daughter of the chief constable of the King of Hanover, and as the fruit of this marriage there were two sons. He was appointed to the chair of Ordinary Professor in the same university in 1847.

In this university he took the deepest interest, and he gave practical proof of his sincere attachment to it by refusing a call, in 1846, to become Ordinary Professor of Botany at Giessen, at a time when the renown of Liebig was attracting students from all parts of the world to that university. He also refused two invitations which came to him simultaneously, in 1851, from Leipzig and Berlin respectively. In 1855 he likewise refused two other applications to accept a professorial chair at Munich and at St Petersburg ; while, in 1866, a second invitation reached him from Leipzig, which he also declined. Notwithstanding his high intellectual ability and great fame, Grisebach was a man of true humility, which in his case amounted even to shyness ; he was specially amiable, and a steadfast friend. As has been well said of him, "his character was harmonious in an unwonted degree."

His great work, which is indeed of very high merit, is his "Vegetation of the Earth according to its Climatological Distribution: a Sketch of the Comparative Geography of Plants," in 2 vols., published at Leipzig in 1872. For the production of such a work the course which would naturally commend itself as likely to be the most efficient, would be to allot to several authors, famed for scientific ability, and inhabiting the different regions of the globe, the botany of that particular part where the lot of each might be cast, and thus by the combination of these a work in some degree equal to the occasion might be expected. But failing this series, probably no *one* author could have been found who could have done more justice to such a subject than Professor Grisebach. His mind, which was of a very high order, had been continuously directed to this subject for many years. His first impressions regarding the relation of a Flora to the soil and climate were received when he was little more than fifteen years of age, amongst the varied vegetation of the Hartz district; and, while still a student at Göttingen University, Grisebach contributed to the periodical called "Flora" an account of a Botanical Journey to Dauphiné and Provence, which he had made in the autumn of 1833. The same special tendency is shown in his article, "On the Influence of Climate on the Limitation of the Natural Flora," which he published in the "Linnæa," in 1838. Indeed, in 1837, or thirty-five years before the appearance of the work, the plan which he intended to pursue in it had been laid down in a small handbook. In 1839 he was appointed by the Hanoverian Government to undertake a scientific journey to Turkey, which he accomplished; and on his return he published an account of this "Journey through Roumelia and to Brussa," in 2 vols., in 1841; a work of great value and of deepest interest to the botanist; and this was followed in 1843–5 by another work of 2 volumes, entitled "Spicilegium Floræ Rumelicæ." After his return in 1841, however, he also began that regular series of articles which kept him in a special manner *au courant* for his "Vegetation of the Earth." I refer, of course, to his Annual Reports on Botanical Geography, which appeared in the year 1840 in "Wiegmann's Archiv." for 1841, and which were regularly continued in the same periodical till 1853 inclusive, from which time an interruption occurred till 1872, when they were resumed, and three notices up to 1876 appeared in Behm's "Geographical Year-Book." In 1844 he wrote "On the Character of the Vegetation of Hardangen in Bergen," in connection with his visit to Norway in 1842, which was rich in its yield to botanical geography, and which led to a lively epistolary correspondence between him and Alexander von Humboldt. We find him again, in 1847, writing "On the Lines of Vegetation in the North-West of Germany"; and five years afterwards (in 1852), "A Commentary on the Geographical Distribution through Europe of the Genus *Hieracium*," and in that year, along with Schenk, who had been his fellow-traveller, he published "Certain Observations on Plants collected from the year 1851 on an Alpine Journey"; and also an account of a "Hungarian Journey undertaken in 1852," with the same companion; and "Contributions to the Systematic Arrangement of the Flora of Hungary." This last appeared in "Wiegmann's Archiv." for 1862. With Schenk he also visited the Pyrenees in 1853. In the following year, in the Göttingen Reports there appeared "Systematic Remarks on the Collection of Plants by Philippi and Sechler in the South of Chili and at the Straits of Magellan"; and in 1857, "Systematic Remarks on the Vegetation of some Islands in the Carribean Sea, especially of the Island of Guadaloupe, after the Collection of Ducharssaing." "Novelties of the Flora of Panama" was published by him in the following year; while in 1860, from the same prolific pen, appeared "Select Illustrations of the Plants of Tropical America." In 1864 he published a "Flora of the British West Indian Islands," with which, at the request of our Government, he had been engaged since 1857, during which period he had six times visited this country in connection with the publication, which he himself regarded as one of great importance; the relative Herbaria were also sent to him, and it is a fact of some interest to us to know that the names now attached to many of the West Indian plants in the Botanical Garden are owing to the authoritative opinion expressed regarding them by Professor Grisebach. In 1866 he brought out "The Geographical Distribution of West Indian Plants." 1866 saw the publication by him of "The Vegetation Regions of the Earth clearly arranged." A paper "On the Grasses of High Asia" appeared from his pen in 1868. Besides the above, he wrote many other articles more or less closely connected with phytogeography, as, *e.g.*, some of the plants of Surinam, in Dutch Guiana. In 1849 he furnished the articles on "Malpighiaceæ and Gentianaceæ" in Klotsch's "Contributions to the Flora of the Æquinoctial Regions of the New World." Ten years previously (1839) he had written on the "Malpighiads of Brazil"; and along with Oersted, in 1853, he wrote on the "Malpighiads of Central America, with Notes on *Coutubea volubilis*, Mart., and some other Gentians of Tropical America." To the Gentians he had long had his attention directed, for we find him carefully studying that family while a student at Berlin, and he brought out his monograph on the subject shortly after his return to Göttingen; and in the "Annals of Natural History" for 1838 he is found associated with Hooker in a paper on the "*Gentiana scilloides*," Linn. fils., with some remarks on the genus. In 1843 he first published his "*Gentianeæ*," and in 1853, "*Schenkia*" (so called after his friend), a new genus of *Gentianaceæ*. From time to time he also furnished reports on the progress of systematic botany. Many other writings from this fertile mind could be adduced, but enough has surely been brought under your notice to prove that with such rare and superlative qualifications Grisebach stood out as preeminently the man who could do justice to such an *opus magnum* as the "Die Vegetation der Erde," and accordingly we find this publication occupying the very foremost place, being indeed the only comprehensive work on that subject. After its appearance, as already stated, in 1872, Grisebach was not inactive, but continued, as above indicated, his "Phytogeographical Reports." In his great work he divides the earth into twenty-four regions of vegetation, depending on physical and climatological considerations; and of this arrangement Bentham has thus expressed himself: "A closer examination of his regions shows them to be much better conceived, in a phytoclimatic point of view, than I had at first thought them to be, when regarded as phytogeographical regions;" and again: "the data he has collected and methodised will be found to be an important contribution to the scientific study of geographical distribution;" and yet again: "the undoubted influence of climatological and other physical conditions on the progress, dispersion, and life-history of species is here worked out with a care and detail deserving the attention of all physiologists, as well as of all cultivators of exotic plants." Such a testimony borne by so high an authority cannot fail to have its due weight with you, especially when we remember the Darwinian proclivities of Bentham, to which system Grisebach was a very strong and decided opponent, regarding it, as he did, as a doctrine of transmutation. Even in its most moderate application Darwinianism found in him an uncompromising foe. He was too close an observer of nature, too rigid in his method of induction, and too just and accurate in his reasoning, to have any sympathy with those speculators who, when such a desperate course is regarded as necessary for the support of their rash hypotheses, do not scruple to shuffle and toss about continents as a man would a pack of cards; and who pride themselves on the happy allusions to the existing tropical Fauna and Flora as "the monuments of the departed continents, Atlantis and Limuria." But it is time enough to speak of a monument when we are assured that death has actually taken place, and it is time to inquire into the fact of the death when we have made sure of the previous objective existence. Now the soundings of the "Challenger" in the various oceans through which it cruised have thoroughly disproved any such existing objects as the above, and have shown that the assumption of their existence is "but the baseless fabric of a vision"; while Grisebach's science and philosophy are thus seen to accord with the latest discoveries of science.

The attention of Grisebach was specially directed to the territory of La Plata, of the botany of which little was known till it was explored by Lorentz and Hieronymus. In acknowledgement of the services rendered by Dr Lorentz, Grisebach's first work on the botany of this territory was styled "Plantæ Lorentzianæ," and appeared in 1874, which was followed this year (1879) by another treatise, "Symbolæ ad Floram Argentinam." This treatise on the plants of the Argentine Republic was founded "on the collection prepared through the influence of the Government at Buenos Ayres, by Professors Lorentz and Hieronymus, as well as on the Herbaria of other naturalists preserved in the Museum at Göttingen." A short but interesting criticism of these works appears in the "Botanische Zeitung" of the 1st of August 1879, where any one can examine the differences between them, and the mode in which the variation in the number of species can be explained. In the "Symbolæ" five entirely new genera have been added,—viz., *Dermatophyllum*, *Cascaronia*, *Garaguandra*, *Dynoseris*, and *Halochloa*,—belonging respectively to the natural orders, *Zygophyllaceæ*, *Leguminosæ*, *Terebinthaceæ*, *Mutisiaceæ*, and *Gramineæ*. It was never Grisebach's intention to write a complete Flora of this district, but rather to give new genera and species, so far critical cases; but on both occasions there was a short but very significant general view of botanico-geographical species which is one of the most important parts of the treatise.

Yet another work was in contemplation by this indefatigable author, viz., a Flora of all Europe, and was already progressing under his diligent hand, for he thought he had a call to prepare such a work, as he had a personal intimate acquaintance with most of the European regions of vegetation, and as he possessed an unusually complete herbarium, seeing that scarcely any really European species were wanting in it. While thus engaged his April holidays arrived, which he spent most pleasantly with his family in visiting Rome and Upper Italy, but through the peculiar inclemency of the weather this year he caught a cold which gradually increased in severity, and closed his earthly career in the sixty-sixth year of his age. The deepest sorrow pervaded all Göttingen when the sad news was communicated there. By this mournful event a heavy blow has been inflicted on botanical science, for Grisebach was assuredly its ornament and boast. We specially deplore the loss which our Society has sustained, for he was one of our esteemed Honorary Fellows. His able works and the genus *Grisebachia* will keep alive his memory in the minds of botanists.

In ARTHUR FORBES, the ninth laird of Culloden, our Society has lost a very able Non-Resident Fellow, and one of the most worthy and amiable of men. I only once had the pleasure of meeting him, and was deeply impressed with his kindly and genial nature, his high Christian character, and that genuine humility which shed a softened lustre over all his other excellences. He was the representative of a very old branch of the family of Lord Forbes, that namely of Tolquhon, which was noted for its wealth and power. One of the cadets, Duncan Forbes, went to Inverness in the beginning of the seventeenth century, where he became influential in the burgh, and was chosen Provost—a portrait of him in that capacity adorning the Town Hall. He was also the Parliamentary representative of the district. He purchased the estate of Culloden in 1625, to which Ferintosh and other properties were afterwards added. In the eighteenth century the far-famed Lord President of the Court of Session, who occupied that dignified post from 1737 to 1747, threw a halo of renown around the Culloden family, but it has been well and truly remarked that—"of all who preceded and succeeded him it may well be said of the late Arthur Forbes, that none led a more unblemished life or was more anxious to do well whatever duty his position imposed on him." He was born at Douglas, Isle of Man, on January 25, 1819, and was educated at the Universities of Aberdeen and Trinity College, Cambridge. One who knew him well has said of him that in early life he exhibited a decided taste for scientific pursuits, and ever after was a very close and accurate observer. Even in his common-place walks nothing escaped him. Natural history was perhaps his first study, and for years he kept up a naturalist's calendar. Botany was also early prosecuted, and during many a ramble he collected a rich and interesting herbarium of plants found in the district, and among rare specimens were *Goodyera repens** and *Pinguicula alpina*. To the last he took a great interest in both these

* Rare in other districts, though not in pine forests of the north.

sciences. But it was in meteorology and astronomy that he took the deepest interest, and on which he bestowed most labour. He was most faithful and diligent in discharging all the duties that he undertook, and hence as a country gentleman he was pointed and regular in his attendance at county meetings. As chairman of the School Board he was never absent from a meeting when at home, and so, as we might expect, the meteorological observations at Culloden were carried on by him without a single day's interruption from 1841 down to the month of March of the present year. It was by the advice of the late Sir David Brewster and Professor James D. Forbes that his attention was first specially drawn to these studies. The observations taken by Mr Forbes during that long period with such remarkable accuracy, are of great value, and the results when published, which will shortly be the case, will possess more than ordinary interest, establishing as they do many important and interesting facts relating not only to the climate but also to the changes of seasons in the northern parts of Scotland. He was a member of the Meteorological Societies of Scotland and London, and contributed from time to time many results of the more valuable and important of his observations to these societies as well as to the Royal Observatory at Greenwich. The researches connected with the British Rain-fall, so long and so ably conducted by Mr Symons of London, also received the benefit of his results. He was likewise fond of antiquarian pursuits, and took a deep interest in Druidical Circles; he also determined one of the Pictish marches to have crossed from the Moray Firth to Drummossie. He carefully preserved all relics of Culloden, and the portion of the battlefield where the Highlanders were buried is left unplanted and enclosed.

He was most persevering in whatever he undertook, and generally succeeded in accomplishing his object. A most striking instance of this has been supplied to me by another friend of his, viz., that after he was advanced in years he began the study of the Gaelic language, and acquired such an excellent knowledge of it that he was able to read and speak it fluently—a fact full of encouragement to the enthusiastic founder of our Celtic Chair. Nor did he neglect the fine arts, for he took great delight in music and, when other engagements permitted, he devoted considerable attention to it. He had a particularly fine and accurate ear, and was able to note down from memory any piece which struck him, on having merely once heard it played.

As a man of business he was prompt in action, but also most kindly and generous. He was a very liberal landlord, who made the interests of the tenants his own, and was always most unwilling to part with them. When the rights of the people were acknowledged by the abolition of Patronage a few years ago Mr Forbes asked for no compensation from the parishioners. He took a deep interest in education and was the chief agent in securing its highly satisfactory condition in that district, and he most generously presented to the School Board the handsome building which he had erected at his own expense. But did I make no allusion to his religious character I should be ignoring the very foundation on which all his excellences rested, and the source from which those most estimable features of his daily life sprang. The gentleness, amiability, shrinking modesty, and warm-hearted philanthropy were no signs of weakness in the case of Mr Forbes, but were conjoined with a firm grasp and unflinching maintenance of the truth of God; and, while many in our day regard the attitude of doubting as the one befitting the student of nature and of God's Word, to the well-regulated mind of Arthur Forbes such an attitude indicated only weakness and imperfect enlightenment, while he himself rose far above those pestilential swamps, and soared in the clear, bright, and healthy region into which a living and assured faith in God's Word had introduced him. I conclude this sketch in the language of the friend above referred to: "It may truly be said of him that in all relations of life he was loved and esteemed, and few have been more sincerely mourned. He died suddenly at Aldershot on the 16th of March of this year, trusting alone in that Saviour whom he had all his life long loved and sought to serve."

Alexander James Adie was the son of the late Mr Adie of Edinburgh, a well-known optician, and was born on December 16, 1808. From a very early period of his life he showed a strong liking for birds and animals of all kinds. This propensity developed itself more and more as he grew older, and became at last a marked feature in his character. He was educated at the High School, while in his own home he met with every encouragement in his studies, and even his leisure time was expected to be improved in prosecuting some useful and healthy pursuit. After completing his course at the High School he studied at the University here. He subsequently became a pupil of the late Mr Jardine, C.E., with whom he continued a considerable time, and was sent by him to various parts of Scotland on engineering work. To such a mind as his, early imbued with a love of nature, it can easily be imagined how the opportunities so abundantly afforded him, in this and the subsequent periods of his professional career, were fully taken advantage of by him for cultivating his taste for landscape gardening, and extending his knowledge of all kinds of trees and plants. A short time after leaving Mr Jardine he commenced on his own account, and accepted an appointment in the spring of 1838 as resident engineer to the Bolton and Preston Railway, a new line, the works of which were executed entirely under his superintendence. When these were completed he left Lancashire in 1844 and returned to Scotland; and in the following year, or about that time, was connected first with the Monkland Railways, and soon afterwards with the Edinburgh and Glasgow Railway. This latter connection lasted for many years, during which he had much parliamentary work, which brought him into contact with all the leading engineers of the day. He was, however, engaged in many other engineering works besides railways.

He was early made a Fellow of the Royal Society of Edinburgh, and though, in consequence of his residence being out of town, he could not for many years attend its meetings, he always took a deep interest in scientific subjects.

He was one of our Resident Fellows, and though for the same reason as that above mentioned he was not a frequent visitor at our meetings, yet for the last thirty years of his life it was his special delight to collect within his own garden, at Rockville, near Linlithgow (which was entirely laid out by himself), all kinds of trees, shrubs, and flowers at all fitted to the situation, taking particular interest in the importations from Japan. Whilst in his humility he did not consider himself a botanist, yet he was so in the truest sense of the word, for he continued an ardent and devoted student of that science, and whenever any object engaged his attention and regard—whether shrubs, flowers, ferns, &c., he made a study of procuring books bearing on the subject, and of visiting such nurseries or other places as afforded him an opportunity of seeing specimens and of obtaining them for himself, and this love of collecting whatever was new and interesting to him, and enjoyment in the results of his efforts continued in full vigour to the last. His death occurred on the 3d of April 1879.

Among our Resident Fellows we also mourn the loss of Dr James Cumming, a young physician of high promise, whose sun has gone down at noon. He graduated as M.B. and C.M. in our University in 1868, and became house surgeon to Professor Lister in the Royal Infirmary. Influenced no doubt by this position he was fired with the zeal of his master, and chose as the subject of his thesis, "An Enquiry into the Theory and Practice of Antiseptic Surgery," for which he obtained a gold medal when he took his degree of M.D. in 1871. The thesis is characterised by learning and ability, and exhibits his powers of original research. He availed himself of the advantages which Berlin and Vienna afford by studying at these cities. On returning home he was appointed one of the medical staff of the New Town Dispensary, and shortly afterwards he was elected to the office of extra physician to the Sick Children's Hospital, and ultimately to that of ordinary physician to that institution. He was a Fellow of the Royal College of Physicians, and assisted his father in an extensive practice. He communicated to the "Edinburgh Monthly Journal of Medical Science" a very interesting and instructive article on the "Uterine Souffle and the Fœtal Heart," while his last production on "Alopecia Areata," which appeared in the pages of the "Practitioner," was a paper of great merit, and augured well for his future career, had he been spared to lecture on cutaneous diseases, which, I believe, he had contemplated doing; but alas! in the very beginning of his usefulness he was called to cease from his labours, having died on the 9th of May 1879.

Latterly his time was mainly taken up with his professional duties, but in his student days he took a deep interest in the botanical excursions connected with the class, and from few, if any, of them was he absent; and even after he had obtained his degree he still manifested a sincere regard for botanical science by making an annual excursion in company with a few friends. He communicated to our Society a paper, entitled "Notes on Microscopic Fungi," which was subsequently published in our Transactions for 1872, illustrated by several lithographs, which he generously contributed out of his own resources. In his experiments he employed infusions of various substances, and marked the corpuscular or filamentous fungi which were developed after from 10 to 30 days' exposure to the atmosphere. It is an article of considerable merit, and contains some interesting results. For example, he found that there are certain forms of fungi proper to certain fluids; thus he always found the same form of fungus in Digitalis, Aconite, and Claret. He found also that in certain vegetable substances containing alkaloids, the special action of these alkaloids was in a great degree retained, even though bacteria and vibriones had made their appearance. He found this in the case of the alkaloids contained in *Tinct. Digitalis*, *Tinct. Aconiti*, *Tinct. Physostigmatis*, and *Liquor Strychiæ*. The result is important as modifying Dr Bourdon's statements. This paper seems to have been suggested while studying the "Germ Theory," and making experiments on the subject in connection with his thesis, and it gives us a hint how in societies such as ours secondary- or bye- or waste-products, as they are called, may be utilized.

His memory is fragrant among all who knew him as a man of a frank and gentle disposition, thorough uprightness of character, faithfulness and conscientiousness in the discharge of his duties, and kindness and considerateness in his attention to the sick poor.

Karl Heinrich Emil Koch, one of the most eminent horticultural botanists, was born on his father's estate, Ettersberge, near Weimar, on June 6, 1809. From early boyhood Koch exhibited an ardent love for plants, so much so, indeed, that it seriously interfered with the regularity of his training at school. His father, who seems to have been a man of a stern and unsympathising disposition, and who had already decided that his son Karl should succeed him in farming his estate, would make no allowance for the peculiar bias and precocity of the little botanist, but considered all his pursuits in collecting and studying plants as but another name for a life of idleness. His mother, on the other hand, had a kind and loving nature, but even she could not understand the peculiar conduct of the boy; and when in consequence of the warlike times his parents removed to Weimar he was obliged to conceal in a hay-loft his treasures,—books, pamphlets, and his self-collected herbarium. But Koch soon found friends outside his family circle who could appreciate his peculiar talents and his earnest devotion to botanical pursuits. Such an one was Fischer the head gardener of the Duke of Saxe-Weimar, who took a deep interest in him when he was only ten years of age, and afforded him facilities of advancing his knowledge, and even went the length of allotting him a plot of ground in the castle gardens to cultivate just as he chose. This piece of ground lay near a favourite walk of the Grand Duke Karl August, and also of Goethe; here the latter was perfectly astounded on finding an arrangement of living plants similar to that of the natural system of *Jussieu*, all accomplished by the hands of this little boy, only eleven years old, and, on the poet asking him who had taught him to do so, he received the striking and interesting reply, "I think it out for myself that it must be right," a most beautiful illustration of how a human being can either deductively or inductively grasp the divine idea from his having, at first, been made in the image of God, at least as regards knowledge. Goethe was delighted with this answer, and was in consequence led to take a deep interest in the boy and to honour him with his friendship, as he exclaimed, "We shall now work together; bring me everything new and rare, which you seem to find in abundance." Goethe was much occupied with his doctrine of metamorphosis in plants, and made the boy, who was frequently roaming through the country, bring him deformed plants and such like; and the knowledge of the changes which, under so distinguished a master, Koch was privileged to acquire, seems to have suggested to him the special theme of his after life, viz., the investigation into the origin of our fruit trees. Fischer instructed him in horticulture and arboriculture, but another Grand Ducal gardener, Mr Mohs, in Bertuch's garden, took also a fatherly charge of him, and gave him instructions in the subject of fruits, which ultimately proved to have been of the highest use to him. Through his intimacy with Goethe he soon made the acquaintance of the Grand Duke, who treated him with great kindness, frequently giving him sweetmeats (for he was still but a boy), and thus a link was being formed which proved of very great importance in his future career.

As already stated, his frequent excursions in search of plants had seriously interfered with his school duties, but Koch now became alive to the necessity of more diligent application to study, which he prosecuted with such success that he soon overcame all his previous disadvantages, and in 1829 was able to enter the University of Jena. What enabled him to make such proficiency was his frequenting in Weimar the house of the privy councillor Kruse, at that time inspector of the Grand Ducal gardens, a family distinguished for their accomplishments, and here he not only improved his manners, but also his knowledge of modern languages. In Jena Koch studied medicine and became intimately acquainted with Fritz Reuter, the poet, one of the heads of the Burschenschaft (an association of students who were ardently attached to the cause of German unity, and who afterwards suffered much in seeking to promote that object). Koch's love of nature withdrew him very much from all political excitement. To him the forest and the field presented greater attractions than all the burning questions of political economy; and though to his last day he loved the noble goal at which the association aimed, yet he avoided all political demonstrations, and escaped the sad fate of many fellow students.

The charming environs of Jena with its chalk hills, presenting an almost southern vegetation, impressed themselves on his mind. During this time he sometimes saw Goethe in Dornburg, in the enchanting parks of which the great poet loved to walk, and Koch to the end of his life preserved a myrtle branch which Goethe had presented to him when the former found him sitting in a rose-arbour reading the poet Tasso. In 1831 Koch left Jena and went to Würzburg to enrol himself among the pupils of the celebrated physician Schönlein. In the autumn of 1836 he made a journey to Switzerland, and studied the Flora of the Alps up to the sources of the Rhine and Rhone. In 1833 Koch took his degree of Doctor of Medicine, his dissertation on that occasion being a monograph on the genus *Veronica*, and then returned for a short time to Weimar, when his father was reconciled to him. He again visited Jena to take the degree of Doctor of Philosophy and to become a lecturer there. In 1834 he delivered his first course of lectures, which were distinguished by the absence of all pedantry and by a freshness and learning which gave them a peculiar interest. His excursions were not less so, and the zeal and enthusiasm with which he himself was fired could not fail to make themselves felt among his students. In March 1835 he was appointed to a professorial chair, and having now the means of gratifying his love of travel he planned his voyage to the East, in the accomplishment of which he was aided by the means which he had inherited on his father's death. Koch, probably influenced by the consideration that in the East had been the cradle of the human family, and that there had been situated the garden of Eden, stocked with every kind of fruit which could conduce to the enjoyment of our first parents, determined to seek the origin of our fruit trees in that locality.

Besides his pecuniary resources he enjoyed other special advantages, for Froriep and Friedrich von Müller seconded his efforts, and drew the attention of the Grand Duchess Maria Paulowna to his bold undertaking. She was the sister of the Emperor Nicolas, the mother of the excellent

Empress Augusta, and Koch found her to be a most gracious and friendly protectress. She furnished him with letters of introduction and recommendation to the Czar. Before setting out on his journey, which he did on May 4, 1836, he formed an engagement with the daughter of the Professor of Mathematics at Jena—Miss Theresa Weichhart, sixteen years of age. The marriage, which proved a most auspicious union, took place on October 2, 1838, after his return from the Caucasus. In his journey he first visited Berlin, where he enjoyed the intimate friendship of Ehrenberg and Alexander von Humboldt, who introduced him to Dubois de Montpereux, who had just returned from the very regions that Koch was about to visit. He then went to St Petersburg, Moscow, &c., and reached Tiflis. Here he was seized with a fever, brought on by a sun-stroke, but here also he formed the friendship of Prince Constantine Suworoff, who tended him during his illness with a brother's care. After Koch's return in 1838 he was appointed Assistant Professor of Botany at Jena, and in 1839 published a work entitled "The Natural System of the Vegetable Kingdom exhibited in the Flora of Jena." In the "Report of the German Naturalist Society" for 1840 he published "His Journey to the Caucasus," and "The Plants of the Caucasus;" while in "Linnæa" for 1841–3 there appeared from his pen "A Catalogue of Plants collected in the years 1836–7 in his Journey through the Caucasus, Georgia, and Armenia." He then, in 1842–3, published his journey in the form of a book of much celebrity, under the title of "A Journey across Russia to the Isthmus of the Caucasus," which was no less valuable for its contributions to geographical than to botanical science. Through the influence of Humboldt, Ritter, and Gustav Rose, he was sent by the Berlin Academy of Sciences on his second journey, with George Rosen, the young linguist, as his companion. In May 1843 he started for the eastern provinces of Turkey, and again scaled the Caucasus, and brought treasures from regions probably never before visited by a botanist. Near the close of the following year (1844) he returned home, and published in that year "Meteorological Observations taken at Bucharest," in the "Monthly Journal of the Berlin

Geographical Society," and "Contributions to the Flora of the Northern Maritime Coast of Asia Minor." He also published "Some Remarks on the Plants collected by Dr Thirke on the North Coast of Asia Minor, and on Olympus in Bithynia."

In 1847 he gave up his chair at Jena and removed with his family to Berlin. Here he formed most intimate friendships with Ehrenberg, Mitscherlich, Heinrich and Gustav Rose, Poggendorf, &c., and in 1846–7 he brought out his work in three volumes, entitled "Wanderings in the East." In 1848, in the "Monthly Journal of the Berlin Geographical Society," he published an article "On the Forests of the Caucasus in relation to the War at present being carried on there," and in the "Botanische Zeitung" for the same year, a paper "On the so-called Persian Insect Powder," which has an additional interest now since the Pulegium is attracting such attention as an insecticide. In the spring of 1849 Koch was appointed assistant to Link as Director of the Royal Botanical Garden, and in that year began his lectures at the University. From 1848 to 1851 he gave a series of papers in the "Linnæa," being "Contributions to a Flora of the East." In 1849, "*Acanthopleura*, a new genus of *Umbelliferæ*," appeared from his pen in the "Botanische Zeitung"; while in 1850 he wrote "On Manna, specially that of Hither Asia." In 1851 he published an excellent map of the Caucasian Isthmus, with various scientific notes, geographical, botanical, &c.; and in the same year he furnished to the Berlin Monatschrift a review of the Flora of the Caucasus for illustrating the above mentioned map. In 1852 he accepted the office of Secretary to the Horticultural Society of Berlin, and the prosperity of that Society was in great measure owing to his exertions. He retained this position till 1873, and during the portion of this time up to 1857 he edited the Transactions of that Society, and after that period he brought out his own weekly journal. In 1856 he published a paper "On the District about the River Rian" (the ancient Phasis) in "Petermann's Mittheilungen." From 1856 he represented German Horticulture at all International Congresses, and was sent as Commissioner of the Prussian Government to London, Paris, Amsterdam, St Petersburg, Ghent, Brussels, Hamburg, Vienna, Trieste, and Florence. He was ever ready to undertake all the trouble which these various missions involved. From his acknowledged ability he was in innumerable cases called upon to act as umpire, and in this capacity he always excelled by strict conscientiousness, and the quickest discernment sharpened by much experience. Besides the numerous papers above referred to, many more came from his prolific pen, as, for example, "A Monograph on the genus *Æsculus*," "Notice on the genus *Philadelphus*," "A Monograph on Agaves," all in 1862, and "A Study of the Agaves" in 1866; "On the Classification of the Species of Crocus," "The New Holland Gum-trees—Eucalypti," "The Oranges—Citri."

The *Bromeliaceæ* and *Araceæ*, so far at least as their cultivated genera were concerned, specially engaged his attention; thus in 1862 he wrote his "Study of the *Bromeliaceæ*," in the "Belgian Horticulturist," while the Arads were treated in a paper entitled "A few words on *Anthurium*, *Philodendrum*, and *Monstera*," and in another styled "A Notice on the *Caladium*, and Description of a new Species *Caladium pusillium*."

In 1869 the first part of his "Dendrologie" appeared, which was a treatise "On Trees, Shrubs, and Under-Shrubs which are cultivated in the open air in the Centre and North of Europe," which sustained his high reputation, and contains much useful information in his attempt to trace our cultivated fruit trees to their original sources.

In 1874–5 Koch gave popular lectures on horticulture to the upper classes of the German capital. His extensive acquaintance with his subject gained from thorough personal observation, his genial nature, and real eloquence captivated his audience, and for the time brought this branch of science into the ascendant. But the subjects chosen had also doubtless no small share in bringing about this happy result, for in the first division of his lectures we find the following heading—"The History of Gardens, including those of the Egyptians, the Semitic Races, the Persians, the Chinese and Japanese, the Greeks and Romans, Italians, French, Dutch, and English. The second division related to the life and growth of trees, and their relations to man and climate, where the subject of Miasmata, &c., is treated. The third division deals with coniferæ—a subject whose importance is universally acknowledged.

I cannot conclude without remarking that Koch's *patriotism* was a very prominent feature in his character; to him "das Vaterland" was really what the name implies, and for it he refused some excellent offers of preferment in Russia, Austria, and Belgium. He had a most independent and thoroughly unselfish nature, was possessed of vast energy, great amiability and benevolence, and was unswervingly truthful. His turn of mind was of an eminently practical kind, and hence his motto was,—"The end and purpose of all science is the mental and physical welfare of all mankind." As a botanist he held a first rank, but from his utilitarian tendency he chose rather the horticultural branch of the science as his special path, and all Germany has reaped the benefit of his devotion to this department, for his reports on "Fruit Culture in the German Empire, and the Fruit Crops of the Year," were full of useful information, and, like all his other writings, were characterised by great accuracy, and tended to promote the cultivation of fruit, while, at the same time, they pointed to the best varieties. Koch aimed at becoming Director of the Botanical Garden of Berlin, and this wish was gratified by his being appointed to that office on the death of Alexander Braun, but unfortunately his health began to fail, and he resigned this honourable post after having held it only for a year. He longed to have an Arboretum at Berlin, and so completely was his mind set on this object that he had planned the whole, though there seemed little prospect of its being accomplished, but his longings and efforts and toils were destined to be ultimately rewarded, for on the last day of his life he received the news that the Minister of Agriculture had issued a grant for the founding of a Dendrological Garden. The various objects which had occupied him were fast coming to a close, for only about thirty hours before his death he had completed the writing of what proved to be his last work, viz., "The Trees and Shrubs of Ancient Greece," and their application in an æsthetic point of view. Koch, whose special and profound observations were directed to the origin of certain species, had no sympathy with the theory of Darwin, or with modern scientific atheism, with its darkness, chilliness, and gloom, for when the evening sun illumined his room with its rays, he exclaimed with a radiant smile, "Now, I am in God's beautiful free Nature." He bade his wife good night, and on May 25, 1879, fell into a sleep from which he never awoke in time, being within twelve days of having completed his seventieth year, which great preparations were being made to celebrate in a manner worthy of one of such renown. Alas! how true it is that "Man proposes but God disposes."

Dr Charles Murchison is one whose loss we all deeply deplore, and as my old classfellow at the University I may be permitted to say that I felt a special pang when I heard of his decease. He was indeed a many sided character, but "*Nihil tetigit quod non quoque ornavit*," for whatever he undertook, to that he applied a mind characterised by much acuteness and soundness of judgment, and well stored with facts and observations. His was not the sparkling genius; nor did he captivate us with his eloquence; his was the substantial plodding work undertaken and prosecuted by a mind of large capacity, comprehensive range, and varied acquirements, so that when at length the work was completed, it bore on its very face the impress of distinguished ability, transparent honesty, and lasting value. No wonder, then, that in Murchison's death we felt that a prince and a great man had fallen, for the high position which he occupied was one to which his merits had justly raised him, and on which he reflected a bright lustre. He was at the time of his death one of our Non-Resident Fellows. As a short notice of Murchison was read before our Society during last session, I shall not devote to his biography that amount of space which would be justly his, and without which one could not even enumerate the important and varied positions which he occupied, and the valuable contributions to science, but specially to medical science, which came from his pen.

Dr Murchison was born in 1830 at Springfield, Vere, Jamaica, and was the son of Dr Alexander Murchison, and grandson of Professor Copland of Aberdeen University.

He began his medical studies in Aberdeen in May 1846, but soon removed to Edinburgh, and in November of that year we find him a student in our University, where he most successfully prosecuted his studies, carrying off prizes and medals in many classes, and obtaining at the end of his career the gold medal for his Graduation Thesis in 1851. As a student of botany I remember his ardour and devotion to that science, and how he astonished us all in 1848, when he handed in the beautifully and accurately executed dissections of certain natural orders, which now adorn the museum at the Botanic Garden and will hand down his fame as a laborious and able student. I should have mentioned that in the previous year (1847) he obtained three botanical prizes at the University, and was elected a member of our Society. In 1849 he was chosen a member of our Council, when only nineteen years of age, which shows the high esteem in which he was held as a botanist. In 1848 he contributed a paper to our Society (Dec. 14) "On certain Glandular Bodies occurring in the Epidermis of Plants," and in 1851 he supplied another "On certain Monstrosities of *Leontodon taraxacum* and *Trifolium repens*."

After obtaining his degree he was for a short time Physician to the British Embassy at Turin, and again returned to Edinburgh and acted as resident Physician in the Royal Infirmary, and then passed a few months in the Maternity Hospital here, and thereafter went and studied at Paris. In January 1853 he entered the Honourable East India Company's service, and in the same year was appointed to act as Professor of Chemistry in the Medical College at Calcutta. The whole current of his after life might have been changed, and we might now have been recording his achievements in chemistry and his extension of the boundaries of that science rather than those of medicine, had not some difficulties in regard to the Medical Department in Burmah, where great sickness prevailed, rendered it needful that he should be sent thither, and accordingly in compliance with the call of duty (but much against his own inclination) he left Calcutta; while in Burmah he was not inactive, but sent valuable papers on the climate and diseases there, which appeared in the "Edinburgh Monthly Journal." He there also made observations in April 1854 near Rangoon on the *Flata limbata*, which he afterwards communicated to the Linnæan Society, to which I shall immediately refer.

In 1855 Murchison left the Indian medical service and returned to London, where he became a Member of the Royal College of Physicians. In this year his article entitled "Notes on the White Secretion of the *Flata limbata*, and on its relation to the Insect White Wax of China," was contributed to the Linnæan Society, and published in their "Proceedings." It is an able and well-reasoned paper, and seems to justify his conclusion, that, while Hanbury was right in regarding the *Coccus pela* as a source of Chinese wax, he erred in excluding *Flata limbata* from that honour, for it seems highly probable that it is one of the sources of that supply. In December 1855 he contributed to our Society a paper "On the Chaulmoogra Seeds of India," the produce of *Chaulmoogra odorata*, Roxb., or *Gynocardia odorata*. After referring to the poisonous nature of the tree, but the bland character of the seeds, and of the expressed oil, he proceeds to show how it is employed, and what a high reputation the latter has in India in cutaneous affections, and even in leprosy, and that it is also highly prized by the Chinese. He acted as Demonstrator of Anatomy at St Mary's Hospital during the same year, but this office he soon resigned, and was appointed in 1856 Lecturer on Botany in that Hospital. His next appointment was that of Assistant Physician to King's College Hospital in 1856. In 1859 he became a Fellow of the Royal College of Physicians. He was also a Fellow of the Royal Society. In 1860 he was elected Assistant Physician, and in 1861 Physician to the London Fever Hospital, an appointment to which we are in great measure indebted for that noble work on "Continued Fevers" which made his name famous, and which will remain a lasting monument of those high faculties of mind which he largely possessed, and of the unwearied diligence and great accuracy and honesty with which he prosecuted his extensive researches. The first edition appeared in 1862, and the second in 1873. In 1861 he edited for the New Sydenham Society "Frerich on Diseases of the Liver." I pass over some appointments at Middlesex Hospital in 1860 that I may not weary you with too many details. About 1867 he lost by death his great friend Dr Hugh Falconer, the famous naturalist, who was superintendent of the Government Botanical Gardens, and whose guest Murchison had been on his first arrival in India. Animated by warm feelings of regard for the memory of the deceased, he initiated a movement to perpetuate that memory, which found its fitting expression in a Falconer Memorial Fellowship in our University, to which Murchison's generous heart was always linked. He also re-edited the Geological and Palæontological MSS. of his friend.

In 1868 he published his "Clinical Lectures on Diseases of the Liver," which maintained his high reputation. In 1869 his *alma mater* conferred on him the well-earned honorary degree of LL.D.

In 1871 Murchison accepted the invitation to become Physician to St Thomas' Hospital, and Joint-Lecturer on Medicine. In 1873 he delivered the Croonian Lectures on "Functional Derangements of the Liver," which he subsequently enlarged and published. He was appointed Examiner in Medicine in the London University in 1875; and in 1877 he was chosen President of the Pathological Society; and only this year he was appointed Physician in Ordinary to the Duke and Duchess of Connaught. It would be out of place here to record the numerous medical papers which he wrote, and which all partook more or less of the same excellences, so I conclude in the words of one who knew him well, and who employs no language of hyperbole, but shows a just appreciation of his character when he writes—"Judicious in character, calm and sober in his modes of thought and expression, methodical and laborious in investigation, keen and acute in the interpretation both of the symptoms and of the causes of disease, unwearied in unravelling difficult questions, just and impartial in conduct, plain and sincere in manner, trustful, affectionate, and reliable as a friend, Dr Murchison possessed those qualities which we are apt to regard as helping to form the best type of a British Physician."

David Moore, a name illustrious wherever botany and horticulture are studied, was a Non-Resident Fellow of our Society, and we unfeignedly mourn his loss. He was a Doctor of Philosophy of Leipzig. He was born at Dundee in 1807, and in early life was employed in the gardens of the Earl of Camperdown, near that town. After leaving that situation he came to Edinburgh to the nurseries at Comely Bank, then belonging to Mr James Cunningham, and remained there till 1828, when he went to Dublin to assist Dr James Townsend M'Kay, author of the "Flora Hibernica," who was then the Director of the Botanical Garden of the University of Dublin. He profited by the advantages which this position afforded, and was appointed one of the staff of the Ordnance Survey of Ireland. The judicious nature of this appointment was evidenced by an able paper written by Moore on the Flora of the regions examined, which were, I think, the counties of Antrim and Londonderry. After holding this post for five years he was chosen Curator, or (as subsequently) Director of the Glasnevin Botanic Garden, which is the property of the Royal Society of Dublin, and originated in an annual parliamentary grant for its establishment and support, given for the first time in 1790. No sooner had he entered on the duties of his new office, which he did in 1839, than his energy and ability displayed themselves in gradually raising the garden from being comparatively insignificant, to take its place among those in the highest ranks, and that in no small degree by the treasures which he himself collected for it. King Lemuel's description of a virtuous woman could most appropriately be applied to Moore, for like the merchant-ships he "brought his food from afar," Prov. xxxi. 14; for Norway and Sweden, Germany and France, Italy and Spain, and even Russia, were visited by this indefatigable horticulturist, that fresh treasures might be added to the Glasnevin collection; and hence the garden was distinguished by all that was beautiful and rare, and hence also from that source many of our new plants (whether open-air or hothouse) were imported. He rendered it famous also for the variety of new hybrid forms which by his skill and ingenuity he raised there.

The Glasnevin Botanic Garden, which owes so much to him, extends over 27 acres, and is divided into three sections, relating to Agriculture, Horticulture, and Botany.

Moore devoted much attention to cryptogamic botany, especially to the *Musci* and *Hepaticæ* of Ireland (in the department of Mosses he earned a high reputation), and he published on these subjects, as well as on *Graminæ*. He gave valuable aid to his former instructor Dr M'Kay in making up his list of Irish plants, and, conjointly with Mr Alexander Goodman More, he edited the "Cybele Hibernica" in 1866, in which the geographical distribution of plants in Ireland were dealt with. M'Kay's work, the "Flora Hibernica," is one of special merit, but in it few localities are given, and no attempt is made to define the range or frequency of the plants, and it is apparently with the view of supplying this deficiency that the "Cybele Hibernica" was undertaken. It everywhere exhibits extensive reading and careful research, and the method pursued for the avoidance of errors is a model of caution. No wonder then that a grant of £25 was given by the British Association towards its publication. No descriptions of the genera or species are given, as the authors strictly confine themselves within the prescribed limits, and leave the reader to gain that information from the other sources, which are plentifully supplied in the published manuals. In this work he divided Ireland into twelve botanical districts, such as had been suggested by Professor Babington. A map of these districts is contained in the book.

At the Moscow Exhibition of 1865, and at that of Paris in 1867, he acted as Botanical Commissioner.

He was a Member of Council of the Royal Irish Academy.

Amid all his renown, however, he was humble and unpretentious, of an amiable disposition, and was esteemed and respected by all those with whom he came into contact. Though his lot was cast in Ireland, he was a thorough Scotchman, and one of our countrymen of whom we may justly be proud. He possessed that indomitable perseverance, high intelligence, and sound common sense, which have by all generous minds been regarded as characteristic of our nation, and to the development of which the kind of education which they have enjoyed, embracing as that does the training of the whole man, as an intellectual, moral, and spiritual being, has so powerfully contributed.

An acute disease cut short his life in the midst of his activity and usefulness, his physical and mental powers exhibiting no signs of natural decay, though he had by two years surpassed the threescore years and ten.

On September 16, 1879, our Society lost another able and energetic horticulturist in the person of Mr Peter S. Robertson, at the age of sixty-one. He was born at Dalchonzie, near Comrie, of parents who were in very humble circumstances. He was sent to school at Dunira, and afterwards served a regular apprenticeship at Drymen, under Mr Montgomery, gardener to the Duke of Montrose. In 1837 he got a situation in the Royal Botanic Garden here, under the father of our late Curator, than whom no one was better qualified to train those under him to a thorough knowledge of their vocation; and we may be sure that with Robertson's abilities and good common sense, the six years' training which he here underwent would not be in vain. From the Botanical Garden he went in 1843 to the Messrs Peter Lawson & Son, where he remained for sixteen years, during fourteen of which he held the position of manager. His advantages here were very great, and his acquaintance with the seed trade was correspondingly extensive.

A friend informs me that Mr Robertson had an ardent desire for knowledge, and a great propensity to launch into new fields of discovery, and was animated by an enthusiasm for the beautiful in plant form, which roused even unimpassioned natures to a like feeling. When he started on his own account he was most enterprising, and his efforts were crowned with success; for having begun business at Trinity, he was not long ere he extended his nurseries to Inverleith Row and Stanley Road. His ability both as a nursery- and seeds-man were soon publicly acknowledged by his being frequently called upon to act as a valuator in both departments. If there was one feature more than another in which the excellency of his nurseries appeared, it was in the hardy trees and shrubs to which he devoted special care, and which he cultivated with much success. He knew flowers well, not only those of the greenhouse and under cultivation, but also the wild flowers of our country. I am informed that Mr Robertson, mindful of his own early struggles, interested himself in the welfare and prosperity of the younger members of the trade, and was very helpful to young foresters and gardeners by advice and sympathy, that he proved himself a kind and constant friend, and was esteemed by those who knew him. His death, which resulted from disease of the heart, was sudden.

Mr William Mudd, Curator of the Botanical Garden at Cambridge, died of a brief illness at the age of forty-nine. He was an Associate of our Society, as well as of the Linnæan. He was born near Bedale, in Yorkshire, in 1830, where his early education was very deficient. His first appointment was to the garden of Joseph Pease, Esq., at Southend, Darlington, where he enjoyed the advantage of good training under Mr Pope. He married in early life, and was appointed to the charge of the garden of T. Richardson, Esq., at Great Ayton in Cleveland. While here he became acquainted with some teachers in a boarding-school in the neighbourhood who were fond of science, and by their aid he strove to supply the defects of his education. He also made long botanical excursions through the district, the results of which were published in a local periodical in 1863. A new era now dawned on his history. He purchased a microscope and devoted himself to the study of lichens, and by dint of great industry, zeal, and self-denial (for all this time he was regular at his garden duties), he secured a fine collection of these cryptogams, which he carefully dissected and accurately described. Shortly after this, viz., in 1861, he published his "Manual of British Lichens," which was very complete, containing as it did all the species and varieties then known in Britain. This work gave him a high position as a botanist, and with his previous thorough training and experience in horticulture, we need not be surprised that, when a vacancy occurred in the curatorship of the Botanic Garden at Cambridge, Mr Mudd should have been chosen to fill that important office. He would, doubtless, in his new sphere have prosecuted with no less energy and success his studies in lichenology, had not the state of his eyes prevented him from using the microscope. He accordingly was compelled to abandon that pursuit; but, being of an active disposition, he, in addition to discharging his duties as Curator, occupied his time in giving instructions to those studying for the Natural Science Tripos, and for the special examination in Botany, in which he proved a most efficient teacher, and gained the affection and esteem of all his pupils. Dr Babington thus writes of him—"He raised the standard of the botanical garden;" and again—"We have lost a very valuable man, one who had the interest of the university and garden thoroughly at heart, and worked constantly for the advancement and benefit of all subjects of his department."

Dr Johann Friedrich Thilo Irmisch, Professor of Botany at Sonderhausen, Thuringia, was a Foreign Member of our Society. He died of apoplexy at Sonderhausen, on the fourth day after the attack, viz., April 28, 1879. He was a man of great eminence, and his name spread far beyond the limits of his native country. We grieve over the loss which our Society and botanical science in general have sustained by his removal, while his personal friends mourn over his departure, and speak of him as a most amiable, simple, unpretending character, full of warm feeling for friendship and domestic happiness; in fact, he was artless as a child, destitute of that ambition which aims at high positions and outward honours, as evidenced by his refusing several honourable invitations to other university chairs, thus at the same time exhibiting the like patriotism which we have seen in Koch and Grisebach, for he was warmly attached to his beloved native town, whose rich and beautiful flora had peculiar attractions for him; and yet, with all his modest retirement, he was a man of high culture, as his education, and literary and scientific writings testify.

Irmisch was born on January 14, 1816, at Sonderhausen. His childhood was spent in the small town of Schlotheim, belonging to the precincts of Schwarzburg-Rudolstadt, and situated between Sonderhausen and Mühlhausen, where his father was a forester. Even in his school days he took a lively interest in botany, and devoted his leisure hours to its prosecution. In course of time he attended the college at his native town, and afterwards studied theology and philosophy at Halle; but he specially applied himself to the natural sciences, under the care of Professor von Schlechtendal, Burmeister, and Germar, but more particularly to botany. He then obtained a tutorship in an excellent family, which he retained for some years; and was thereafter appointed as a teacher at the princely college of Sonderhausen, and here he continued to act as professor till removed by death.

He was indefatigable in his prosecution of botanical science, and by his numerous and able writings soon attracted the attention of the principal botanists of the day; and for years he lived in constant scientific and intellectual intercourse with the most eminent scholars of Germany and foreign countries. Alexander von Humboldt, St Hilaire, Francois Guizot, Treviranus, Martius, and many others, favoured him with their attention and correspondence. His principal works are in the province of the Morphology of Phanerogamous Plants, especially of the underground portion of the axis in Monocotyledons. The Philosophical Faculty of the University of Rostock, granted him the honour of the degrees of Doctor of Philosophy and Master of Arts *honoris causâ*, and in the diploma they thus speak of him:—"This skilful scholar, by keenness of sight, has most happily observed the most hidden mysteries of plants, both under and above ground; he has most skilfully expounded, and most learnedly illustrated them."

The number of societies which admitted him to their fellowship is another proof of the high estimation in which he was held. He was a member of the Antiquarian, and an honorary member of the Agricultural Society of Sonderhausen. He was also Keeper of the Natural History Museum there. He was a member of the Royal Bavarian Botanical Society of Regensburg; and also of the Association for the Science of Nature in Saxony and Thuringia; and of the Society of Natural Philosophers of Halle. He was also a member of the Physico-Medical Society of

Erlangen, and of the Botanical Association of the province of Brandenburg, in Berlin. He was likewise a member of the Grand Ducal Saxon Society of Mineralogy, Geology, and Palæontology in Jena; of the Association of Naturalists in Bremen; of the Royal Botanical Society of Ratisbon; of the Society for Natural Sciences in Cherbourg. He was an honorary member of the Association of Naturalists of the Bavarian Palatinate; and of the Philomathic Society of Strassburg. His government honoured him with the medal for Art and Science. Since 1866 he has been a member of the Imperial German Academy Leopoldino Carolina of Natural Philosophers.

In 1874 he was appointed Keeper of the Archives, and devoted the last years of his life, when he was less able to undertake botanical excursions, to the investigation of the more ancient parts of the history of the princely house of Schwarzburg, and it has been said of him that, "the forty-seven contributions to the knowledge and history of Schwarzburg, which he published in the 'Sonderhausen Government Journal,' conducted by himself, are a fair proof of his restless activity, and are of lasting value."

The mere mention of the titles of his botanical treatises, which amount to about 100, would occupy all our time, so I can only indicate a few—

1. Additions to Meyer's *Chloris Hanoveriana* from the district of Hohnstein, 1838.
2. Description of a remarkable Irregularity in the Flowers of *Hordeum himalayense trifurcatum.*
3. Remarks on the species of *Epipactis* of the German Flora, 1842, and also
4. Addition to these Remarks, 1847.
5. Description of the Rhizome of *Sturmia Loeselii*, 1847.
6. On some Gamopetalous Flowers, 1847.
7. Monstrous Flowers of *Anemone*, 1848.
8. On the Inflorescence of Fruit-bearing Plants of *Humulus Lupulus*, 1848.
9. On the Morphology of Monocotyledonous Plants, 1850, Berlin. 10 plates.
10. Contributions to the Biology and Morphology of Orchids, 1853, Leipzig. 6 plates.
11. The Structure of the Shoots and Buds of *Aconitum Napellus*, 1854.

12. Contributions to the Comparative Morphology of Plants, 3 parts, in 1854–5–6 respectively, with 13 engravings. 4th part in 1863. 5th part in 1874, Halle.
13. Morphological Observations on some Excrescences (Growths) of the Natural Families *Melanthaceæ*, *Iridaceæ*, and *Araceæ*, Berlin, 1854. Folio, with 2 plates.
14. Contributions to the Morphology of the *Amaryllidaceæ*, 1860, Halle. 12 plates.
15. On some *Fumariaceæ*, Halle, 1862. Quarto, with 9 plates.
16. A small contribution to the Natural History of *Microstylis monophylla*, 1863.
17. Some Observations on *Scilla autumnalis* and *S. bifolia*, 1863.
18. On some *Ranunculaceæ*, 1865 and 1868.
19. On the Natural History of *Stratiotes aloides*, 1865.
20. On *Aconitum anthora*, 1873.

Thiloa, a genus of *Combretaceæ*, and Irmischia one of the *Asclepiadaceæ*, were named in honour of this eminent botanist, but in the "Genera Plantarum" these names do not occur, nor are they needed to perpetuate his name, for by his many valuable works "*exegit monumentum aere perennius*," and by his many excellent qualities he is embalmed in the hearts of all who knew him.

Samuel Hay was the youngest son of the late Sir John Hay, Baronet. His father, Sir John, was a leading partner in the well-known and old established house of Sir William Forbes & Company.

Mr Hay was brought up originally as a merchant, and, for some years, was established at Havre, but he removed from that position and came to the bank at Parliament Square, where he was made secretary and then a partner, and continued connected with that private bank until its fusion with the Union Bank of Scotland. He continued, till within a short time of his death, as one of the managers of that bank. As a friend informs me, he took a deep interest in everything connected with the prosperity of the city, and was esteemed.

He also took a great interest in many Societies, and was a Resident Fellow of ours. Though latterly he did not attend our meetings, yet at an earlier period he did so, and was also a Member of Council. Horticulture seemed to attract his attention, and in his garden were found some of the most recently imported plants.

The two following Fellows had been omitted last year in the obituary list, but, as I got notice of them from the Secretary only a few days ago, I have been unable to do anything like justice to their memories:—

Matthew Alexander Eason Wilkinson, M.D. of Edin. in 1838, died at his residence, Greenheys, Manchester, on July 26, 1878. His death was caused by disease of the heart, accelerated by bronchitis.

He was born at Manchester, and spent the whole of his professional life in that town, where he was held in the highest respect and esteem. Those who knew him best considered the possession of his friendship as a great privilege, for he had a high sense of professional honour. His philanthropy was free from everything like ostentation, and his whole deportment towards his fellows was marked by peculiar kindness and courtesy, so that their esteem of his high professional ability and attainments deepened into genuine love of the man. He was at one time officially connected with the Deaf and Dumb Institution, and the Ardwick and Ancoats Dispensary; and was appointed in 1844 to the office of Physician to the Royal Infirmary, which he held till his death. The high estimate which the profession had formed of him as a physician, &c., was expressed by his being called upon to fill the presidential chair of the British Medical Association. In this post of honour he had acquitted himself to the satisfaction of all, having proved himself most diligent, faithful, energetic, and judicious, in forwarding the interests of the Association; and there was little more than a week to pass ere he would have resigned the chair to his successor, when the sad event occurred to which I have referred.

His address prepared for that occasion, but which, alas! was read by other than his own lips, proves the fine and noble estimate which he had formed regarding the true dignity of the medical profession; for, after referring reproachfully to the influence of private interests engendering pitiable jealousies, to the unworthy ambition of merely "getting on," and to the sordid avarice of merely making money, "instead of the gallant *esprit de corps* and steadfast pride in raising and upholding our grand profession," he went on to define what a doctor in the true sense ought to imply. "It means," he said, "a costly, and though a very interesting, yet a very anxious and laborious education; it means, in all who are worthy of the profession, enormous self-denial, earnest thought, truthfulness, integrity, purity of life, sympathy with human suffering, unceasing labour, obedience to God's word." And, he continues, "we must endeavour to influence all who are about us to look upwards and onwards in the highest sense, *i.e.*, in the hope of being an honour to their calling and a blessing to their generation, and not in damaging aim at self-aggrandisement." These were no empty words, but were exemplified in the life and character of the man who *wrote*, but alas! never *uttered* them.

Of Dr Wilkinson some longer and better notice should have been prepared, and yet, viewed in another light, it may with equal truth be affirmed that such a man needs no monument, for his deeds of benevolence, and the high tone of character from which they proceeded, justify us in adopting the trite quotation, "*si monumentum quæris, circumspice.*"

During his student days he showed his love of botany by joining our Society as a Resident Fellow in 1836, and after returning to Manchester, he was one of our Non-Resident Fellows. Though I am not at present aware of any contributions to our "Transactions," yet, that he was attached to the Biological Sciences, the above facts indicate, when conjoined with the circumstance that he was an Extraordinary Member of the Royal Physical Society here.

William Bruce Cunningham, Minister of the Free Church, Prestonpans, is another of our Non-Resident Fellows, whose loss we are called upon to mourn. Combining, as he did, high intellectual gifts with an ardent love of science, his name reflected honour on any Society with which he was connected.

He was born at Musselburgh in 1806, but was soon deprived of the fostering care of his mother, as she died six weeks after his birth. He was in consequence taken to Prestonpans, where his infancy and childhood were spent. In boyhood he removed to North Berwick, and lived with his maternal grandfather, Dr Oliver, who was a medical practitioner in that town; and here he obtained his early education. When sixteen years of age he went to Glasgow University, where he studied for four years, and after having thus completed his Arts curriculum, he came to Edinburgh to study divinity, and, what is interesting to note, was the first student enrolled by Dr Chalmers in his first session as professor here. During the five years that he attended our University he joined many Societies, and in 1827 was a Member, and subsequently Secretary, when Allen Thomson was President of the Plinean Natural History Society, and that at a time when young men of high intellectual gifts and extensive knowledge constituted the membership, and took an active part in the lively discussions, many of whom also held high and honourable positions in after life. These latter pursuits he successfully cultivated, and to them he continued to the end to have a warm attachment.

He was licensed to preach the Gospel in 1831, and was ordained to the charge at Prestonpans in 1833.

He took a deep interest in his parish, and faithfully ministered to the spiritual wants of old and young; he also with Chalmers, Cunningham, Begg, and Candlish, took an important part in the great questions of that time. When the Free Church was formed he took a prominent part in its public business. During one winter session, he delivered in the Free Church College a course of lectures on Natural Science, which were characterised by great ability, and into which, as being congenial to his long cherished tastes, he threw his whole soul. To the "Presbyterian Review" and the "British and Foreign Evangelical Review" he contributed freely; for in science, literature, and theology he was well-versed, and he brought to bear on these themes a mind of a high stamp, and imbued with a fine Christian spirit.

He was related by marriage to the late Professor Bannerman, as they had each married a daughter of the late Lord Reston, one of the judges of the Court of Session.

The zeal of Mr Cunningham for science seems to have been communicated to his sons, for, while all of them have become Doctors of Medicine, the second son holding a high place in the medical department of the Indian Army, the eldest son has distinguished himself by his scientific experiments, and is Professor of Natural History in Queen's College, Belfast.

Mr Cunningham's death, which took place on August 2, 1878, has proved a severe loss to science and religion.

Regarding the two remaining Fellows I can obtain very little information.

EDWARD VINCENT SANDILANDS was the youngest son of the late Lieut.-General Philip Sandilands, Royal Artillery, and was born at Hythe, in Kent, on April 5, 1847. His death, which occurred about January 24, 1871, at the early age of twenty-three, was caused by the swamping of his boat in the neighbourhood of the Fiji Islands. He was a Non-Resident Fellow of this Society, and was admitted as such in 1865. It was only this year that we became aware of his death, else his name would have been recorded in our obituary list several years ago.

Mr ALEXANDER GRAHAM, formerly of Kirkhill, Stirlingshire, and latterly at Brimstage, Birkenhead, was admitted a Non-Resident Fellow in July 1, 1859; but beyond thé fact of his death, nothing further is known regarding him.

And now, Gentlemen, in conclusion, I cannot leave this chair, without again expressing to you my high sense of the uniform kindness and courtesy which I have received at your hands. With a Society more harmonious than this I have never been connected, and I do trust that the fine spirit which has characterised us in the past, may be equally manifested by us in the future ; and that we shall strive together as one man to maintain and promote the interests of this Society, which owes its existence to the enlightened zeal and enthusiasm for botanical science of that noble band of distinguished men, few of whom, alas! are now amongst us. As year after year is thus thinning our ranks, it is a comfort to know that so many yet remain to seize the standards from the dying hands of such noble champions of our science, and to bear them aloft with the resolute purpose of handing them down unsullied to the future generation. But, as in all societies, true success is attained, not so much by the brilliant achievements of a few, as by the steady and persevering efforts of the whole, I do trust that we may all be stirred up, each in his special sphere, faithfully, conscientiously, energetically, and with the highest end ever in view, to prosecute botanical science, ever bearing in mind the lesson which the sad obituary list is designed to teach us, that the night is coming to each of us wherein no man can work.

On the Growth of the New Zealand Flax Plant (Phormium tenax) *in the Orkney Islands.* By Dr W. Traill.

(Read 11th December 1879).

The acclimatisation of foreign plants in this country is a subject of so much general interest, whether as regards their economic value or as ornamental additions to our gardens, that I have put together the following notes on the result of a late attempt to introduce the *Phormium tenax*, or New Zealand flax lily, into the Orkney Islands, which islands, from their high latitude—59° north—enjoy comparatively little heat in summer, though their winters are remarkably mild, there being little snow and frost, which is perhaps partly attributable to their insular position, but is chiefly caused by the action of the Gulf Stream, which makes its presence felt, not only by raising the temperature of the sea 7° above that of the air in the months of December and January, but by frequently casting up seeds of tropical plants on the shores of the different islands. During the severe gales of wind that often occur, there is usually a good deal of salt in the atmosphere, hence the extreme difficulty of growing trees or even shrubs, although there are a few exceptional plants that do not seem to be much affected by this, such as different kinds of evergreen shrubby veronicas, and a few other plants, such as the New Zealand manuka or Captain Cook's tea-plant (*Leptospermum scoparium*), the *Pernettya mucronata*, and the Japan *Euonymus*, &c., which, favoured by the mildness of the winters, thrive remarkably well, and to all appearance the New Zealand flax lily is likely to prove as well adapted to the climate of Orkney as any of them.

About eight years ago, or rather more, I got some of the seeds from a friend in New Zealand, which I raised in a hot bed in St Andrews, and during the same season I planted out several of them in the open air in my garden at North Ronaldshay, Orkney, where they have remained ever since, with no protection beyond the proximity of a low wall, some having a southern exposure and others an eastern aspect. These plants seem in no way affected by the winter except that the tips of their leaves become somewhat frayed and ragged, but in the course of the following summer they soon recover their beauty, and they have gradually increased in size until the leaves on some plants now measure from 5 to 6 feet, and in others from 6 to 7 feet long.

I had also distributed duplicate plants among friends in the neighbourhood, in whose gardens they appear quite healthy. It was not until the first week of June this year that my plants showed any signs of flowering, but I then observed that (of the three largest plants) two were throwing out each two flower-shoots; the third and largest plant, however, produced no fewer than five flower-stalks, enveloped by long sheathing leaves that closely embraced tho stems, which were at this time from 4 to 5 feet high; the upper part, which evidently contained the future flower, being inflated, and tapering to a point at the apex, not unlike the head of a spear. They increased in length at the rate of about an inch a day; the swollen mass of spathes separating, and successively unfolding, revealing numerous bunches of flower-buds, until, when the stem reached the length of from 8 to 9 feet, there were twelve or fourteen distinct clusters of flower-buds of a purplish-brown colour, disposed alternately on each side of the stem.

The spathes at this stage added much to the effect, their interior being of a deep orange colour. Our weather had been rather dry for some time, which seemed to retard the opening of the buds; but after a heavy shower of rain on August 1, the buds rapidly increased in size, and in three or four days the first flowers opened; they were tubular in shape, 1½ or 2 inches in length, of a deep red colour, with projecting orange stamens. The odour of the flowers was powerful, like that of Russia leather. It seemed to be very attractive to bees, moths, and other insects. Each main stem bore at least 300 flowers. Altogether it is a most magnificent example of the lily family, and the general appearance of the plant is highly suggestive of tropical vegetation. It is well known that the fibre of the leaves possesses extraordinary tenacity, though, from its containing a large quantity of silica in its composition, the economic value of the plant has hitherto fallen short of what was at first expected. For the manufacture of ropes and cordage, however, I should think it most valuable. The leaf, even in its natural state, is so strong and pliable, that I have seen strips of it torn off and used as boot-laces; and it is evident that the flower-stalks partake of the same tough character as the leaves, as they were not at all damaged by the equinoctial gales of last September, though they were not tied to sticks or otherwise secured from injury. I may add that the flowers, after lasting for some two months, were succeeded by numerous seed capsules containing apparently well-ripened seeds. I understand that two other plants from the same batch of seeds have also flowered this season; one at Strathkinness, here, and another at Professor Swan's residence on the west coast. It is curious that they should all flower in the eighth year of their age, but whether the phenomenon is attributable to that cause entirely, or to any peculiarity in the past season, time alone can determine.

Notes on New Zealand Plants that withstood the severe Winter of 1878-79 *at Rait Lodge, Trinity, near Edinburgh.* By WILLIAM GORRIE of Rait Lodge.

(Read 8th January 1880).

Having long been strongly impressed with the notion that on the mountain ranges of New Zealand, and more particularly those of the middle and southern islands—New Munster and New Leinster—many hardy forms of the southern flora might be got that would impart new and highly important features to our forests, pleasure grounds, and gardens, I secured the good services of some friends who, from time to time within the last fifteen years, sent me such seeds from the provinces of Canterbury and Otago as they thought likely to interest me. From these seeds a few generally known hardy plants were reared, as well as the after-named less known kinds that, having withstood the rigours of the unusually severe and long protracted winter of 1878-79, may be looked upon as sufficiently hardy for our climate.*

1. PITTOSPORUM TENUIFOLIUM (*Kohuhu* of the natives, and the fine-leaved Turpentine-tree of settlers).—"A bush or small tree, 20 to 40 feet high, with slender trunk." Timber, according to Captain J. Campbell Walker, "adapted for turnery purposes, and difficult of combustion." A plant 5 feet in height, on a south wall, withstood the last winter without injury, but several smaller ones of the same age suffered more or less in the open ground. Its beautiful, glaucous, smooth, undulated, evergeen leaves

* The minimums for the seven months of 1878-79 in which the temperature fell below the freezing-point were as follows :—First column from observations taken at Edinburgh by the Scottish Meteorological Society with thermometer protected from direct radiation by louvre boarding, in the usual manner ; and second column from observations at the Edinburgh Botanic Garden, by a thermometer fully exposed to direct radiation :—

November 1878	26°·5	24°
December ,,	9°	9°
January 1879	16°·5	12°
February ,,	21°·4	19°
March ,,	17°	10°
April ,,	28°·7	26°
May ,,	29°·2	—

render this an important addition to our ornamental wall plants; and a closely allied species (*P. Colensoi*) has thriven for a number of years in the shrubbery of my neighbour, I. Anderson-Henry, Esq. of Woodend, at Hay Lodge, where they now measure from 6 feet to over 13 feet in height.

2. Plagianthus betulinus (Ribbon-tree of the settlers, and *Houi* of the Maori natives).—Described in Sir J. D. Hooker's "Handbook of the New Zealand Flora" as a lofty tree, attaining 40 to 70 feet in height, but that its wood is worthless; and by Captain J. Campbell Walker, Conservator of State Forests, in his Report of 1877, as "a graceful tree, 30 to 50 feet high, having white, compact, fissile, but not durable wood." Of several trees that I raised from seeds about ten years since, one that was planted in the open ground now measures fully 15 feet in height, and one on the south wall of my house is 23 feet. Both are of straight handsome growth, bearing considerable resemblance to our native weeping birch, especially in the size and form of their lower leaves, but those on the upper branches are three to four times larger. You will see by the branches before you that they are remarkably tough, so much so that they may be used like packing twine in tying; and I have found them very serviceable for fastening the branches of wall trees, not as is usually done with twisted willows, but by knot-tying. In fact, their toughness is so remarkable, that on the occasion of a Botanical Club visit in 1877, the members admitted that they had never seen such toughness in any unmanufactured vegetable substance. Having devoted considerable attention in endeavouring to discover a vegetable fibre capable of being profitably cultivated for paper making, I some years since felt satisfied that the tough fibrous twigs and wood of the ribbon-tree would be much more suitable for forming paper-pulp than the native poplar, fir, or other trees now in most demand for that purpose, and in this opinion I have been fully confirmed by that of eminent paper-makers and others well-qualified to judge. Neither of my plants have as yet flowered; and as their propagation is somewhat difficult as well as tedious, seeds will have to be procured in considerable quantity from the native habitats of the

ribbon-tree in order to ensure its early and extensive introduction to British forest culture. As to the forementioned worthless and non-durable character of its wood, it may be remarked that in young colonies the timber of unknown indigenous trees is generally judged of by its capability of withstanding the weather when employed for fencing and other out-of-door constructions, without regard to, or in ignorance of, its durability when kept dry; hence it may be presumed that the fissile or splitting properties and toughness of the ribbon-tree timber may recommend it for making riddle rims, basket handles, barrel hoops, and many other purposes. A keen angler, on testing some small twigs that I gave him, remarked that they would make excellent points for fishing-rods.

3. Plagianthus divaricatus.—A small shrub, with many slender, spreading, tough branches. In all respects very different from, and much inferior to the last, but equally hardy, and would seemingly make good sweeping brooms and pot scrubbers. As it is only found in salt marches, where very few shrubby plants thrive, its cultivation in u ch places might be found beneficial.

4. Aristotelia racemosa (*Makomako* and *Mako* of the natives).—"A small, handsome tree, 6 to 20 feet high. Wood white, very light, makes veneers." Has grown for seven years on a south wall, where its branches have frequently been partly killed down, but were reproduced in the following season without any apparent diminution in vigour. The very elegant, largish, irregularly-formed deciduous leaves of this plant fully entitle it to a place on ornamental garden walls. Some plants which I gave to Lady Orde, four or five years since, have proved perfectly hardy in the mild west coast climate of Kilmory, Lochgilphead.

5. Discaria toumatou (the "Wild Irishman" of settlers).—"A thorny bush in dry places, becoming a small tree in damper localities, with spreading branches, and branchlets reduced to spines 1 to 2 inches long, which were used in tatooing" (Hooker). This curious and very interesting plant has stood in the open ground with me perfectly unharmed for five or six years, as have also plants which I gave to Miss Hope of Wardie, and Charles Jenner, Esq., Easter Duddingstone Lodge. The seeds from which

these were raised were from the province of Canterbury; and one of my plants produced in the middle of last June a number of pretty small white flowers.

6. Coriaria ruscifolia, and C. sarmentosa of botanists (the Toot poison-plant of settlers, and the *Tutu* or *Tua-tutu* of the natives).—The disastrous cattle-poisoning peculiarity of the toot have rendered it too well known to New Zealand agriculturists. Having cultivated a number of plants for some years, the seeds of which I had from the province of Canterbury, I found that at the base of a south wall they stood most winters unharmed, and had only the points of their shoots injured by frosts of unusual severity. In consequence of making some ground alterations at an unfavourable season for transplanting, I lost my toot plants three or four years since. Although they seemed to thrive well all the time I had them, they never assumed that tree-like form of growth which Sir. J. Hooker and other New Zealand botanists attribute to this species, but presented more of a sub-shrubby habit.

7. Edwardsia (Sophora) pulchella, and E. grandiflora (the native Laburnums of settlers, and *Kowhai* of the Maoris).—These two, and the *E. microphylla*, grow to about the size of our European laburnums, and, like them, have dark-coloured heartwood, which is "valuable for fencing, veneers," &c. Although all very distinct, these three and another have been included under the generic name *E. tetraptera;* and the first, although easily distinguished by its slender, zigzag, flexuose branches, has been deemed identical with the straight-branched and more robust-growing *E. microphylla.* It has grown quite freely with me for the last twelve years on the south side of a 7 feet high wall, which it now overtops with its thickly-branched head; and its seeds have this peculiarity—that while many came up the first season that they were sown, others came up successively in each of the five following years. *E. grandiflora* was planted out in spring 1878, when about 2 feet in height; also on a south wall, and it stood the last winter perfectly uninjured.

8. Clianthus puniceus (the Glory Pea and Parrot-beak flower of the settlers, and *Kowhai ngutukaka* of the natives).—This being, according to Sir J. D. Hooker, a

native of only the Northern Island, or New Ulster, it has, since its introduction to Britain in 1832, been generally treated as a greenhouse plant, although in numerous instances it has survived mild winters on southerly exposed walls. A variety having much smoother leaves than the original, which was raised in England and named *C. p. magnificus*, is also much hardier than it, and has fully as beautiful racemes of 2 to 2½ inches long scarlet flowers. A well-spread plant of this variety on a south wall attained with me a height of about 14 feet, and had upwards of a thousand flowers all fully expanded at one time. Next winter, however, it was killed down to within 3 or 4 feet of the ground, and although two seedlings from it flowered and seeded in the open ground in summer 1877, they were both killed in the succeeding winter; but several residents at Bute and other west-coast watering places to whom I gave seeds were more successful with their products.

9. Rubus australis, *var.* cissoides.—The leaves of this variety have the peculiar appearance of being almost exclusively composed of rigid, prickly midribs. It and several other varieties form thick, rambling, very prickly, various-sized bushes, and are all about equally hardy, standing our severest frosts in moderately sheltered dry places. They are termed "Lawyers" by the settlers, and *Tataramoa* by the Maories.

10. Leptospermum scoparium (the Tea-tree and Brown Myrtle of Settlers, and *Manuka* of the natives).—A pretty white-flowered, large evergreen bush or small tree, the leaves of which are used as tea, and the twiggy branches for brooms. Among a number of three-year-old plants in the open ground several almost escaped injury, while others were more or less killed down. Like No. 4, it appears to be perfectly hardy in our west coast climate.

11. Fuchsia excorticata (*Kohutuputu* of the natives).—This once common inhabitant of our greenhouses, although never entirely killed, has its shoots so frequently cut down as to prevent it from flowering, and gives it a sub-herbaceous appearance.

12. Fuchsia procumbens.—This pretty little trailing plant, which within the last few years has become common

in our greenhouses and flower shows, has stood on a rockery for the last three years, and appears quite hardy.

13. Aciphylla Colensoi (the "Wild Spaniard" and "Spear-grass" of the settlers, *Kurikuri* and *Papaii* of the natives).—In Sir J. D. Hooker's "Handbook of the New Zealand Flora" this extraordinary evergreen herbaceous plant is described as forming a circular bush, 5 to 6 feet in diameter, of bayonet-like spines, impenetrable to men and horses, having 6 to 9 feet high flowering stems, covered with spreading spinous leaflets. "In another description its leaflets were stated to be as long, broad, and rigid as British bayonets, and a great deal sharper." Induced by these descriptions I procured a number of packets of "Wild Spaniard" seed in different years, but only one of those packets produced plants, and that after they had lain in the soil over one year. Although a real umbellifer, it has more an appearance of some of the dwarf palms; and an eminent botanist to whom I gave a plant, had it included among these in a list of his rarities which he afterwards sent me. The carrot-worms knew better, for on looking at my pot of seedlings one morning I found that they had destroyed more than the half of them. Planted on rockeries where fully exposed, several plants have stood uninjured for five or six years. The strongest of these flowered last summer, when it sent up a flower-stem nearly 4 feet in height; but owing, I suppose, to the very wet and cold weather, it damped or rotted off without perfecting seeds.

14. Griselinia littoralis.—According to Capt. J. Campbell Walker, this in its native localities is a handsome tree 30 to 40 feet in height, the timber of which is hard, compact, and of great durability, valued for fencing-posts, sills, boat-knees, &c. A plant, now about six feet high, has stood in the open ground without injury for eight years. As an ornamental broad-leaved evergreen it is superior to the common bay laurel, and is decidedly hardier than either it, the *Laurustinus*, or the *Aucuba japonica*; hence its cultivation is being rapidly extended. Another species, *G. macrophylla*, has been repeatedly killed in the open air, even although having the protection of a south wall; but its much larger and very handsome foliage entitles it to a prominent place among plants for house and table decoration.

15. Corokia Cotoneaster (*Korokia* of the natives).—A low, spreading evergreen shrub, with thickly interlaced small tortuous branches. Two varieties of this curious and highly interesting plant, trained on a south wall—the one about 5 and the other fully 7 feet in height—were uninjured, and last spring both were thickly clothed with a profusion of small bright yellow flowers. In each of the last four seasons they have borne a few oblong bright red berries, which remained throughout the winter, and may be produced in much greater abundance as the bushes become older. Last winter some plants in the open ground were considerably injured, but these sent up numerous young shoots in summer.

16. Olearia Haastii (*Eurybia parvifolia*), Mr Julius Haast's arborescent Aster, or Daisy.—A dense growing small tree or large shrub, with rigid ovate leaves, averaging about an inch in length, of a dull somewhat glaucous green on their upper surface and whitish below. A young plant, about 18 inches in height, growing in an open border, was not the least injured. In Hooker's "Handbook of the New Zealand Flora," twenty arborescent and frutescent species of this genus are described, most of which are natives of the Middle Island, where several of them are found at such high altitudes as to ensure their being suitable for our climate; and apart from the peculiarities of their foliage, their daisy-like flowers would give a novel and interesting appearance to our shrubberies and woodlands. Like their near relation, that old greenhouse favourite the *Aster argophyllus*, or musk-tree, several of them are musk-scented. The timber of the larger growing kinds is hard, beautifully mottled or veined, and used for inlaying and veneering.

17. Veronica Traversii (W. T. Luke Travers' Speedwell).—A very pretty evergreen shrub, thickly clothed with small, light green, smooth, opposite leaves, which are regularly set in four rows along the branches. A plant about 18 inches high was perfectly uninjured, although several of the more generally known *V. decussata* of the Falkland Islands were completely killed in its vicinity. These last were from the Island of Rousay, where, as well as in others of the Orkney Isles, this species may be said to have become naturalised, coming up abundantly from

self-sown seed, and forming the best of shrubs for withstanding the violent sea winds of that comparatively mild climate.

18. Veronica Salicifolia, *var.* (the Willow-leaved Speedwell and *Koromiko* or *Korimuka* of the natives, also known as *V. Lindleyana*).—Of this somewhat variable old inhabitant of our gardens I had seeds from Canterbury, New Zealand, about ten years since, which produced plants that were of a more rigid bushy growth, as well as decidedly hardier than those I had growing previously. They were, however, a good deal injured by the unusual severity of last winter, but are readily reproduced from self-sown seed.

19. Veronica pinguifolia.—This small dense growing glaucous-leaved shrub is remarkably pretty at all times, but more especially when covered with its profusion of white flowers. It proved perfectly hardy in different situations; and is particularly suitable for rockeries.

20. Veronica hulkeana.—A somewhat slender shrub of about 3 feet in height, with dark green ovate leaves, from 1 to 1½ inch in length, and handsome large branched spikes of pinkish-lilac flowers. I had no plant of this species in the open air last winter, but previous experience showed it incapable of withstanding our severest frosts without suffering more or less. Its very handsome flowers, however, entitle it to a little protection from very hard frosts; and they recommend it as a pot plant for winter forcing, or blooming in greenhouses during spring.

21. Muhlenbeckia complexa (*Polygonum complexum* and *Coccoloba complexa*—interlaced, or complex branched Supple-Jack).—A tough slender climber, rambling over bushes and trees to considerable lengths; but comparatively dwarf and compact when grown without support. Planted on the west wall of a two-storey house, it reached the slates in six years, and two years later (in 1877), it covered a considerable portion of the wall with its thickly interlacing slender branches, and a profusion of small pretty light green leaves. In August and September of that year it produced an abundance of inconspicious green flowers, which, however, were not followed by the expected crop of its mistleto-like berries. Previous to last winter it never

sustained the least injury from frost, but then many of the branches were so much affected that they had to be shortened or cut out. Of this very interesting plant I have cultivated two varieties, the one having entire leaves, while those of the other are deeply indented or contracted in their middle.

22. Libertia grandiflora major.—A very handsome herbaceous evergreen, with stout grassy-like leaves, from 20 to 30 inches in length by a third to half an inch in width; and having spike-like panicles about 3 feet high or pure white showy flowers, that are produced in succession from a month to six weeks. This variety, which I have grown about twelve years, has larger flowers and more compact panicles than that previously in cultivation. Till last winter it grew freely, flowering and seeding abundantly; but the plants then suffered less or more from the excessive frost, although none were entirely killed, and some even flowered and seeded last summer as profusely as before. The bulky produce of tough leaves which this *Libertia* yields claim for it the attention of paper-makers; and as an ornamental plant for flower borders, shrubberies, or moderately open woodlands, the abundance and pure whiteness of its flowers render it particularly attractive, while if once introduced where its self-sown young plants are allowed to grow up, it will maintain a conspicuous existence even among our stronger growing wild flowers.

23. Libertia ixioides.—A pretty white-flowered evergreen herbaceous plant, with more branched inflorescences than the last, and only about a third of its size. Well adapted for growing on rockeries, and perfectly hardy.

24. Cordyline australis (Cabbage-tree or Grass-tree of the settlers, and *Houka* or *Ti* of the Maoris).—In hopes of acquiring hardier forms of this well-known elegant palm-like tree than those usually cultivated in our greenhouses, I, through the kind assistance of Mr James Melvin of Bonnington, Ratho, obtained seeds from its colder habitats in Otago, the plants raised from which grew for six or seven years, sustaining a minimum temperature of 20° without any artificial protection, by which time they attained a height of 3 to 4 feet; but a severe winter then killed them to the ground, with the exception of one, which

stood unharmed till last winter, when it also succumbed. The late Dr Moore of Dublin, who saw this plant in April 1876, told me it was now recognised as a new species, named *C. calicoma,* and distinguished from *C. australis* by having flat instead of incurved leaves. The graceful growth and wind-withstanding properties of this cabbage-tree and its varieties recommend them as portable summer decorative plants for growing in vases or large flower-pots, and they may be wintered in any glass-roofed structure without artificial heat.

25. Chrysobactron Hookeri (*Anthericum Hookeri*).—A showy deciduous herbaceous plant, $1\frac{1}{2}$ to 2 feet in height, with bright yellow flowers, having much the appearance of our pretty bog asphodel (*Narthecium ossifragum*), but larger in all its parts. Is quite hardy.

26. Phormium tenax (the New Zealand Flax or Flax Lily: *Harareke, Harakeke, Korari* and *Coradi* of the Maoris).—The highly interesting paper which was read at our last meeting from Dr. Wm. Traill on the growth of *P. tenax* in Orkney, where it flowered and perfected seeds last year, showed its greater suitability for that northern climate than for the occasional severer winters that we experience in the Lothians. A minimum temperature of 15° seems about the lowest that it will stand without injury, so that the last winter minimum of 9° injured the tops of the leaves, and disfigured the plants considerably. Of late years several variegated leaved varieties of the *P. tenax* have been special objects of attraction in our greenhouses and flower shows, but they have generally been deemed too tender for outdoor cultivation; two of these, however, stood the last winter on my rockery fully as well as the ordinary green sorts, and all sent up fine young leaves in the course of the summer. All the varieties, when grown in large vases or flower-pots for outdoor decoration in summer, contrast effectively with the surrounding shrubs and flowers; and, like the *Cordyline australis*, may be wintered in glass-roofed structures without artificial heat.

27. Carex secta or Carex virgata, β secta (the Grass-tree of settlers).—Is so called from its forming large tufts of roots from 1 to 6 feet in height, and 6 to 18 inches in

diameter, somewhat resembling the stems of tree ferns. Three-year-old plants have stood uninjured, without as yet showing any appearance of forming tufts or stems.

28. Arundo conspicua (New Zealand Reed, *Tohi-Tohi* or *Toe-Toe* of the natives).—This tallest of New Zealand grasses frequently exceeds 10 feet in height; and bears a considerable resemblance to the now generally known pampas-grass of South America (*Gynerium argenteum*), but its elegant feathery white panicles are produced in July instead of October, as are those of the latter, compared with which it is decidedly more tender, and was so much injured last winter that my old plant had to be lifted, and those portions that were alive replanted.

29. Aspidium Richardi (*Polystichum aristatum*).—Height 6 to 10 inches. This fern has stood in my rockery without protection for the last fourteen years, and its remarkably dark green, rigid shining fronds, entitle it to much more general cultivation than it has yet received.

30. Todea superba (*Leptopteris superba,* the superb New Zealand Filmy Fern).—This most elegant of ferns has grown well with me for the last six years in a cool frame at the north back of a garden wall, having only a thin covering of tiffany under the glass to ensure for it the deep shade of its native forest habitats. When the plant came into my possession its fronds were only about 9 inches long, but now several of them are more than twice that length. On lifting the frame-sash where it was growing during the hardest frosts of the present and last winter, I found the soil about it a solid frozen mass, while its densely crowded minute pinnæ, which retain the condensed moisture, were separately enveloped in a white icy covering, so that the fronds far surpassed the finest ostrich feathers in elegance.

In concluding these remarks on the few New Zealand plants which have been objects of cultural experiment with me, I may state that their number is much too limited, and the indigenous habitats of most of them are at too low altitudes to convey any idea of the variety and extent of the botanical treasures suitable for our climate which still await introduction from the snow-capped Canterbury and Southern Alps, as well from other elevated mountain ranges, of which may be mentioned the following from among other trees and shrubs described in Sir J. D. Hooker's "Handbook of the New Zealand Flora:"—At least ten Leguminosæ, six Saxifrageæ, four Myrtaceæ, eight Araliaceæ, twelve Rubiaceæ, thirty Compositæ, twenty Ericeæ, five Cupuliferæ (evergreen Beeches), and ten Coniferæ. One palm, the *Areca sapida*, found on the higher parts of Banks' Peninsula, and above the lower glaciers on Mount Cook. Herbaceous plants in immense variety and many of them of great beauty; while for the quantity and elegance of its ferns, New Zealand is not surpassed by any country of like extent in the world.

In 1850 Mr John Jeffrey, and in 1863 Dr Robert Brown, were sent to North-West America as botanical collectors by an association which originated in Edinburgh. Could not such an association be now organised for sending an efficient botanical collector to New Zealand? And if so, it would be well to secure the co-operation of proprietors on the western and northern coasts and islands of Britain, where the mildness of the winters would be most conducive to the success of the introduced plants, and where they might be extensively reared and grown on private estates; or by public enterprise, as in botanical gardens having judiciously selected sites, for of all botanic gardens now in Britain, only one of any importance, viz., that of Liverpool, is situated within the influence of the west coast climate, and even compared with it many much more favourable situations could be got along the western coasts of Scotland. As showing that this notion of introducing the hardier plants of New Zealand has been one of some standing with me, I may mention that, at a meeting held in 1863 to consider the best place for sending Dr Robert Brown to as a collector, on the question being put to me by George Patton, Esq. of The Cairnies—afterwards the Lord Justice-Clerk—I unhesitatingly replied, "To the great western mountain range of the Middle Island of New Zealand;" which was met by the objection "That place has never been thought of; and besides it cannot be got at, as there is no shipping or trade connected with it." The finding of gold has since, however, brought both shipping and trade to it; and yet its native flora is almost as little known to British cultivators as ever.

In addition to the scientific names of New Zealand plants in the preceding list, those applied by the settlers and natives are also given, so far as they are known, as by such names collectors can get any kinds of seeds they may be in want of, with more ease and certainty than by using the botanical names only.

On the British-American Species of the Genus Viola. By Professor GEORGE LAWSON, Dalhousie College, Halifax.

(Read 11th March 1880).

In this paper the author states that his object is to interest botanists in the study of a lowly but beautiful family of plants whose headquarters are in the temperate regions of America, but whose relations to each other as species, varieties, or hybrids, are as yet imperfectly known.

He has some of the related species in cultivation for the purpose of studying the remarkable variations in form, texture, and size of organs, of the same individual plants at different periods of the year, and he hopes that other botanists and cultivators may be induced to undertake a careful study of the living plants in the same way, which seems to hold out the only hope of arriving at satisfactory conclusions.

The number of British-American species, not counting varieties, is twenty. Of these, eight grow within the limits of the Nova Scotia peninsula, and four others are not unlikely, sooner or later, to be added.

The species are divided into four groups:—(1) those with long and thick fleshy rhizomes, sending up annually radical leaves and flowers from terminal buds; (2) those with rhizomes sending up annually long-stalked radical leaves and leafy flower-shoots; (3) those with slender and woody roots and stems branching into annual leafy flower-shoots; (4) those that have permanent and leafy stems and leafy stipules.

The distinctive characters of each species and of its varieties are pointed out, and also the geographical and local distribution of the various forms, which in many cases has been incorrectly indicated in published works.

The first and most beautiful of all the American violets is *V. pedata,* a Saskatchawan and extreme Western species. *V. palmata,* Linn., which proves to be a constant and distinct species, has, thus far, been found only in one place in British America, viz., on the banks of the Sackville River, at Lucyfield, although it is not rare in the Southern and Western States. Of *V. cucullata,* the common blue violet, there are several forms. It abounds in the maritime provinces generally, and in Ontario, and extends far west, both in Canada and the United States. *V. sagittata* (including *ovata*) is a rarer species, but still not uncommon from the Atlantic seaboard to the western parts of Ontario, wherever there are sandy soils dry and sunny banks. Its flowers are paler, and have more of a purplish tinge than those of the common blue violet, and they come later. *V. rotundifolia* is more circumscribed in its distribution. *V. blanda* is the common white violet, so abundant everywhere about Halifax, and throughout the other maritime provinces and Ontario, growing in wet places, and on alder banks. It is the first violet to bloom in spring, appearing in average seasons in April with the May-flower. Its flowers are delicately sweet-scented. We read in Aiton's "Hortus Kewensis," the standard work of its time on garden plants, that this species was introduced to England by His Royal Highness the Duke of Kent, who no doubt obtained it at "The Prince's Lodge," near Halifax, where it still abounds. *V. primulæfolia* was found for the first time last summer in a swamp at the Three Mile Church, near Halifax. It is closely related to the *V. Patrinii,* described in the East Indian Floras as inhabiting the Nilgherries. It does not appear to have been previously found in British America. It seeds sparingly, and there seems reason to believe that it may be a hybrid between *V. lanceolata* and *V. blanda*; this point still remains to be determined. *V. lanceolata* is the white-flowered, narrow-leaved violet, so common about Steele's Pond and Lily Lake, usually found only in swamps and by the margins of lakes. Although this species occurs in Illinois and Kentucky, and is nowhere else so abundant as in Nova Scotia, yet it appears to be absent from the greater portion of the province of Quebec and the whole of Ontario.

V. striata, on the other hand, is essentially an Ontario species. The most puzzling of all the British American species is the blue leafy-stemmed violet, which has been mostly known to botanists as *V. Muhlenbergii*, having been named in honour of the American (Dutch) botanist of that name. More recently it has been identified with the *V. canina* of Europe. *V. canina* is an aggregate species, embracing several very distinct segregates in Europe. The only one of these which the plant resembles is *V. sylvatica*, of Fries—the common dog violet of Western Europe.

Although there is no plant in America corresponding to the European forms *canina* (proper), *lactea*, or *stagnina*, yet in the Far West, on both sides of the Rocky Mountains, there is a remarkable cæspitose form, viz., *Albiflora* of Hooker's "Flora Boreali-Americana," which does not seem to occur in Europe. The nearest European approach to it is apparently the mountain and Arctic sub-species, *Arenaria*, DC. *V. rostrata* belongs to the same group as *V. canina*, but is very distinct in appearance, and a larger and more handsome plant, yet almost the only technical character is the greater length of the spur of the flower, and there is a form intermediate in this respect.

There is an Ontario species, occurring in the woods around Kingston, Belleville, Toronto, &c. *V. canadensis* is more abundant throughout Ontario; it is the tallest of all the violets, growing from 9 inches to 2 feet in height.

The last is the leafy stipuled species, *V. tricolor*, the original of the parti-coloured varieties of the garden pansy. Its perennial form occurs in some places, but it is not originally a native plant in America.

Note on the Flora of Colonsay and Oransay, with List of Plants collected in July 1879. By Symington Grieve.

(Read 8th April 1880.)

The Island of Colonsay, one of the Lesser Hebrides, lies out in the Atlantic, west of Jura, north of Islay, and south of Mull. It is attached to the Island of Oransay at low water, and, as far as the Flora is concerned, the two islands may be almost considered the same. The length of the two combined is about 12, and the breadth varies from $2\frac{1}{2}$ to 3 miles. Both are somewhat low lying, having no great altitude, the principal elevation being a hill called Car-a-Mor, near the middle of the Island of Colonsay, which has a height of 437 feet above sea-level.

The surface of these islands may be described as mostly rugged; but there is a wide central valley in Colonsay, where there is considerable cultivation, and in this valley or strath is situated Loch Fada, the principal sheet of water on the island, which at one period was probably of much greater extent than at present, as it evidently has been drained, by the bed of the stream which flows from it having been deepened; and it is somewhat remarkable that this stream, which has a comparatively strong flow of water and has only a short course, partially disappears before it reaches the sea in the sand at the head of Kiloran Bay. From this cause salmon or sea trout cannot run up, and Loch Fada is only known for its brown trout, which are supposed to have been put into it by the monks, who had their headquarters at Oransay, but had two dependent chapels on Colonsay. These trout are said to be the same as are found in Loch Leven, but if so, they have sadly degenerated, and there are few points of resemblance between them and their supposed relatives in Kinross-shire. This loch, about a mile and a quarter long, is divided into three parts; the northern and central parts being divided by the public road, which is carried along the top of an artificial embankment, but at the western point of this work there is a cutting or canal connecting these two sections of the Loch, which is bridged over. The southern section is divided from the central division by a dense bed of *Nymphæa alba*, which is quite impenetrable to a boat; and as visitors, unless guests at Colonsay House, are only allowed to fish the central division, it was in this section alone that I collected any aquatic plants.

Having less than four working days on the islands, these were very fully employed, and we were unable to visit the northern and south-western parts of Colonsay; but of the remainder of their surface, the only cultivated spots we saw were a few fields at or near Scallasaig, and a track of sandy soil on the southern portion of Oransay. It was evident that the true wealth of the islands lay in their rich pasture-lands, on which are reared fine herds of cattle, and large numbers of sheep.

The Flora of this district is such as one expects to meet with in the Lowlands, but from the humidity of the atmosphere the climate proves most congenial to those plants requiring moisture; we find it therefore the home of some of our best ferns, which grow with a luxuriance perhaps only equalled on the coasts of Cornwall or Devon. For instance, we found in the caves along the shore of Kiloran Bay hundreds of *Scolopendrium vulgare*, and among others a specimen with fronds 2 feet 6½ inches in length; and it is curious to note that this fern seems mostly confined to these caves, and is comparatively scarce on the east of the island, where *Asplenium marinum* is in great plenty; and in the deep clefts of the rocks near the sea we found several plants of this Asplenium, with fronds of the same length as those of the largest hart's tongue above mentioned. It seems to vary greatly, for on exposed cliffs it exists in a dwarf state with thick curled fronds, and might easily be mistaken for a different plant; and we noticed on the walls of the ruins at Oransay that the dwarf variety and the ordinary form of this fern grow together, which is remarkable.

Nephrodium æmulum grows plentifully; *Osmunda regalis* is abundant, and *Hymenophyllum unilaterale* in some places forms the sward beside the heather. Altogether, we noted seventeen varieties of ferns, and there may be others which did not come under our observation.

With regard to flowering plants *Anagallis tenella* and *Sedum anglicum* adorn almost every bank about Scallasaig, and on the western cliffs the chief ornament is *Sedum Rhodiola*. In the marshy meadows the show of orchids is magnificent, among the number being *Listera ovata*, *Orchis maculata* and *latifolia* with *Habenaria viridis* and *bifolia*, while on a sandy meadow is the only station known on the west of Scotland for *Orchis pyramidalis*. In the ditches are found *Samolus valerandi*, *Ajuga reptans*, and many others; but as a Catalogue is appended of flowering plants, ferns, club mosses, and horse tails, numbering upwards of two hundred, besides between forty and fifty mosses, it is needless to name them. Mr H. C. Watson, author of

"Topographical Botany," informs me that this district, to which he gives the name of "Vice County 102 Ebudes South," and which comprises Islay, Jura, Colonsay, and their islets, has not previously had the following plants noted:—

Geranium sylvaticum	Listera cordata
Epilobium obscurum	Habenaria bifolia
Myriophyllum alternifolium	Scilla verna
Sanicula europæa	Potamogeton lucens
Valerianella olitoria	Scirpus lacustris
Scabiosa arvensis	Carex lepidocarpa
Veronica montana	Nephrodium æmulum
Veronica hederifolia	Nephrodium spinulosum
Myosotis palustris	

It is strange that such an interesting locality has not been examined botanically before; but as far as we are aware the only record of plants from these islands is to be found in Lightfoot's "Flora Scotica," published in 1777, and it comprises only ten plants. Six of these were noted on Oransay and four on Colonsay.

Those from Oransay are—

Carum carui	Sclerochloa maritima
Convolvulus soldanella	Bromus arvensis
Carex arenaria	Triticum junceum

From Colonsay—

Orchis pyramidalis	Habenaria viridis
Gymnadenia albida	Osmunda regalis

There are, without doubt, many plants still to note, and it is interesting to observe that of the ten species mentioned by Lightfoot I have only recorded three, but if spared I hope in future visits to add to my list, until we have a comparatively complete Flora of these islands.

With regard to mosses, I may say that among the rarer species found were—

Campylopus flexuosus	Aulacommon palustre
Ptychomitrium polyphyllum	Fissidens adiantoides
Ulota crispa	Pterygophyllum lucens
Brentelia arctuata	Pterogonium gracile
Bryum roseum	

but appended is a full list of all collected.

If any member of this Society desires a pleasant and retired place to spend a holiday, he should go to Colonsay. It has the advantage of being easily accessible, being only ten hours by steamer from Greenock, and as you sail during the night, both going and returning, you may go to bed before the steamer starts and only rise and dress to go ashore. No doubt the *mal de mér* may take away some of the pleasure, but it is not so bad after all; and if one prefers to enjoy the scenery in the early morning as you approach the southern shore of Islay, and then proceed through the sound, they will feel amply repaid for getting up a little earlier than usual.

The accommodation at Scallasaig is very good for such an out of the way situation, the fare homely, and the charges moderate. There are fine stretches of sandy beach for sea-bathing; and visitors are permitted to roam almost all over the islands, which abound in objects of interest to all scientifically inclined. The caves on the west are well worth a visit, and the cliffs, rising in perpendicular precipices from the sea, are very grand. Near Scallasaig there is a Druid's circle, and on the top of eminences all over the islands are the sites of duns or ancient Scottish forts, and the remains of at least one Danish fortification is on Oransay. The ecclesiastical ruins on the same Island are justly celebrated, and it is there the finest stone cross in the West of Scotland is to be found. It may not be so well known that these ruins should have special interest to the inhabitants of Edinburgh, as this abbey was a dependency of the Abbey of Holyrood.

If any one wishes retirement and food for quiet study, permit me to assure them they will find in Colonsay an earthly paradise.

Catalogue of Colonsay Plants, collected July 1879, and Arranged and Named according to the London Catalogue.

RANUNCULACEÆ, 1.

Thalictrum minus, var. maritimum.
Do. do. var. flexuosum.
Both found growing on sandy banks on shore of Kiloran Bay.
Ranunculus Flammula. Common.
acris.
repens.
Caltha palustris.

NYMPHÆACEÆ, 3.

Nymphæa alba. Loch Fada.

PAPAVERACEÆ, 4.

Papaver Argemone. Cultivated field, Scallasaig.

CRUCIFERÆ, 5.

Sinapis arvensis.

Cardamine pratensis.
 hirsuta.
Arabis hirsuta.
Nasturtium officinale. Ditches, Kiloran and Scallasaig.

VIOLACEÆ, 8.

Viola sylvatica, var. Riviniana.

DROSERACEÆ, 9.

Drosera rotundifolia. Common near Loch Fada.

POLYGALACEÆ, 10.

Polygala depressa.

CARYOPHYLLACEÆ, 12.

Silene maritima. On cliffs near Scallasaig and Ruins Oransay.
Lychnis diurna.
 Flos-cuculi.
Cerastium tetrandrum.
 triviale.
Stellaria media.
 uliginosa.
Sagina procumbens.
Spergula arvensis.

HYPERICACEÆ, 16.

Hypericum Androsæmum.
 humifusum.
 pulchrum.

MALVACEÆ, 17.

Malva sylvestris variety. Under cliffs near ruins, Isle Oransay.

LINACEÆ, 19.

Linum catharticum. Common, apparently wild.
 usitatissimum. On quay at Scallasaig.

GERANIACEÆ, 20.

Geranium sylvaticum.
 pratense.
 molle.
 Robertianum.
Erodium cicutarium.
Oxalis Acetosella.

LEGUMINIFERÆ, 25.

Ulex europæus. Kiloran and Kilchattan.
Anthyllis vulneraria.
Medicago lupulina.
Trifolium pratense.
Lotus corniculatus.
Vicia Cracca.
 Sepium.
Lathyrus pratensis.
 sylvestris.

ROSACEÆ, 26.

Spiræa Ulmaria.
Alchemilla arvensis.
 vulgaris.
Potentilla Tormentilla.
 anserina.
Comarum palustre. Loch Fada.
Fragaria vesca.
Geum rivale.
Rosa spinosissima. Near Scallasaig.
 tomentosa.
Pyrus aucuparia.

LYTHRACEÆ, 27.

Lythrum Salicaria. Near Scallasaig.

ONAGRACEÆ, 28.

Epilobium obscurum.

HALORAGIACEÆ, 28.

Myriophyllum alternifolium. Loch Fada.

CRASSULACEÆ, 31.

Sedum Rhodiola. Cliffs west of island.
 anglicum. Common.
 acre. Not plentiful, but found near Scallasaig, and on Oransay.

SAXIFRAGACEÆ, 32.

Chrysosplenium oppositifolium.

UMBELLIFERÆ, 33.

Hydrocotyle vulgaris. Near Loch Fada.
Sanicula europæa.
Petroselinum sativum.
Œnanthe crocata.
Ligusticum scoticum.
Angelica sylvestris. Near Scallasaig.
Heracleum sphondylium.
Daucus carota.

ARALIACEÆ, 34.

Hedera Helix.

CAPRIFOLIACEÆ, 37.

Lonicera periclymenum. Near Kiloran.

RUBIACEÆ, 38.

Galium verum.
 saxatile.
 Aparine.
Sherardia arvensis. Near Scallasaig.

VALERIANACEÆ, 39.

Valerianella olitoria. Near Scallasaig.

DIPSACEÆ, 40.

Scabiosa arvensis.

COMPOSITÆ, 41.

Carduus lanceolatus.
 palustris.
 arvensis.
Arctium minus.
Centaurea nigra.
Chrysanthemum segetum.
 leucanthemum.
Matricaria inodora.
Achillea Millefolium.
Gnaphalium dioicum. Rocks on hil north of Scallasaig
Senecio Jacobæa.
 aquaticus.
Bellis perennis.

Tussilago farfara.
Taraxacum officinale.

CAMPANULACEÆ, 42.

Campanula rotundifolia.

ERICACEÆ, 43.

Vaccinium Myrtillus.
Arctostaphylos uva-ursi. Common.
Erica Tetralix.
  cinerea.
Calluna vulgaris.

GENTIANACEÆ, 46.

Erythræa centaurium.
Menyanthes trifoliata.

SCROPHULARIACEÆ, 50.

Digitalis purpurea
Veronica hederifolia.
  arvensis.
  officinalis.
  Chamædrys.
Euphrasia officinalis.
Pedicularis palustris.
  sylvatica.
Rhinanthus Crista-galli.
Melampyrum pratense.

LABIATÆ, 53.

Mentha hirsuta.
  arvensis.
Thymus Serpyllum.
Prunella vulgaris.
Lamium purpureum.
Ajuga reptans.
Teucrium Scorodonia.

BORAGINACEÆ, 54.

Anchusa arvensis.

PINGUICULACEÆ, 55.

Pinguicula vulgaris.

PRIMULACEÆ, 56.

Primula vulgaris.
Lysimachia nemorum.
Anagallis tenella. Common.
Samolus Valerandi.

PLUMBAGINACEÆ, 57.

Armeria maritima.

PLANTAGINACEÆ, 58.

Plantago maritima.

CHENOPODIACEÆ, 61.

Salicornia herbacea. On shore, near the Quay, Scallasaig.

POLYGONACEÆ, 62.

Rumex Acetosa.
  Acetosella.
Polygonum aviculare.

EMPETRACEÆ, 67.

Empetrum nigrum.

EUPHORBIACEÆ, 68.

Euphorbia Helioscopia. Corn field, Scallasaig.

URTICACEÆ, 71.

Urtica dioica.

AMENTIFERÆ, 72.

Myrica Gale.
Salix aurita.
  repens.

CONIFERÆ, 73.

Juniperus communis. Common.

NAIADACEÆ, 77.

Potamogeton polygonifolius.

ORCHIDACEÆ, 80.

Orchis pyramidalis. Kiloran Bay.
  mascula.
  latifolia.
  maculata.
Habenaria viridis.
  bifolia.
Listera cordata.
  ovata.

IRIDACEÆ, 81.

Iris Pseudacorus. Near Scallasaig. Common.

LILIACEÆ, 84.

Scilla verna. Common near the Coast.
  nutans. Common.
Narthecium ossifragum.

JUNCACEÆ, 86.

Luzula sylvatica.
Juncus effusus.
  lamprocarpus.
  supinus.

CYPERACEÆ, 87.

Schœnus nigricans.
Scirpus lacustris.
Eriophorum angustifolium.
Carex stellulata.
  vulgaris.
  binervis.
  flava, var. lepidocarpa.

GRAMINEÆ, 88.

Alopecurus geniculatus.
Agrostis vulgaris.
  do. var. pumila.
Aira caryophyllea.
Avena pratensis.
  elatior.
Holcus mollis.
Koeleria cristata.
Catabrosa aquatica.
Glyceria fluitans.
Cynosurus cristatus.
Dactylis glomerata.
Festuca ovina.
Bromus mollis.
Brachypodium sylvaticum.
Nardus stricta.

FILICES, 89.

Hymenophyllum unilaterale.
Pteris aquilina.
Lomaria Spicant.
Asplenium Trichomanes.
 marinum.
 Adiantum-nigrum.
Athyrium filix-fœmina.
Scolopendrium vulgare.
Cystopteris fragilis.
Aspidium aculeatum.
 var. lobatum.
Nephrodium filix-mas.
Nephrodium spinulosum.
 dilatatum.
 æmulum.
Polypodium vulgare.
Osmunda regalis.

LYCOPODIACEÆ, 90.

Lycopodium selaginoides.

EQUISETACEÆ, 92.

Equisetum sylvaticum.
 limosum.

List of Mosses collected at Colonsay, July 1879, Named and Arranged according to the London Catalogue.

SPHAGNACEÆ. Tribe 1.

Sphagnum acutifolium, *Dill.* Scallasaig.
 cymbifolium. Near Loch Fada.

WEISSIACEÆ. Tribe 3.

Weissia viridula (controversa), *Hedw.*
Dicranum scoparium, *Hedw.*
Campylopus flexuosus, *Brid.* (Rocks on Hills, Scallasaig.

LEUCOBRYACEÆ. Tribe 5.

Leucobryum glaucum, *Hampe.* Common.

POTTIACEÆ. Tribe 7.

Barbula muralis, *Hedw.*

GRIMMIACEÆ. Tribe 9.

Racomitrium heterostichum, *Brid.*
 lanuginosum.
 canescens, var. ericoides.
Ptychomitrium polyphyllum, *B. & S.*
Ulota crispa (Orthotrichum), *Mohr.*

BARTRAMIACEÆ. Tribe 12.

Bartramia pomiformis, *Hedw.* Near Scallasaig.
Philonotis fontana, *Brid.* Near Loch Fada.
Brentelia arcuata, *Schpr.* Near Loch Fada.

BRYACEÆ. Tribe 13.

Bryum cæspiticium, *Dill.*
 capillare.
 pseudo-triquetrum.
 roseum. On bank at side of road between Scallasaig and Kiloran.

MNIACEÆ. Tribe 14.

Mnium hornum, *L.*
Aulacomnion palustre, *Schwg.* Near Loch Fada.

POLYTRICHACEÆ. Tribe 16.

Polytrichum piliferum, *L.*
 juniperinum.
 commune.

SECTION II.—AMPHOCARPI.

FISSIDENTACEÆ. Tribe 18.

Fissidens adiantoides, *Hedw.* Near Loch Fada.

SECTION IV.—PLEUROCARPI.

HOOKERIACEÆ. Tribe 25.

Pterygophyllum lucens, *Brid.* Near Loch Fada.

LESKEACEÆ. Tribe 27.

Thuidium tamariscinum, *Schpr.*

HYPNACEÆ. Tribe 28.

Pterogonium gracile, *Swartz.*
Thamnium alopecurum, *Schpr.*
Climacium dendroides, *Brid.*
Isothecium myurum, *Brid.*
Homalothecium sericeum, *Schpr.*
Brachythecium rutabulum, *Schpr.*
Eurhynchium striatulum, *Schpr.*
 prælongum.
 pumilum. (Walls of the New Cave, Kiloran Bay.)
Rhynchostegum rusciforme, *Schpr.*
Plagiothecium denticulatum, *Schpr.*
 undulatum.
Hypnum commutatum, *Dill.*
 cupressiforme.
 cuspidatum.
 Schreberi.
 purum.
Hylocomium splendens, *Schpr.*
 squarrosum.
 loreum.
 triquetrum.

Notes of a Tour in the Engadine, with a List of Alpine Plants. By JAMES BLAIKIE, M.A., F.R.S.E., Her Majesty's Inspector of Schools.

(Read 12th February 1880.)

The Engadine (Engiadina in Romaunsch) or upper valley of the Inn is situated in the extreme south-east corner of Switzerland. The Inn rises in the lake of Sils, and flows in a comparatively straight course north-eastwards to join the Danube. This lake is about 6000 feet above the sea, and, after leaving it, the Inn forms the lakes of Silva Plana and San Moritz, so that the upper part of the valley is nearly level. To those who, like my wife and myself, first enter this valley from the Italian side, by crossing the picturesque Maloja Pass, the effect is very striking. It is a long flat grassy plain, bounded on both sides by snow-capped hills; no trees or corn are at first to be seen, and birds are rarely heard. Farther down we come on the *Pinus cimbra* and the larch, and small patches of barley and rye, but wheat does not ripen in any part of the Engadine.

The air is dry and invigorating, and hence it has lately become a favourite resort of both tourists and invalids. The high elevation places mountain and glacier excursions within the reach of all, while the rich Alpine Flora affords a never-ending source of interest and enjoyment. Our first visit was paid late in September. The flowers were over, but here and there a *Gentian* or a *Phyteuma* still showed their dainty blossoms, and we determined that when an occasion arrived we should revisit the Engadine earlier in the season. Accordingly, on the 11th of August 1879, we set out from Chur (Coire), and walked to the Engadine, over the Parpan and Albula Passes. On the Albula, after passing through a weird and desolate hollow, strewed with lichen-covered rocks, called the Teufelsthal, we suddenly found ourselves on a grassy meadow surrounded by exquisite Alpine plants. Among others were—

Saxifraga oppositifolia.
Arenaria biflora.
Dryas octopetala.
Androsace Chamæjasme.
Primula farinosa.
Ranunculus alpestris.
Gentiana acaulis.

Captivated by their beauty, we determined to take home specimens of as many as possible, and at Samaden, the principal village of the Engadine, we purchased boards, paper, Hallier's edition of Koch's "Flora," and Weber's coloured pictures of Alpine plants. Unfortunately, the idea of making a complete botanical collection did not at first occur to us, and our list of plants will be found incomplete, inasmuch as it omits cryptogams, grasses, sedges, &c., and some plants which are either common at home or were too bulky to make pretty specimens.

At Samaden the Inn is joined by a considerable stream—the Flatz, or Bernina Bach—and the tourist may either proceed up the Inn to San Moritz, celebrated for its mineral waters, and a great resort of invalids, or by the steeper Bernina Valley to Pontresina.

Pontresina is admirably situated as a centre for Alpine excursions. To the westward, in the angle formed by the Inn and the Flatz, rise the glorious group of the Bernina Alps. The highest point, Piz Bernina, is 13,300 feet, and the ascent, though difficult, is often made. Two great glaciers, the Rosegg and the Morteratsch, stretch far down towards the Flatz valley, and form highways by which man penetrates these vast solitudes. On the eastern side of the valley Piz Languard (10,700 feet) and other mountains offer climbing, without either the attraction or the danger of ice, and are clothed in many parts with a rich and varied Flora. Less ambitious persons have only to cross the stream to enjoy shady walks, where the banks under the trees are carpeted with the creeping stems and tender pink-lined cups of the *Linnæa borealis.*

One morning I left Pontresina at 4 A.M., along with a friend, who was both a bold and cautious mountainer and an accomplished botanist, and walked to Samaden, in order to climb Piz Ot (the high peak) a superb granite pyramid, whose summit reaches 10,650 feet above the sea.

Leaving the village, we passed first through closely mown meadows, where the lilac buds of *Colchicum autumnale* were beginning to peep through the ground. Higher up among the long grass grew the showy blossoms of *Dianthus superbus* and *Knautia sylvatica.* Still higher up was *Gentiana campestris,* both purple and white, and when the shoulder of the hill was turned, we came on a grassy flat which abounded in *Nigritella angustifolia, Dryas octopetala, Viola calcarata, Silene acaulis, Gentiana bavarica, Phyteuma hemisphæricum,* and other plants.

Before us lay the peak of the hill, apparently a granite mass, unrelieved by even a blade of grass; but as we climbed we found many a tiny plant clinging to the rocky wall. We reached the top about ten o'clock, and enjoyed a magnificent view of the surrounding mountains. Presently, we observed what seemed to be a path descending the northern side of the hill, and as it occurred to us that this must lead to the Bevers Valley, celebrated for its beauty, and interesting botanically, we determined to follow it.

We had not gone far before we began to doubt the wisdom of our resolution. The path stopped short at a rock which overhung a vertical precipice. What we had taken for a path was, in fact, a stone *couloir*, ending in a stone cascade.

But the rocks around us formed a garden where the most characteristic Alpine flowers blossomed with singular luxuriance.

These wonderful little plants, nearly all perennial, and sometimes less than an inch in length, growing in mossy tufts in the interstices of the rocks, defy alike the burning sun of summer and the severest frost of winter, and expand their tiny blossoms with unfailing regularity, in many places rarely seen by human eye.

Here we obtained *Geum montanum* and *Geum reptans*, the pure white blossoms of the newly expanded *Ranunculus glacialis*, and the rose-coloured blossoms of the same flower at a later stage, the pretty pink tufts of *Dianthus glacialis*, the deep blue of *Eritrichium nanum*, and the dainty pink and white *Androsace glacialis*. Less conspicuous, but even more interesting, from their characteristically Alpine growth, were *Phyteuma pauciflorum*, and the saxifrages. Of the latter, we obtained—

Saxifraga bryoides	Saxifraga stenopetala
exarata	Seguieri
muscoides	planifolia

As we gazed with wonder around, a chamois made its appearance, and, surprised at the unexpected intrusion, sprang from rock to rock along the face of the precipice, passing only a few yards from us. This piece of good luck, as well as the botanical treasures we had found, encouraged us to continue our difficult descent. With a good deal of trouble we at last reached a steep slope of snow, down which we *glissaded*, and, crossing the glacier without adventure, descended a second cliff into the Bevers Valley.

Here we found *Gentiana punctata*, large quantities of which had been cut down by the peasants, probably with a view to its use in Materia Medica. In one rocky gully *Pedicularis atro-purpurea* was expanding luxuriantly its fern-like foliage. Further down, a great variety of *Aconites*, blue, variegated, and yellow, were growing along with *Senecio sarracenicus*, and many other plants. After a long walk we returned to Pontresina.

Another excursion which proved botanically interesting, was that to the *Val del Fain* (or Hay Valley), which opens into the Bernina Valley, not far from the pass. The mountains on both sides of this valley consist of limestone. Here we found *Lilium Martagon*, *Aquilegia alpina*, *Gentiana lutea*, *Campanula thyrsoidea*, *Helianthemum vulgare* and *œlandicum*, *Sempervivum arachnoideum*, *Wulfeni* and (I think) *Brownii*, *Gnaphalium leontopodium* (the celebrated Edelweiss), *Senecio abrotanifolius*, *Aronicum scorpioides*, *Ranunculus montanus*, *Papaver alpinum*, *Phyteuma humile*, with several cruciferous, leguminous, and other plants.

Our return journey was made from the Engadine to Davos by the Scaletta Pass, and from Davos to Chur by the Strela; both these passes are crossed only by footpaths. Our dried specimens were sent round by coach; those in process of drying we carried with us. We found very frequent changes of paper the best means of preserving the natural colours of the plants. We had particular difficulty with *Dryas octopetala*, but at last succeeded in inducing *one* specimen to remain white, the campanulas were obstinate to the last.

*List of Dried Specimens of Plants from the Engadine.**

MONOCOTYLEDONS.

Colchicum autumnale, *L.*
Veratrum album, *L.*
Lilium Martagon, *L.*
Lloydia serotina, *Salisb.*
Allium Victorialis, *L.*
Orchis globosa, *L.*
latifolia, *L.*

* The arrangement is that adopted in Hallier's edition of Koch's "Flora Germanica."

Gymnadenia conopsea, *R. Brown.*
odoratissima, *Richard.*
Nigritella angustifolia, *Richard.*
Eriophorum angustifolium, *Roth.*
Poa alpina (vivipara), *L.*

DICOTYLEDONS.

Thesium alpinum, *L.*
Oxyria digyna, *Campdera* (=reniformis, *Hooker*).
Polygonum Bistorta, *L.*
viviparum, *L.*
Salix herbacea, *L.*
Daphne striata, *Trattinnick.*
Thalictrum aquilegifolium, *L.*
alpinum, *L.*
Anemone alpina (sulphurea), *L.*
Ranunculus alpestris, *L.*
rutæfolius, *L.*
glacialis, *L.*
montanus, *Willd.*
acris, *L.*
nemorosus, *DC.*
Caltha palustris, *L.*
Aquilegia alpina, *L.*
Aconitum Napellus, *L.*
paniculatum, *Lam.*
Lycoctonum, *L.*
Gypsophila repens, *L.*
Dianthus glacialis, *Hänke.*
sylvestris, *Wulfen.*
deltoides, *L.*
superbus, *L.*
Saponaria ocymoides, *L.*
Silene nutans, *L.*
inflata, *Smith.*
acaulis, *L.*
rupestris, *L.*
Lychnis diurna, *Sibthorp.*
flos-cuculi, *L.*
Lepigonum rubrum, *Wahlenb.*
Alsine recurva, *Wahlenb.*
Arenaria biflora, *L.*
Stellaria nemorum, *L.*
Cerastium latifolium, *L.*
arvense, *L.*
Helianthemum vulgare, *Gärtner.*
œlandicum, *Wahlenb.*
Viola biflora, *L.*
tricolor, *L.*
lutea, *Smith.*
calcarata, *L.*
Zoysii, *Wulf.*
Parnassia palustris, *L.*
Papaver alpinum, *L.*
Nasturtium palustre, *DC.*
Arabis alpina, *L.*
auriculata, *Lam.*
bellidifolia, *Jacq.*
Cardamine amara, *L.*
resedifolia, *L.*
alpina, *Willd.*
Draba aizoides, *L.*
tomentosa, *Wahlenb.*
Biscutella lævigata, *L.*
Hutchinsia alpina, *R. Brown.*
Polygala vulgaris, *L.*
Gentiana lutea, *L.*
punctata, *L.*
cruciata, *L.*
asclepiadea, *L.*
acaulis, *L.*
excisa, *Presl.*
verna, *L.*
bavarica, *L.*
bavarica subacaulis, *L.*
brachyphylla, *Vill.*
nivalis, *L.*
utriculosa, *L.*
campestris, *L.*
campestris (alba).
obtusifolia, *Willd.*
tenella, *Rottböll* (=glacialis, *Thom.*)
ciliata, *L.*
Convolvulus arvensis, *L.*
Cuscuta Epithymum, *L.*
Solanum Dulcamara, *L.*
Lunaria alpina, *Mill.*
Veronica aphylla, *L.*
latifolia, *L.*
chamædrys, *L.*
officinalis, *L.*
alpina, *L.*
saxatilis, *Jacq.*
bellidioides, *L.*
Pedicularis palustris, *L.*
rostrata, *L.*
verticillata, *L.*
incarnata-tuberosa, *Caviezel.*
atrorubens, *Schleicher.*
Alectorolophus minor, *Eber.* (=Rhinanthus cristagalli, *L.*)
Euphrasia officinalis, *L.*
minima, *Schleich.*
Salvia glutinosa, *L.*
Thymus Serpyllum, *L.*
Calamintha Acinos, *Clairville.*
Dracocephalum Ruyschiana, *L.*
Prunella grandiflora, *L.*
Teucrium montanum (supinum), *L.*
Echium vulgare, *L.*
Myosotis sylvatica alpestris, *Hoffm.*
Eritrichium nanum, *Schrad.*
Androsace chamæjasme, *Host.* (not *Wulf.*)
obtusifolia, *All.*
glacialis, *Hoppe.*
Primula farinosa, *L.*
villosa, *Jacq.*
latifolia, *Lapeyrouse.*
viscosa, *DC.*
integrifolia, *L.*
Soldanella alpina, *L.*
pusilla, *Baumg.*
Pinguicula vulgaris, *L.*
Plantago alpina, *L.*
media, *L.*
Calluna vulgaris, *Salisb.*
Azalea procumbens, *L.*
Rhododendron ferrugineum, *L.*
Vaccinium Vitis Idæa, *L.*
Pyrola (Ramischia Opiz.) secunda, *L.*
uniflora, *L.*
Euphorbia cyparissias, *L.*
Geranium sanguineum, *L.*

Phyteuma hemisphæricum, *L.*
humile, *Schleich.*
pauciflorum, *L.*
orbiculare, *L.*
Campanula pusilla, *Hänk.*
rotundifolia, *L.*
rapunculoides, *L.*
Trachelium, *L.*
thyrsoidea, *L.*
barbata, *L.*
Epilobium angustifolium, *L,*
Fleischeri, *Hochstetter.*
montanum (collinum), *L.*
organifolium, *Lam.*(=alsinefol: *Vill.*)
alpinum, *L.*
Ononis repens, *L.*
Medicago falcata, *L.*
lupulina, *L.*
Melilotus officinalis, *Desrousseaux.*
Trifolium pratense, *L.*
medium, *L.*
alpinum, *L.*
cæspitosum, *Regnier.*
badium, *Schreber.*
Phaca astragalina, *DC.*
Oxytropis campestris, *DC.*
Hippocrepis comosa, *L.*
Hedysarum obscurum, *DC.*
Onobrychis sativa, *Lam.*
arenaria, *DC.*
Vicia cracca, *L.*
Sepium, *L.*
Alchemilla vulgaris, *L.* (subsericea).
alpina.
Dryas octopetala, *L.*
Geum montanum, *L.*
reptans, *L.*
Fragaria vesca, *L.*
Potentilla anserina, *L.*
argentea, *L.*
Tormentilla, *Sibtherb*
aurea, *L.*
Rosa alpina, L.
Sedum annuum, *L.*
villosum, *L.*
dasyphyllum, *L.*
acre, *L.*
Sempervivum Wulfeni, *Hoppe.*
montanum, *L.*
arachnoideum, *L.*
Sempervivum Braunii, *Funk.*
Saxifraga Aizoon, *Jacq.*
cæsia, *L.*
oppositifolia, *L.*
aspera, *L.*
bryoides, *L.*
aizoides, *L.*
stellaris, *L.*
Clusii, *Gauan.*
planifolia, *Lapeyr.*
exarata, *Vill.*
muscoides (compacta), *Wulfen.*
stenopetala, *Gaud.*
Seguieri, *Spreng.*
Astrantia minor, *L.*
Bupleurum stellatum, *L.*
Meum Mutellina, *Gärtner.*
Linnæa borealis, *L.*
Valeriana tripteris, *L.*
tripteris (integrifolia), *L.*
Knautia sylvatica, *Dub.*
Scabiosa columbaria, *L*
Adenostyles albifrons, *Reichb.*
hybrida, *DC.*
Aster alpinum, *L.*
Bellis perennis, *L.*
Erigeron uniflorus, *L.*
alpinus, *L.*
Inula montana, *L.*
Gnaphalium sylvaticum, *L.*
Hoppeanum, *Koch.*
Leontopodium.
dioicum. *L.*
Achillea nana, *L.*
moschata, *Wulfen.*
atrata, *L.*
millefolium, *L.*
Chrysanthemum leucanthemum, *L.*
alpinum, *L.*
Aronicum scorpioides, *Koch.*
Senecio cordatus, *Koch.*
viscosus, *L.*
abrotanifolius, *L.*
carniolicus, *Willd.*
saracenicus, *L.*
Doronicum, *L.*
Cirsium acaule, *All.*
Carlina acaulis, *L.*
Crepis aurea, *Cassin.*
Hieracium Pilosella, *L.*

On the Exact Measurement of Trees. (Part 4.) *The Influence of the unfavourable Season of* 1879 *on the Growth of Trees.* By Sir R. Christison, Bart.

(Read 8th January 1880.)

It was my hope and intention to present at the present time, in continuation of former notes on the "Exact Measurement of Trees," a contribution of facts relative to the growth of the common oak in this country. I have already accumulated some observations of interest on this subject. But I have the prospect of others which are likely to increase the value of those now at my disposal. It is better therefore to postpone this topic; and I do so the more willingly, because I can substitute a different one, of more immediate interest, and which has arisen incidentally from the measurements of numerous trees of various species during our last most ungenial season. This subject is the influence of that season on the growth of tree-wood.

Various notices have appeared in newspapers and periodicals as to the influence of the unpropitious season of 1879. In some respects the statements of fact are somewhat conflicting. There is a general agreement, however, that the foliage of trees was abundant, or even luxuriant, but that their fructification was very defective; and some statements represent the annual shoots to have been of the usual length. According to my own observation in the country around Edinburgh, and also in the district of the Tay between Blair-Athole, Loch-Tummel, and Aberfeldie up-stream, and Dunkeld below, the foliage of most trees was rich and healthy. But there were exceptions. Not universally, but in many places in both counties, the beech and elm were decidedly deficient in foliage, and especially the elm. On the contrary the oak and sycamore struck me as luxuriant in that respect. As to the fruit, it was observed that the sycamore parted with most of it not long after its formation; and the elm, which drops it always early, did so after an unusually brief existence. The same was probably the fate of other unobserved species. A singular concordance was noticed in the case of the cherry; which in three gardens within my observation gave promise of an abundant crop, till the fruit was a little bigger than cherry-stones, when they almost all dropped off, without wind, frost, or any other atmospheric hardship.

It also deserves notice, though bearing but slightly and collaterally on the object of this paper, that the lateness and coldness of the summer season appeared to exert no injurious effect on the flowering of annual herbaceous plants, whether indigenous or of the hardy introduced kinds. Among the former, I was particularly struck with the splendour of the fox-glove in all quarters of Strath-Tay, even on the bare, exposed, southern slopes of Ben Vrackie, at 1700 feet above the sea-level. Nor were they defective in fruit,—except indeed that those, which do not usually ripen until late in autumn, such as the bramble-berry, had scarcely time to reach maturity, at least had not done so in Strath-Tay on the 2d of October. I may add, as a circumstance of probably very rare occurrence, that on the same day, in a garden seven miles above Dunkeld, 250 feet above sea-level, with a gentle slope and fine exposure towards the south, I gathered, ripe and of good quality, strawberries, raspberries, red currants, and red gooseberries, though they had not been subjected to any means of artificial retardation. The little indigenous ornaments of our Highland mountains underwent a chequered fate. *Erica cinerea* and *E. tetralix* showed flower in profusion ; but the more abundant *Calluna vulgaris* was not only very late, but also defective in flowering. Of the berry-bearing hill plants some fruited well, and others were unproductive. In many rambles I found no fruit on the crow-berry, very little on the bear-berry, but abundance on the bil-berry at the Falls of the Bruar, and on numberless elevated slopes a profusion on the whortle-berry, the *Vaccinium Vitis Idæa.**

Returning from this digression, I repeat that, in spite of the inclement spring and summer of 1879, the foliage of most trees was abundant, or even rich. But I doubt the statements made by some in print, that the annual shoots of trees were of average length. In no instance has comparative measurement been given ; and mere eye-measurement with comparison by memory merely, can go for very little in such a question. Were I to trust that method of investigation, I should say that the hawthorn shoots in October were very much under the average in length, and that the pine-tribe generally, though not invariably, showed more or less of the same inferiority. In regard to the Araucaria there can scarcely be a mistake, on account of the usual length and sharp definition of its internodes. Each internode in most trees marks two years of growth. It is easy to observe everywhere around Edinburgh, that the newest growth for 1879 is much under one-half, and often

* In the Highlands this is often gathered as the cran-berry, the fruit of a much less common species, *V. ~~uliginosum~~*. Oxy[illegible]

barely reaches one-fourth of the lower internode in length. I have no measurements, however, to test accurately these eye-observations.

But in regard to the growth of tree-trunks by their annual

	1878.			1879.	
	May.	October.	Increase.	October.	Increase.
Birch, weeping, near entrance	55·25	55·50	0·25	55·55	0·05
Beech } each side of E. walk at S.E. corner {	71·25	72·45	1·20	73·40	0·95
Beech } of the original garden . . . {	60·35	61·55	1·20	62·40	0·85
Beech } Arboretum, S. walk of Inverleith {	75·65	76·25	0·60	76·85	0·60
Beech } House grounds . . . . . {	60·15	60·75	0·60	61·20	0·45
Beech, Craigiehall, on river bank . .	116·35	117·15	0·80	117·75	0·60
Beech } Craigiehall, very tall and slim in a {	71·85	71·55	0·70	73·05	0·50
Beech } deep dell on the river bank . {	61·75	62·35	0·60	62·65	0·30
Lime, in middle of garden	75·95	76·45	0·50	76·60	0·15
Lime, near N.W. corner	42·55	43·25	0·70	43·65	0·40
Chestnut, Sweet, close to Amaryllidaceæ .	70·65	71·75	1·10	72·65	0·90
Tulip-tree, near W. end of pond, 20 yards .	75·55	76·55	1·00	77·15	0·60
Horse-Chestnut, S.E. corner of original garden	48·60	49·35	0·75	49·85	0·50
Hawthorn, E. walk, half-way S. of Museum	37·85	38 65	0·80	38·75	0·10
Flowering-Ash, N. of Labiatæ . . .	75·15	75·75	0·60	76·15	0·40
Sycamore, smoothed-barked, near N.W. corner	58·45	58·95	0·50	59·15	0·20
Oak, Common, Craigiehall, largest in E. park	120·35	121·35	1·00	122·15	0·80
Oak, Common, Craigiehall, river-side, near Hermitage gate	69·45	70·10	0·65	70·60	0·50
Oak, Common, Cammo, S. gate . . .	131·15	131·90	0·75	132·65	0·75
Hungary Oak, near E. end of Winter Garden	23·45	25·25	1·80	26·05	1·70
Turkey Oak, opposite weeping birch . .	41·75	42·35	0·60	43·00	0·65
American Red Oak, near middle of garden .	30·65	31·15	0·50	31·55	0·40
Hornbeam, lowest part of the W. walk .	44·35	44·75	0·40	45·10	0·35
Douglas Pine, close to Liliaceæ . . .	55·95	56·55	0·60	57·00	0·45
Douglas Pine, oldest, clump of Pinaceæ, W. walk	64·15	64·95	0·80	65·40	0·45
Corsican Pine, N.W. corner of Palm-house lawn	64·15	64·55	0·40	64·75	0·35
Scotch Fir, Arboretum, largest, half way between house and S.W. corner . .	94·15	94·45	0·30	94·45	0·00
Scotch Fir, Arboretum, N.E. clump . .	52·40	52·65	0·25	52·95	0·30
Scotch Fir, Arboretum, clump E. of house	52·80	53·05	0·25	53·05	0·00
Scotch Fir, Cammo, bowling-green. . .	121·35	121·55	0·20	121·75	0·20
Pinus excelsa } terrace in front of the chief {	30·75	31·10	0·35	31·30	0·20
Pinus excelsa } range of hot-houses . . {	32·55	32·95	0·40	33·15	0·20
Sequoia gigantea } at E. and W. ends of hot- {	23·95	25·10	1·15	25·90	0·80
Sequoia gigantea } houses' terrace . . {	23·95	25·70	1·75	27·35	1·65
Sequoia gigantea } two of a clump in old {	18·95	20·80	1·85	22·30	1·50
Sequoia gigantea } Horticultural Garden {	23·85	25·10	1·25	26·80	1·70
Deodar, slender tree, W. walk, low down .	26·10	27·20	1·10	27·90	0·70
Deodar, oldest, W. walk, clump of Pinaceæ	64·00	65·00	1·20	65·60	0·60
Picea Lowei, upper end of Picea pinetum .	15·00	16·40	1·40	17·65	1·25
Cedrus Atlantica, S. from tulip-tree, 20 yards	27·55	29·20	1·65	30·60	1·40
Araucaria imbricata, E. end of terrace .	18·10	18·70	0·60	19·20	0·50
Araucaria imbricata, W. walk	20·20	20·70	0·50	21·60	0·90
Yew, W. walk at an iron seat . . .	34·10	34·60	0·50	34·75	0·15
Yew, at Linnean monument, 200 years old	67·45	68·05	0·60	68·65	0·60

addition of woody layers, numerous measurements made for other purposes than testing the influence of season, incidentally supply proof, which leaves no doubt of the baneful influence of the inclemency of last year's growing months. I present in evidence the foregoing tabular view of all the measurements yet taken which are comparative. The trees measured were 53 in number, and comprised the lime, beech, sycamore, sweet chestnut, horse-chestnut, hawthorn, flowering-ash, tulip-tree, walnut, hornbeam, common oak, Hungary oak, Turkey oak, and American oak, among trees with deciduous leaves,—and, among those with evergreen leaves, the Ilex, Scotch fir, Douglas pine, Corsican pine, Pinus excelsa, Sequoia, Deodar, Picea nobilis, Picea Lowei, Cedar of the Atlas, Araucaria, Cypress, and Yew. The trees examined are chiefly in the Botanic Garden ; and all those are so whose site is not marked. The others are either in the Arboretum, or in the grounds of Mr Hope-Vere of Craigiehall, or on the adjoining property of Mr Campbell of Cammo. All have been marked with zinc-paint, as recommended in my first paper on tree measurements; so that the observations may be continued by myself or others.

Of the 15 trees with deciduous leaves, the sum of their growth in girth of trunk was in 1878, a decidedly favourable year, 11·30 inches,—in 1879, 8·15 inches. This is equivalent to a reduction of 28 per cent., or a little over a fourth in 1879.

Of 17 evergreen trees,.all belonging to the pine tribe, the sum of their increase in trunk-girth was 15·7 inches in 1878, and 12·5 inches in 1879,—a diminution in the latter year equivalent to exactly 20 per cent., or a fifth. [Since this paper was read I have been able to annex a similar observation from the section, now in the Botanic Garden, of a fine larch over 12 feet in girth, which was uprooted at Glamis Castle, the seat of Lord Strathmore, during the Tay Bridge storm of 28th December last. The annual layers being in general sharply defined, I took the width of those of 1878 and 1879 with great care with compasses, at twelve different points of the circumference, where I could measure them with confidence ; the several widths were then projected on two parallel lines, and the result was 3·0 inches for 1878, and 2·22 inches for 1879. The difference in radial growth thus indicates an inferiority of 26 per cent. during the latter year compared with the former. This exceeds the loss of other pines, but the larch is not evergreen.]

It appears then that evergreen trees suffered rather less than trees with deciduous leaves. A sufficient cause will be pointed to presently. But in the first place let me turn attention to a singular difference of the like kind among leaf-shedding trees themselves. I have placed together at the end of that list all the oak tribe, including the hornbeam, which is closely allied to the true oaks. This has been done to show their agreement in the property of resisting the influence of an unfavourable season, injurious to other trees with deciduous leaves. Of eight observations one may be excluded, as made on a Craigiehall oak which in 1878 must have been subjected to some special cause of inferior growth. The other observations were made on three healthy common oaks (*Q. pedunculata*), and one each of Turkey oak (*Q. Cerris*), Hungary oak (*Q. Pannonica*), American red oak (*Q. rubra*), and hornbeam (*Carpinus Betulus*). I regret that I had only one tree of the four last species at my command. But, using such opportunities as I possessed, it appears that the sum of these seven measurements, all very close to one another for the two years, is an increase of 5·70 inches for 1878, and 5·15 for 1879,—being a difference of a tenth only, or 10 per cent.

If we now separate the oak tribe from the other leaf-shedding trees, it will be found that the aggregate growth of trunk in the latter was for 1878 8·6 inches, and for 1879 5·05 inches,—being a reduction actually of 41 per cent., or between one-third and one-half. The effect of a bad-growing season is thus made very conspicuous on a considerable variety of species of our most common and familiar forest trees.

The cause, or rather the causes, of this inferiority of growth, are not far to seek. It may be said that, as there was generally in 1879 no material defect in foliage on which the growth of wood depends, there was no sufficient reason against its usual annual increase. But there was one positive cause against it, and two others extremely probable.

In the first place, the usual five months of growing season were reduced by nearly an entire month. In 1878 a cold spring, not cold enough however to injure tree buds, or to prevent their gradual progress, was succeeded by much sun in the month of May, which, qualifying a rather low atmospheric temperature, soon clothed the woods with ample foliage; and the four following months were on the whole genial, yet by no means peculiarly so. But in 1879 a similar, and indeed colder spring, was followed by a cold, cloudy, uncomfortable May; and, as the result, the tree buds generally did not begin fairly to unfold till the beginning of June. Trees were therefore deprived of a fifth part of their usual season for growing.

But secondly, the temperature of the five growing months of 1879 was materially under that of 1878; and this was the case with each month separately, as well as of course for the general average of the whole. To illustrate this interesting fact, I refer to the following remarkable table, which has been kindly communicated by Mr Buchan, secretary of our Meteorological Society. The table, which is complete and most significant, presents both the average maximum temperature, and the average mean temperature, for each of the five growing months, and also for the month of April, which may be regarded as usually the budding month in this climate.

Mean of Daily Maxima.

	April.	May.	June.	July.	August.	September.	Of Five Months.
1878 . .	52·7	59·0	65·2	69·3	66·4	63·4	64·7
1879 . .	46·5	54·2	58·4	59·8	63·4	59·2	59·0
Mean of Daily Mean Temperatures.							
1878 . .	46·0	51·4	56·8	61·0	58·8	55·8	56·8
1879 . .	40·6	46·2	52·4	54·4	56·4	52·0	52·3
Mean Defect in 1879.							
Maximum .	6·2	4·8	6·8	9·5	3·0	4·2	5·7
Mean . .	5·6	5·2	4·4	6·6	2·4	3·8	4·5

No one can doubt the serious influence on vegetation arising from so great, so steady, and so lasting a want, as is here indicated, in the ordinary spring, summer, and autumn heat. A natural result was that April failed to bring the buds as usual to the point of expansion in May; that a no less ungenial May, barely brought them to that point in the beginning of June; and that every vegetable function must have been more or less checked during the three subsequent months.

Thirdly, it is well-known that sun-light, apart from its heating power, has an important influence on the activity, and even the integrity, of various vegetable functions. I am not aware of any inquiry having been made into the question of its influence on the growth of tree-wood. But there is no reason for supposing this function exempt from such influence and at any rate it must be affected by the mere heating power of the sun's rays. Now, every one must have been struck with the extraordinary deficiency of sunshine during the growing months of 1879, and especially in the months of May and June. Meteorologists have not yet struck out a satisfactory method of registering the amount of daily sunshine. But the following observations are worthy of notice as supplying comparative results.

The *Times* newspaper gives the following observations made at Greenwich Observatory with an instrument which, during the daily progress of the sun, marks "bright sunshine" by discolouring or burning a card-board. Thus are obtained the monthly hours of sunshine for 1878 and 1879, as follows:—

Monthly Hours of Bright Sunshine at Greenwich.

	April.	May.	June.	July.	August.	Sept.	Total.
1878 . .	150·4	166	183·4	163·9	160	127·5	950·9
1879 . .	74·6	135·6	141·9	99·3	139·1	116·5	707·0
Loss per cent. .	51·3	20·0	23·0	39·0	13·0	9·0	25·0

The sun of Greenwich of course does not regulate the sunshine of the Lothians and Strath-Tay. But the indications of its register are conformable with what was matter of general observation all over Britain; and such meteorological data as are attainable in regard to this locality, show an inferiority of sunshine for Edinburgh in 1879, even considerably greater than in the neighbourhood of London.

The following Table is extracted from a register of sunshine kept for the Meteorological Society by their Edinburgh observer, Mr Blackwood, and kindly communicated to me by Mr Buchan. The daily hours of bright sunshine are put down by the observer from estimate. The results therefore are only approximate; but as the system of estimate is always uniform, these results must be at all events fairly comparative.

Monthly Hours of Bright Sunshine at Edinburgh.

	April.	May.	June.	July.	August.	Sept.	Total.
1878 . .	127·3	198·7	198·1	215·2	138·0	147·0	1024·3
1879 . .	23·3	120·9	111·3	95·6	156·6	124·0	631·7
Loss per cent. .	81·7	39·2	43·9	55·6	+14·0	16·0	41·1

Professor Piazzi Smyth, Astronomer Royal, has also had the kindness to communicate to me a similar tabular view, deduced from observations made on the relative degree of cloudiness. The data are taken from daily general observation of the state of the hemisphere, complete obscuration by cloud being assumed at 1000. These data, says Professor Smyth, are derived from "a very rough and simple kind of observation, never intended for any grand meteorological purpose; but having been continued with regularity and honesty during a long period, they do seem now capable of some special results." It is to be hoped that the details of his results may find a fitter opportunity for publication by so able an observer. The only conclusions suitable in the present sketch are those which regard the relative seasons of 1878 and 1879. The mean cloudiness of the summer months of 1876–7–8–9 was 721; and that for 1879 was 854, or a ratio of nearly 100 to 120. In 1878 the mean of June and July was 704, and in 1879 it was 855·5, being a ratio of 100 to 121·5.

Remarks on a Specimen of Rheum nobile (Hook. fil. and Thomson) *which has flowered in the Royal Botanic Garden, Edinburgh, in the Summer of* 1880. By J. H. Balfour, M.D., LL.D., Glasg. and Edin., F.R.SS. L. and E., Emeritus Professor of Botany, Edinburgh. (Plate I.)

(Read 10th June 1880.)

In the Royal Botanic Garden of Edinburgh there are numerous species of *Rheum*, which were noticed by me in a communication to the Society in 1879. Two of these species, *Rheum tanguticum* and *R. palmatum*, were described, and the former figured in vol. xiii. of the "Transactions." This year another species, *Rheum nobile* of Hook. fil. (Sikkim Rhubarb), developed a flowering stalk in the month of May, and has progressed ever since, producing a fine pyramidal stalk of flowers, the beauty of which has attracted much attention.

The seeds of this beautiful species were sent to the Garden about seven years ago by Dr King, Director of the Calcutta Botanic Garden. The plant, I believe, has not before flowered under cultivation in Europe. It occurs abundantly on the Himalayan mountains in certain districts. I understand that specimens and seeds have on several occasions been sent to Britain, but this is the only plant which has flowered. I have therefore thought it right to draw up a description of the plant, and to get a figure of it, for the "Transactions" of the Society, sketched by Miss Woon.

The plant has excited much attention among the visitors to the Garden. It is undoubtedly showy and interesting.

It is figured on a large scale by Mr Fitch in Cathcart and Hooker's splendid royal folio work on the Himalayan Flora.

The peculiar colour of the bracts on the tapering floral axis is striking and attractive, and has excited the interest of all visitors. The plant looks like a conical tower, covered with downwardly imbricated straw-coloured showy bracts, which are strongly convex on their upper surface. The plant has not yet produced ripe seed. In its native country insects abound, and cause fertilisation. The crown of the root is short and thick, and is scarcely visible when the plant is in full flower. The radical leaves are bright green. The stem yields an acid juice. The reflexed bracts are remarkable both as regards colour and arrangement. They are nearly entire, straw-coloured, and translucent, overlapping each other like slates. Certain portions are of a red colour. When the bracts are turned up the flowers are seen. The plant has a branching inflorescence, with numerous small greenish flowers, having 6 equal oblong sepals and 6 stamens. As regards the pistil, the ovary is short and slightly stalked. The styles vary from 2 to 3, and the stigmas are capitate. The achenes are slightly winged.

The following report was drawn up by Mr Sadler, the Curator, on the 9th of June:—

Height of flowering stem—3 feet 8 inches.

Circumference of flowering stem at 3 inches from base—5$\frac{3}{4}$ inches.

Circumference of flowering stem at 2 feet from base—4$\frac{1}{2}$ inches.

Number of radical leaves—5.

Number of straw-coloured imbricating bracts (in the axils of which arise the branching inflorescence)—53.

Size of largest radical leaf—lamina, 1 foot long by 1 foot broad; petiole, 5$\frac{1}{2}$ inches long.

Size of lowest bract—lamina, 11$\frac{1}{2}$ inches long by 10$\frac{1}{2}$ broad; petiole, 5 inches long.

Size of bract at 2 feet from base—7 inches long by 8$\frac{1}{2}$ broad; petiole, 2 inches long.

Size of bract at 3 feet from base—5$\frac{1}{2}$ inches long and 6 inches broad; petiole, 1 inch long.

Size of second bract from top—$\frac{3}{4}$ of an inch long and $\frac{3}{4}$ of an inch broad; length of petiole, $\frac{1}{8}$ inch.

Longest of the ultimate subdivisions of the inflorescence—8 inches.

Circumference of "cone" at 2 feet from the ground—28 inches.

Circumference of "cone" of bracts at 4 inches from top—8 inches.

Spread of radical leaves—3 feet across.

Hooker states that this is one of the most striking plants of the Sikkim Mountains, and different in appearance from ordinary Rheums. He says: "I first saw the plant fully a mile off on the black cliffs of the Lacker Valley, at an elevation of 14,000 feet." He makes the following remarks on this rhubarb in his "Himalayan Journal:"—"On the black rocks the gigantic rhubarb formed pale pyramidal towers a yard high, of inflated reflexed bracts, that conceal the flowers, and over-lapping one another like tiles, protect them from the wind and rain; a whorl of broad green leaves edged with red spreads on the ground at the base of the plant, contrasting in colour with the transparent bracts, which are yellow, margined with pink. This is the handsomest herbaceous plant in Sikkim: it is called 'Tchuka,' and the acid stems are eaten both raw and boiled; they are hollow and full of pure water: the root resembles that of the medicinal rhubarb, but it is spongy and inert; it attains a length of 4 feet, and grows as thick as the arm. The dried leaves afford a substitute for tobacco; a smaller kind of rhubarb is, however, more commonly used in Tibet for this purpose."

Under Hooker's direction, Fitch has given a beautiful sketch of the plant in all its parts.

I may notice that the *Rheum nobile* grows in an elevated part of the garden, protected on the west by a wall 16 feet high, and on the other sides by abundance of trees and shrubs. When there is a fall of snow, such as took place during the past two winters, it continues long in that part of the garden, and this may partly account for the flowering of the *Rheum*.

Mr Elwes, in "The Garden," remarks as follows:—"I may say, as one of the very few Europeans who have ever seen that most noble of Alpine plants, *Rheum nobile*, on its native rocks, that it grows in a climate of excessive dampness for six months in the year, rain or mist usually prevailing for twenty hours out of the twenty-four. Strong wind, however, in summer is hardly known, whilst in winter the plants, growing at an elevation of from 13,000 to 14,000 feet, are buried in snow."

Explanation of Plate I.

Fig. 1. Plant of *Rheum nobile* (Hook. fil.) as grown in the Royal Botanic Garden, Edinburgh (June 1880), showing radical leaves; pale yellow bracts, which cover and protect the inflorescence.

Fig. 2. *a*, Large dependent bract; *b*, large pink membranous stipule; *c*, branching panicle of flowers.

Fig. 3. Panicle in a more advanced state, showing the shortly stalked pendulous unripe fruit.

Fig. 4. Side view of a flower separated from the axis, showing double perianth.

Fig. 5. Fully expanded flower, as seen from above,—showing 6 parts of the perianth, 6 stamens with thickened filaments, and 3 stigmas.

Fig. 6. Longitudinal section of young pistil.

Fig. 7. Longitudinal section of pistil in more advanced state.

Fig. 8. Side view of nearly matured triangular fruit.

The Flowering Plants of New Zealand, and their Relation to the Insect Fauna. By George M. Thomson, F.L.S. Communicated by Professor Balfour.

(Read 8th July 1880.)

The problems which meet the student of nature in New Zealand, and demand solution at his hands, if he would know the why and the wherefore of the most common things he sees around him, are very numerous and varied.

The total absence in these islands of terrestrial mammals, the former occurrence of their peculiar wingless birds, the singular forms which now occur among the birds and reptiles, and the poverty of some very commonly distributed forms of other animals, have often been remarked and commented upon. Among other singular features which have been noticed are the want of brilliantly-coloured flowers, of sweet-scented flowers, and of insect life. I am of opinion, however, that in regard to these three latter points, which are necessarily related together, a certain amount of misconception prevails, and that the fact of the statements which have given rise to this misconception having been made by eminent authorities, has led to their not being sufficiently examined into. I have in the course of my botanical rambles in Otago been brought face to face with so many instances of insect fertilisation among flowers, that I came at last to think that there must be some error in the commonly received opinion, and it is in the hope of throwing a little more light on the subject that I now pen these few remarks.

By way of preface, I will quote a couple of passages from Mr A. R. Wallace's work on the "Geographical Distribution of Animals," which may be taken as expressing the latest and the current opinion on the subject. He says (vol. i. p. 462): "It is a striking confirmation on a large scale, of Mr Darwin's beautiful theory—that the gay colours of flowers have mostly, or perhaps, wholly been produced, in order to attract insects which aid in their fertilisation—that in New Zealand, where insects are so strikingly deficient in variety, the flora should be almost as strikingly deficient in gaily-coloured blossoms. Of course there are some exceptions, but as a whole, green, inconspicuous, and imperfect flowers prevail, to an extent not to be equalled in any other part of the globe; and affording a marvellous contrast to the general brilliancy of Australian flowers, combined with the abundance and variety of its insect-life. We must remember, too, that the few gay or conspicuous flowering-plants possessed by New Zealand, are almost all of Australian, South American, or European *genera;* the peculiar New Zealand or Antarctic genera being almost wholly without conspicuous flowers." A little further on in the same work he adds: "After the preceding paragraphs were written, it occurred to me, that if this reasoning were correct, New Zealand plants ought to be also deficient in scented flowers; because it is a part of the same theory, that the odours of flowers have, like their colours, been developed to attract the insects required to aid in their fertilisation. I therefore at once applied to my friend Dr Hooker, as the highest authority on New Zealand botany; simply asking whether there was any such observed deficiency. His reply was: 'New Zealand plants are remarkably scentless, both in regard to the rarity of scented flowers, of leaves with immersed glands containing essential oils, and of glandular hairs.' There are a few exceptional cases, but these seem even more rare than might be expected, so that the confirmation of theory is very complete."

I have quoted these paragraphs in full, because Mr Wallace, in drawing up his remarks, may be considered to have acquired the fullest and latest information on the subject. While agreeing with the general correctness of his remarks, I think I can point out one or two remarkable features in regard to our Flora and Insect Fauna which have not been noticed before. It is necessary to bear in mind that Mr Wallace's data, though in the main correct, are necessarily imperfect, for our knowledge of the insect fauna is still very incomplete, and requires a great amount of working up. A comparison of the numbers of insects as given in Mr Wallace's work, and as known now, may prove to be of interest, particularly as showing what orders are collected by visiting naturalists, and have consequently been fairly well worked up.

Mr Wallace gives the number of indigenous species of butterflies as 11, Mr Butler of the British Museum as 15, while Mr Fereday of Christchurch, a local entomologist who is intimately acquainted with the Lepidoptera, enumerates 18 species. Mr Wallace mentions the occurrence of our two hawk-moths *Sphinx Convolvuli* and *Aegeria tipuliformis*, the latter supposed to have been introduced with the currant, but he makes no mention of any other moths. Mr Fereday, however, informs me that many hundred species of these exist, some of which are described in numerous publications, while a still greater number are undescribed. Besides being represented by numerous species, this division of the Lepidoptera is extremely rich in individuals. Their habits, food of caterpillars, &c., are very little known, but their is no mistake about their numbers. They rise from the grass in summer evenings in myriads, and are common at all elevations from sea-level to 6000 feet. Many of our flowers are exclusively fertilised by them, and probably all of them visit flowers for their nectar. It would throw some light on this subject if we could obtain information as to whether these insects are mostly attracted by sight or smell; and also as to the relative lengths of their probosces. As compared with the other orders of insects in New Zealand, Mr Fereday considers the moths to be well represented.

Mr Wallace states the Coleoptera at 300 species, belonging to about 150 genera. But Captain Broun, who has worked up this branch of the New Zealand Fauna with great care and success, informs me that there are about 1300 species described. Omitting altogether such families as the *Carabidæ*, which are almost all predaceous ground-beetles, the littoral *Dynastidæ*, &c., we find that beetles play a very important part in this country in flower-fertilisation. I cannot do better than quote here the following extracts from a communication on the subject, which Captain Broun has been good enough to make me. Of "the family *Palpicornes*, two genera, *Hydrobius* and *Philhydrus* consist of water-loving species, as is usual in other countries, but one peculiar New Zealand genus of 6 species (*Rygmodus*) is of quite abnormal habits: one, *R. modestus*, is commonly found on the inflorescence of *Brachyglottis repanda*, *Cordyline Banksii*, &c. It has finely spinous legs, and though somewhat metallic above, is hairy underneath; it undoubtedly plays an important part in the fertilisation of flowers, a remarkable trait in the case of an insect belonging to that family, I think the only instance known to science. Most of the others are rare, and though described by me, were found by other collectors, so that I cannot speak authoritatively as to their habits; I suspect, however, that all frequent plants." . . . . . "Some two or three species, temporarily located in the genus *Cryptophagus*, frequent *Areca sapida*, but do not, I imagine, affect its seeding." . . . . . "Of the *Melolonthidæ*, the pretty *Pyronota festiva*, metallic above, hairy below, is found in profusion on the inflorescence of *Leptospermums*. The *Buprestidæ* and *Elateridæ*, about 80 species, are wood-feeders in the larval state, but when perfect insects, occasionally visit flowers. Some of the *Dascillidæ* do so too, in fact nearly all, and must, being hairy, render important services." . . . . . "All the *Melandryadæ* and *Mordelliæ* frequent flowering shrubs; one insect—*Selenopalpus cyaneus*—is never found away from them, chiefly ti-tree (*Cordyline australis*), but I once noticed numbers of that species on grass in bloom. The *Curculionidæ*, an extensive family, in most cases having scaly or hairy clothing, aid to a great extent the seeding of flowers. The species of *Eugnomus* are very partial to the 'Lawyers' (*Rubus australis*) when in bloom, in fact about 40 species of the group *Erirhinidæ* may be found on most of the indigenous flowering shrubs. *Apion metrosideros* confines itself almost exclusively to the Pohutukawa (*Metrosideros tomentosa*). *Oropterus coniger* lives entirely on the native *Fuchsia excorticata*. The *Longicornia* are wood-feeders, but often visit flowers. *Zorion minutum* confines itself almost exclusively to flowers. Some, but not all the *Phytophaga*, are found on flowering plants. *Arnomus Brouni*, though very rare, is generally found on *Leptospermum*. Eleven species of the genus *Colaspis*, usually found in abundance, frequent the inflorescence of many shrubs." In addition to this valuable information, I am informed by Professor Hutton that "*Lyperobius huttoni* and *Inophlœus inuus*, two large weevils, are only found on spear-grass (*Aciphylla*); and *Cyttalia griscipila* is much more abundant on them than anywhere else. However, I think that *Lyperobius huttoni* lives on the juices of the leaves."

From the foregoing remarks it will be seen that a further acquaintance with the Coleoptera of the colony hardly justifies the statement that they are "strikingly deficient in variety."

In regard to the Hymenoptera, we are still in great ignorance; Mr Wallace states that there are only "a score of species." They certainly are very poorly represented, but as soon as an attempt is made to catalogue them, they will be found to be much more numerous than is supposed. Professor Hutton informs me that there are 10 species of bees, all of which are flower-visitants, and some of them are very abundant in individuals. But there are many other families fairly-well represented, some of which are flower-visitants. He has taken many small species of brightly-coloured *Chalcididæ* on flowers, but is of opinion that they visit flowers in search of *Aphis* and other insects in which to lay their eggs.

The Neuroptera, Orthoptera, and Homoptera do not, as far as I am aware, furnish any flower-visitants, and therefore do not need to be considered by me.

The Heteroptera have not been catalogued, and are very scarce according to Mr Wallace; but even of these Professor Hutton assures me that there are many flower-visiting species, among which *Anubis vittatus*, *Rhopalimorpha obscura*, *Nysius Zealandicus*, and *N. huttoni* are very abundant.

Even perhaps if the orders of insects already mentioned were all that were represented in New Zealand, which affected the fertilisation of our flowering plants, we should be compelled to admit that they exercised a considerable influence. But one of the largest (if not the largest) orders has been omitted, viz., the *Diptera*. This great order has not been mentioned by Mr Wallace, probably because there were not sufficient data to go upon. But, except perhaps the Coleoptera, they are apparently better represented here than any other order. This has all along been my own opinion, but in order to satisfy myself on the point, I put a few queries to Professor Hutton, who has given me the following, among other, information on the subject:—"With regard to the Diptera, 94 species have been described from New Zealand, and I have added I think 12 more, making 106. But this would have to be reduced to 90 or 95 after allowance is made for synonyms and errors in locality. I think that Diptera are very well represented here; I suppose that not more than one-tenth are yet described. I think that they are better represented than any other order." In reply to a second query as to what was known of the flower-frequenting species, he says: "The *Stratiomydæ* and the *Syrphidæ*, both found almost exclusively on flowers, are very abundant in individuals, and well represented in species. So also are some of the flower-frequenting *Acalyptratæ*."

If now we turn to consider our Flora, we shall learn some interesting facts, many of which, though not absolutely new, I am enabled to state in some detail.

I will not here deal with the whole flora of New Zealand, but confine my remarks to my own observations. These have been made on the flowering plants which I have been able to examine carefully during the last two or three years, but do not include the lower forms of Monocotyledons. They are almost all Otago plants, and include 232 species, belonging to 132 genera. For reference sake I append a list of these plants, showing the orders to which they belong, and giving, by symbols, a few facts about each. In drawing up such a list, of course degrees of difference cannot well be pointed out, and it must therefore be taken as only approximately correct. Thus, for instance, among proterandrous and proterogynous flowers, some may have the dichogamy only partially developed, as in *Geranium*, while in other genera, such as *Coriaria*, *Nertera*, and *Forstera*, one or other form is so decided, as to make the plant practically monœcious. Again, in some polygamo-diœcious plants as *Fuchsia*, *Aristotelia*, *Leptospermum*, &c., truly hermaphrodite forms occur; while in others as *Clematis*, *Pimelea*, &c., the flowers are structurally hermaphrodite, but owing to imperfection of one of the sexual whorls, functionally diœcious. With regard to the *Compositæ*, which I have included under the head polygamo-diœcious, most of the flower-heads, as is usual in the order, include both hermaphrodite and pistillate flowers, but in the majority of cases, the former are so distinctly proterandrous, as to be unisexual in function. The following is a summary of my observations:—Of the 262 species referred to, 129 were invariably hermaphrodite, but of these 37 species were so strictly proterandrous, and 10 species so strictly proterogynous, as to be functionally diœcious; 22 species were invariably diœcious (including 14 species of *Coprosma*), and no less than 79 species polygamo-diœcious (including 31 species of *Compositæ*). If then, from the total number observed, we subtract all which are more or less unisexual either structurally or functionally, we shall find that only 82, or a little over 31 per cent., have any chance of being self-fertilised. But even of those, many are so specially contrived, such as the majority of the *Orchideæ*, that even they must be excluded from the list.

Again, out of this total of 262 species, 139 have conspicuous flowers, 83 being conspicuous alone, and 56 by association. These are roughly subdivided as follows:—white, 72 species; yellow, 27 species; greenish, 18 species; red or pink, 11 species; purple or lilac, 9 species; and blue, 2 species. The remaining 123 species are more or less inconspicuous, but even among them are to be found many which are absolutely entomophilous, and depend (as in *Tupeia*) on their fragrance and honey to attract insects.

The total number of species observed to secrete honey was 99, but it is to be remembered that flowers do not contain the nectar at all periods of their development, but that it is produced only at such times as the visits of insects would be of service. I have frequently noticed and recorded that certain flowers produce no honey, and then have come upon these same flowers on a warm, bright day, and found abundance of nectar. Again, after fertilisation, the secretions of flowers seem to dry up very rapidly, even before the petals begin perceptibly to wither. The number given therefore as meliferous, amounting as it does to nearly 38 per cent., is probably somewhat under the mark.

In regard to scent, the same remarks apply; some flowers which are scentless or nearly so on dull days, becoming perceptibly fragrant when the weather is bright, while others again only emit their fragrance at certain times of the day. I have only recorded 64 species of fragrant flowers, or less than 25 per cent. Here again we may note that the largest and most prominent flowers are destitute of scent, whereas many extremely inconspicuous flowers are over-poweringly fragrant. As far as I can make out, these latter flowers are mostly visited by Diptera, and an interesting question has often occurred to me, to which, however, I cannot obtain trustworthy answers—Is it not the case that the most of the Diptera are attracted by smell and not by sight, but the majority of the flower-loving Coleoptera, Lepidoptera, and Hymenoptera more by sight than by smell?

Of the total number of 262 species, I am certain that 110 are absolutely incapable of self-fertilisation. Of these, 63 are entomophilous, and 47 anemophilous; but of the remaining 152 species, I believe 96 are more or less dependent on insects. Eight species, viz., *Fuchsia excorticata* and *F. procumbens*, *Metrosideros lucida*, *Loranthus Colensoi* and *L. flavidus*, *Clianthus puniceus*, *Sophora tetraptera*, and *Phormium tenax*, are mostly fertilised by birds of the family *Meliphagidæ*, such as the Tui (*Prosthemadera*), and Bell-bird (*Anthornis*). These flowers are mostly large and conspicuous, are quite scentless, but produce abundance of honey.

As I have already stated, these plants were all carefully examined by me, and represent only a fraction of all the flowering plants of the colony; but I believe the proportions stated would apply fairly well to the whole flora (if we exclude the Glumiferæ among Monocotyledons). I have not sufficient knowledge personally of the British flora to draw up any comparisons, nor can I obtain sufficient data from other works—even such as Sir John Lubbock's

"British Wild Flowers in relation to Insects." Such a comparison would not only be interesting, but would enable us to form a more correct estimate of the relative poverty of our flora and insect fauna, as compared with those of other countries.

Taken as a whole, I think the figures I have given will show that flower-frequenting insects are much more abundant here than is commonly supposed, and that our flowering plants are very largely dependent on their aid for propagation.

The most remarkable feature to my mind is the fact that the Diptera appear to take the place of and carry out the functions performed by the Hymenoptera in other parts of the world. I cannot find that they are anywhere mentioned as aiding in the pollination of plants, but here many flowers are exclusively dependent on them. *Tupeia antarctica*, a mistletoe with small, pale green, very fragrant flowers; *Corysanthes* (3 species), with small purple scentless flowers, always hidden among foliage, and close to the ground; and *Pterostylis* (3 species), with large solitary scentless green flowers, belong to this category, which also includes, I believe, the fragrant, dark green, diœcious flowers of *Astelia nervosa*. It was the attempt to unravel the mode of fertilisation of *Tupeia* which first induced me to examine into this subject. The plant is a good sized parasite, usually growing in the shelter of the bush (forest), removed from the influence of the wind, and with strictly diœcious flowers, which contain a lot of honey. It is frequented by numbers of very small Diptera, which must be attracted by smell, as the flowers are inconspicuous at the distance of a few yards.

The systematic examination of the questions touched on by me has only been commenced in New Zealand, and this contribution of mine is only intended as a preliminary one. In a paper read before the local Institute—but not published yet—I have gone more into detail on this subject.

The occurrence of Heteromorphism among our flowers has hardly been noticed yet. The two species of *Viola* occurring commonly here, viz., *V. filicaulis* and *V. Cunningmaii*, both produce cleistogamic flowers in abundance, and *Hypericum japonicum* shows a tendency in the same direction. Distinct heterostylism has not yet been pointed out. A form of it occurs in various species of *Pimelea* (and apparently in one or two other plants); but in this case appears to me to be a step towards diœcism (to coin a new word).

In conclusion, I would point out that it is remarkable to what a degree the separation of the sexual functions in the New Zealand Phanerogams is carried out. A reference to the appended table will show this as occurring in *Clematis* (among Ranunculaceæ), *Plagianthus* (Malvaceæ), *Fuchsia* (Onagraceæ), and *Leptospermum* (Myrtaceæ), all orders characterised as a rule by hermaphrodite flowers. In some genera as *Fuchsia* and *Pimelea*, &c., I believe we can see the changes towards absolute separation now going on.

List of Plants mostly found near Dunedin, New Zealand, on which the observations and results recorded in this paper were made during the summers of 1877–80 *inclusive.*

Explanation.—Under the heading *Conspicuous Flowers*, 1 stands for very large blossoms 2 inches in diameter (or length), 2 for flowers about an inch, and 3 for flowers of ½ inch or thereabouts. The same numbers are employed for those blossoms which are conspicuous by association, and sometimes a flower is marked as occurring in both columns, when the blossoms are individually large, and are also associated into prominent masses. Proterandrous hermaphrodite flowers = p.a – proterogynous = p.g.

	Always Hermaphrodite.	Always Diœcious.	Polygamo-Diœcious.	Conspicuous Alone.	Conspicuous by Association.	Inconspicuous Solitary.	Inconspicuous Clustered.	Absolutely Entomophilous.	Absolutely Anemophilous.	Colour.	Observed to have Honey.	Sweet-scented.	Incapable of Self-fertilisation.
Ranunculaceæ.													
Clematis indivisa,	...	...	†	† 1	† 1	...	...	†	...	white	...	...	†
hexasepala,	...	...	†	† 2	† 1	...	...	†	...	white	...	...	†
fœtida,	...	...	†	† 3	† 1	...	...	†	...	yel.-gr.	...	†	†
Ranunculus Sinclairii,	† p.a.	...	...	† 3	...	...	...	...	...	yellow	†	...	...
plebeius,	† p.a.	...	...	† 3	...	...	...	...	...	yellow	†	...	...
lappaceus,	† p.a.	...	...	† 3	...	...	...	...	...	yellow	†	...	...
macropus,	† p.a.	...	...	† 3	...	...	...	...	...	yellow	†	...	...
rivularis,	† p.a.	...	...	† 3	...	...	...	...	...	yellow	†	...	...
acaulis,	† p.a.	...	...	† 3	...	...	...	...	...	yellow	†	...	...
Magnoliaceæ.													
Drimys axillaris,	†	...	...	...	...	† 3	...	...	...	yel.-gr.	...	...	...
Cruciferæ.													
Nasturtium palustre,	†	...	...	...	...	†	...	...	...	yellow	...	...	...
Sisymbrium Nov.-Zæl.,	†	...	...	...	...	†	...	...	...	white	...	...	...
Cardamine hirsuta,	†	...	...	† 3?	...	†	...	...	...	white	...	...	...

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Myriophyllum variæfolium. .	...	...	†	...	...	†	...	...	†	green	...	...	†
elatinoides, ...	...	...	†	...	...	†	...	...	†	green	...	...	†
Gunnera monoica, ...	...	...	†	...	...	...	†	...	†	green	...	...	†
densiflora, ...	...	...	†	...	...	...	†	...	†	green	...	...	†
Callitriche verna, ...	...	...	†	...	...	†	...	...	†	...	...	...	†
Myrtaceæ.													
Leptospermum scoparium.. .	...	...	†	† 2	†	...	...	†	...	white	†	†	†
ericoides, ...	†	...	...	† 3	†	...	...	..	...	white	†	†	...
Metrosideros lncida, . . .	†	...	...	† 2	†	...	...	...	...	red	†	...	...
hypericifolia, . . .	†	...	...	† 3	†	...	...	...	...	red or w.	†	†	...
Myrtus obcordata, . . .	† p.a.	...	...	† 3	...	...	...	...	...	white	†	†	...
pedunculata, . . .	† p.a.	...	...	† 3	...	...	...	...	...	white	†	†	...
Onagrarieæ.													
Fuchsia excorticata, . . .	...	...	†	† 2	...	...	...	birds	...	g. & pur.	†	...	†
procumbens. . . .	...	...	†	† 3	...	...	...	do.	...	g. & pur.	†	...	†
Epilobium nummularifolium, .	†	...	...	...	...	†	...	...	...	white	...	...	...
alsinoides, ...	†	...	...	† 3	...	...	...	...	...	white	...	...	...
rotundifolium. . . .	†	...	...	† 3	...	...	...	...	...	white	...	...	...
junceum, ...	†	...	...	† 3	...	...	...	...	...	purple	...	...	...
pubens, ...	†	...	...	† 3	...	...	...	...	...	white	...	...	...
pallidiflorum, . . .	†	...	...	† 2	...	...	...	...	...	white	...	...	...
Ficoideæ.													
Mesembryanthemum australe,	...	...	†	† 2	...	...	...	...	...	pink	...	...	...
Tetragonia expansa, . . .	† p.g.	...	...	...	...	†	...	...	...	yellow	†	...	...
Umbelliferæ.													
Hydrocotyle elongata, . .	†	...	...	...	...	...	†	...	...	green	...	...	...
americana, ...	†	...	...	...	...	...	†	...	...	green	...	...	...
asiatica, ...	†	...	...	...	...	...	†	...	...	green	...	...	...
moschata, ...	†	...	...	...	...	...	†	...	...	green	...	...	...
muscosa, ...	†	...	...	...	...	...	†	...	...	green	...	...	...
Violarieæ.													
Viola filicaulis, ...	†	...	...	† 3	...	...	...	[†	...	white	†	...	†
Cunninghamii, . . .	†	...	...	† 3	...	...	...	†	...	white	†	...	†
Melicytus ramiflorus, . . .	...	...	†	...	†	...	...	†	...	yellow	†	†	†
lanceolatus, . . .	...	...	†	...	†	...	...	†	...	y. & pur.	†	†	†
Pittosporeæ.													
Pittosporum tenuifolium, . .	† p.g.	...	...	† 3	...	...	...	...	...	purple	†	...	...
eugenioides, . . .	...	...	†	...	†	...	...	...	...	yellow	†	†	...
Caryophylleæ.													
Stellaria parviflora, . . .	†	...	...	...	...	†	...	...	...	white	...	..	...
Colobanthus subulatus, . .	†	...	...	...	...	†	...	...	...	green	...	...	...
Portulaceæ.													
Claytonia australasica. . .	† p.a.	...	...	† 3	...	...	...	...	...	white	†	...	...
Montia fontana, ...	†	...	...	...	...	†	...	...	...	white	†	...	...
Hypericineæ.													
Hypericum gramineum, . .	† p.a.	...	...	† 3	...	...	...	...	...	yellow	...	...	...
japonicum. . . .	†	...	...	† 3	...	...	...	...	...	yellow	...	...	...
Malvaceæ.													
Plagianthus divaricatus, . .	...	†	...	...	...	†	...	†	...	white	†	†	†
betulinus, ...	...	†	...	...	†	...	...	†	...	yel.-gr.	†	† .	†
Hoheria populnea, ...	†	...	...	† 3	†	...	...	...	...	white	...	...	...

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Tiliaceæ.													
Aristotelia racemosa, . . .	...	...	†	...	†	...	...	...	...	pink	...	...	...
fruticosa, ...	...	...	†	...	...	†	...	...	...	pink	...	...	...
Elæocarpus Hookerianus, . .	† p.a.	...	...	...	†	...	...	...	...	gr.-w.	†	...	...
Lineæ.													
Linum monogynum, . . .	†	...	...	† 2	...	...	...	†	...	white	...	...	†
Geraniaceæ.													
Geranium microphyllum, . .	† p.a.	...	...	† 3	...	...	...	...	...	white	...	...	...
molle, ...	† p.a.	...	...	† 3	...	...	...	...	...	w. or red	...	...	...
Oxalis magellanica, . .	†	...	...	† 3	...	...	...	†	...	white	...	...	†
corniculata, .	†	...	...	† 3	...	...	...	†	...	yellow	†	...	†
Rutaceæ.													
Melicope simplex, ...	...	...	†	...	...	†	...	†	...	yel.-gr.	...	†	†
Olacineæ.													
Pennantia corymbosa, . .	...	...	†	...	†	...	..	†	...	white	...	†	†
Rhamneæ.													
Discaria Toumatou, . . .	†	...	...	...	...	†	...	†	...	green	†	†	†
Coriarieæ.													
Coriaria ruscifolia, . . .	† p.g.	..	...	...	...	...	†	...	†	green	...	...	†
thymifolia, ...	...	...	†	...	...	...	†	...	†	green	...	...	†
angustissima, . . .	...	...	†	...	...	...	†	...	†	green	...	...	†
Leguminosæ.													
Carmichaelia flagelliformis, .	† p.a.	...	...	...	...	†	...	...	...	w. & pur.	†	†	...
Clianthus puniceus, . . .	† p.a.	...	...	† 1	†	...	...	...	...	red	†	...	...
Sophora tetraptera, . . .	†	...	...	† 2	†	...	...	...	...	yellow	†	..	...
Rosaceæ.													
Rubus australis, ...	...	...	†	† 2	†	...	...	†	...	white	†	†	†
Potentilla anserina, . . .	†	...	...	† 2	...	...	...	...	...	yellow	†	†	...
Acæna Sanguisorbæ, . . .	† p.g.	...	...	...	...	...	†	...	†	green	...	...	†
Saxifrageæ.													
Donatia Novæ-Zælandiæ, . .	†	...	...	† 3	†	...	...	...	...	white	...	...	...
Carpodetus serratus, . . .	† p.a.	...	...	† 3	†	...	...	†	...	white	†	†	†
Weinmannia racemosa, . .	†	...	...	...	†	...	...	...	...	lilac	†	†	...
Crassulaceæ.													
Tillæa moschata, ...	† p.a.	...	...	...	...	†	...	...	...	white	†	†	...
Halorageæ.													
Haloragis depressa, . . .	...	...	†	...	...	†	...	...	†	green	...	...	†
micrantha, ...	...	...	†	...	...	†	...	...	†	green	...	...	†
Pozoa trifoliolata, . . .	†	...	...	...	...	...	†	...	...	green	...	...	...
Crantzia lineata, . .	†	...	...	...	...	...	†	...	...	green	...	...	...
Apium australe, . .	†	...	...	...	†	...	...	...	...	white	†	†	...
filiforme, ...	†	...	...	...	†	...	...	...	...	white	†	†	...
Oreomyrrhis ramosa, . .	†	...	..	...	...	...	†	...	...	green	...	...	...
Aciphylla squarrosa, . . .	...	†	...	...	†	...	...	†	...	yellow	†	†	†
Colensoi, ...	...	†	...	...	†	...	...	†	...	yellow	†	†	†
Ligusticum intermedium, . .	...	...	†	...	†	...	...	†	...	yellow	†	†	†
aromaticum, . .	...	...	†	...	...	...	†	...	...	wh.-gr.	†	...	...
Angelica Gingidium, . .	...	...	†	...	†	...	...	†	...	white	†	†	†
Geniculata, . . .	...	...	†	...	†	...	...	†	...	white	†	†	†
Daucus brachiatus, . . .	†	...	...	...	...	...	†	...	...	red	...	...	...

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Araliaceæ.													
Stilbocarpa polaris.	...	...	†	...	†	...	...	†	...	yel.-gr.	...	...	†
Panax simplex,	...	...	†	...	†	...	...	†	...	green	†	†	†
Edgerieyi.	...	...	†	...	†	...	...	†	...	green	†	†	†
crassifolium,	...	...	†	...	†	...	...	†	...	green	†	†	†
Colensoi,	...	...	†	...	†	...	...	†	...	green	†	†	†
Schefflera digitata,	...	...	†	...	†	...	...	†	...	green	†	†	†
Corneæ.													
Griselinia littoralis,	...	†	...	...	...	...	†	...	†	green	†	†	†
Corokia Cotoneaster,	†	...	...	† 3	...	...	...	...	...	yellow	†	†	...
Loranthaceæ.													
Loranthus Colensoi,	†	...	...	† 1	†	...	...	...	...	red	...	...	...
flavidus,	†	...	...	† 3	†	...	...	...	...	yellow	...	...	...
micranthus,	†	...	...	...	...	...	†	...	...	green	...	†	...
Tupeia antarctica,	...	†	...	...	...	...	†	†	...	green	†	†	†
Viscum Lindsayi,	...	...	†	...	...	...	†	...	†	...	...	...	†
salicornioides,	...	...	†	...	...	...	†	...	†	...	...	...	...
Rubiaceæ.													
Coprosma lucida,	...	†	...	...	...	...	†	...	†	green	...	...	†
robusta,	...	†	...	...	...	†	...	...	†	green	...	...	†
Cunninghamii,	...	†	...	...	...	†	...	...	†	green	...	...	†
rotundifolia,	...	†	...	...	...	†	...	...	†	green	...	...	†
tenuicaulis,	...	†	...	...	...	†	...	...	†	green	...	...	†
rhamnoides,	...	†	...	...	...	†	...	...	†	green	...	...	†
divaricata,	...	†	...	...	...	†	...	...	†	green	...	...	†
parviflora,	...	†	...	...	...	†	...	...	†	green	...	...	†
virescens,	...	†	...	...	...	†	...	...	†	green	...	...	†
propinqua,	...	†	...	...	...	†	...	...	†	green	...	...	†
fœtidissima,	...	†	...	...	...	†	...	...	†	green	...	...	†
acerosa.	...	†	...	...	...	†	...	...	†	green	...	...	†
linariifolia,	...	†	...	...	...	†	...	...	†	green	...	...	†
repens,	...	†	...	...	...	†	...	...	†	green	...	...	†
Nertera depressa.	† p.g.	...	...	...	...	†	...	...	†	green	...	...	†
dichondræfolia.	† p.g.	...	...	...	...	†	...	...	†	green	...	...	†
setulosa,	† p.g.	...	...	...	...	†	...	...	†	green	...	...	†
Galium umbrosum,	†	...	...	...	...	†	...	...		white	†	...	...
Asperula perpusilla,	†	...	...	...	...	†	...	...		white	†	...	...
Compositæ.													
Olearia nitida,	...	...	†	...	† 1	...	...	...	...	white	...	†	...
dentata,	...	...	†	...	† 2	...	...	...	...	white	...	†	...
ilicifolia,	...	...	†	...	† 2	...	...	...	...	white	...	†	...
virgata,	...	...	†	...	† 3	...	...	...	...	white	...	†	...
Hectori,	...	...	†	...	† 3	...	...	...	...	yel.-wh.	...	†	...
Celmisia coriacea,	...	...	†	...	† 1	...	...	...	...	white	†	...	...
longifolia,	...	...	†	...	† 2	...	...	...	...	white	†	†	...
Hectori,	...	...	†	...	† 1	...	...	...	...	white	†	...	...
sessiliflora,	...	...	†	...	† 1	...	...	...	...	white	†	...	...
Vittadinia australis,	...	...	†	...	† 3	...	...	...	...	white	...	†	...
Lagenophora Forsteri,	...	...	†	...	† 3	...	...	...	...	white	...	...	...
Cotula coronopifolia,	...	...	†	...	† 3	...	...	...	...	yellow	...	...	...
dioica,	...	...	†	...	...	...	†	...	...	green	...	...	...
Cassinia fulvida.	...	...	†	...	† 3	...	...	...	...	white	...	†	...
Ozothamnus glomeratus,	...	...	†	...	† 3	...	...	...	...	white	...	†	...
Gnaphalium trinerve,	...	...	†	...	† 3	...	...	...	...	white	...	†	...
bellidioides,	...	...	†	...	† 3	...	...	...	...	white	...	†	...
filicaule,	...	...	†	...	...	...	†	...	...	...	...	...	...
luteo-album,	...	...	†	...	...	...	†	...	...	...	...	...	...
involucratum,	...	...	†	...	...	...	†	...	...	...	...	...	...
Erechtites arguta,	...	...	†	...	...	...	†	...	...	green	...	...	...
prenanthoides,	...	...	†	...	...	...	†	...	...	green	...	...	...
scaberula,	...	...	†	...	...	...	†	...	...	green	...	...	...
glabrescens,	...	...	†	...	...	...	†	...	...	green	...	...	...

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Senecio bellidioides,	...	...	†	...	† 2	...	...	...	...	yellow	...	...	...
lautus,	...	...	†	...	† 3	...	...	...	...	yellow	...	...	...
Lyalli,	...	...	†	...	† 2	...	...	...	...	yellow	...	...	...
rotundifolius,	...	...	†	...	† 1	...	...	...	...	gr.-yel.	†	†	...
Microseris Forsteri,	...	...	†	...	† 3	...	...	...	...	yellow	...	...	...
Taraxacum dens-leonis,	...	...	†	...	† 3	...	...	...	...	yellow	†	...	...
Sonchus oleraceus,	...	...	†	...	...	...	†	...	...	yel.-gr.	...	...	...
Stylidieæ.													
Forstera sedifolia,	† p.a.	ov.	†	† 3	...	...	...	†	...	white	†	...	†
Helophyllum clavigerum,	† p.a.	...	...	† 3	†	...	...	†	...	white	†	...	†
Stylidium graminifolium,	† p.a.	...	...	† 3	...	...	...	†	...	white	...	...	†
Campanulaceæ.													
Wahlenbergia gracilis,	† p.a.	...	...	† 3	...	...	...	†	...	white	†	...	†
saxicola,	† p.a.	...	...	† 3	...	...	...	†	...	white	†	...	†
Pratia angulata,	† p.a.	...	...	† 3	...	...	...	†	...	white	†	...	†
Selliera radicans,	† p.a.	...	...	† 3	...	...	...	†	...	white	†	...	†
Ericeæ.													
Gaultheria antipoda,	...	...	†	† 3	...	...	...	†	...	white	†	...	†
rupestris,	...	...	†	† 3	†	...	...	†	...	white	†	...	†
Epacrideæ.													
Cyathodes acerosa,	† p.a.	...	...	...	...	†	...	...	...	white	†	...	...
empetrifolia,	† p.a.	...	...	...	...	†	...	...	...	white	†	...	...
Leucopogon Frazeri,	†	...	...	† 3	...	...	...	†	...	white	†	†	†
Pentachondra pumila,	†	...	...	...	...	†	...	†	...	white	†	...	†
Dracophyllum longifolium,	†	...	...	† 3	†	...	...	...	...	white	†	†	...
rosmarinifolium,	†	...	...	† 3	...	...	...	...	...	white	†	†	...
muscoides,	†	...	...	† 3	...	...	...	...	...	white	†	†	...
Myrsineæ.													
Myrsine Urvillei,	...	...	†	...	...	†	...	...	†	...	...	...	†
Apocyneæ.													
Parsonsia albiflora,	†	...	...	...	†	...	...	...	...	white	†	†	...
Gentianeæ.													
Gentiana montana,	† p.a.	...	...	† 3	...	...	...	†	...	white	...	...	†
Convolvulaceæ.													
Convolvulus Tuguriorum,	†	...	...	† 1	...	...	...	...	...	white	...	...	...
Soldanella,	†	...	...	† 1	...	...	...	...	...	pink	...	...	...
Dichondra repens,	†	...	...	...	...	†	...	...	...	wh.-gr.	...	...	†
Scrophularineæ.													
Veronica salicifolia,	† p.a.	...	...	...	†	...	...	†	...	white	†	†	†
Traversii,	† p.a.	...	...	...	†	...	...	†	...	white	†	...	†
elliptica,	† p.a.	...	...	...	†	...	...	†	...	white	†	†	†
buxifolia,	† p.a.	...	...	...	†	...	...	†	...	white	†	...	†
cataractæ,	† p.a.	...	...	...	†	...	...	†	...	lilac	†	...	†
Lyallii,	† p.a.	...	...	...	†	...	...	†	...	white	†	...	†
Lentibularieæ.													
Utricularia monanthos,	†	...	...	† 3	...	...	...	†	...	purple	...	...	†
Verbenaceæ.													
Myoporum lœtum,	†	...	...	† 3	...	...	...	...	...	white	†	...	...
Labiatæ.													
Mentha Cunninghamii,	† p.a.	...	...	† 3	...	...	...	...	...	white	†	†	...

	Always Hermaphrodite.	Always Diœcious.	Polygamo-Diœcious.	Conspicuous Alone.	Conspicuous by Associations.	Inconspicuous Solitary.	Inconspicuous Clustered.	Absolutely Entomophilous.	Absolutely Anemophilous.	Colour.	Observed to have Honey.	Sweet-scented.	Incapable of Self-fertilisation.
Plantagineæ.													
Plantago Raoulii, . . .	† p.g.	...	...	...	...	...	†	...	†	green	...	...	†
Chenopodiaceæ.													
Chenopodium triandrum, . .	...	...	†	...	...	...	†	...	†	green	...	...	†
Polygoneæ.													
Polygonum aviculare, . .	†	...	...	...	...	†	...	...	...	pink	...	...	...
Muhlenbeckia adpressa, . .	...	...	†	...	...	...	†	...	†	green	...	...	†
complexa, ...	...	...	†	...	...	...	†	...	†	green	...	...	†
axillaris, ...	...	...	†	...	...	...	†	...	†	green	...	...	†
Rumex flexuosus, ...	† p.a.	...	...	...	...	...	†	...	†	green	...	...	...
neglectus, ...	† p.a.	...	...	...	...	...	†	...	†	green	...	...	...
Thymeleæ.													
Pimelea prostrata, ...	...	...	†	...	†	...	...	†	...	white	†	†	†
Drapetes Dieffenbachii, . .	†	...	...	...	...	†	...	...	...	white	...	...	...
Euphorbiaceæ.													
Euphorbia glauca, ...	...	...	†	...	...	...	†	...	...	...	†	...	...
Cupuliferæ.													
Fagus Menziesii, ...	...	...	†	...	...	...	†	...	†	...	...	...	†
Urticaceæ.													
Urtica incisa, ...	...	†	...	...	...	...	†	...	†	...	...	...	†
ferox, ...	...	†	...	...	...	...	†	...	†	...	...	...	†
Epicarpurus microphyllus, .	...	†	...	...	...	...	†	...	†	...	...	...	†
Parietaria debilis, . . .	...	...	†	...	...	...	†	...	†	...	...	...	†
Australina pusilla, . . .	...	...	†	...	...	...	†	...	†	...	...	...	†
Orchideæ.													
Earina mucronata, ...	†	...	...	...	†	...	...	†	...	yellow	†	†	†
autumnalis, ...	†	...	...	...	†	...	...	†	...	white	†	†	†
Dendrobrium Cunninghamii, .	†	...	...	† 2	...	...	...	†	...	white	†	†	†
Sarcochilus adversus, . .	†	...	...	...	...	...	†	†	...	green	†	†	†
Corysanthes triloba, . . .	†	...	...	† 3	...	...	...	†	...	purple	...	...	†
rivularis, ...	†	...	...	† 3	...	...	...	†	...	purple	...	...	†
macrantha, ...	†	...	...	† 3	...	...	...	†	...	purple	...	...	†
Microtis porrifolia, . . .	†	...	...	...	...	...	†	...	...	green	...	...	...
Caladenia Lyalli, ...	†	...	...	† 3	...	...	...	†	...	pink	†	...	†
minor, ...	†	...	...	† 3	...	...	...	†	...	pink	†	...	†
bifolia, ...	†	...	...	† 3	...	...	...	†	...	white	†	...	†
Pterostylis Banksii, . . .	†	...	...	† 2	...	...	...	†	...	green	...	...	†
graminea, ...	†	...	...	† 3	...	...	...	†	...	green	...	...	†
foliata, ...	†	...	...	† 3	...	...	...	†	...	green	...	...	†
Chiloglottis cornuta, . . .	†	...	...	† 3	...	...	...	...	...	g. & pur.	...	...	...
Lyperanthus antarcticus, . .	†	...	...	† 3	...	...	...	...	...	g. & pur.	...	...	...
Thelymitra longifolia, . .	†	...	...	† 3	...	...	...	...	...	blue	...	...	...
uniflora, ...	†	...	...	† 2	...	...	...	†	...	blue	†	...	...
Prasophyllum Colensoi, . .	†	...	...	...	†	...	...	...	...	green	...	†	...
Irideæ.													
Libertia ixioides, ...	†	...	...	† 3	...	...	...	...	...	white	†	...	...
micrantha, ...	†	...	...	† 3	...	...	...	...	...	white	...	...	...
Naiadeæ.													
Potamogeton natans, ...	† p.g.	...	...	...	...	...	†	...	†	green	...	...	...
Triglochin triandrum, . . .	† p.g.	...	...	...	...	...	†	...	†	green	...	...	...
Liliaceæ.													
Callixene parviflora, . . .	†	...	...	† 3	...	...	...	...	...	white	...	...	...
Cordyline australis, . . .	†	...	...	...	†	...	...	...	...	white	†	†	...
Astelia nervosa, ...	...	†	...	...	†	...	...	†	...	green	†	†	†
Anthericum Hookeri, ...	†	...	...	† 3	†	...	...	...	...	yellow	...	...	...
Phormium tenax, ...	† p.a.	...	...	† 1	†	...	...	...	...	red	†	...	...

Additional Notes on the Hardiness of New Zealand Plants. By Mr William Gorrie, President.

(Read 8th July 1880.)

At a meeting of the Edinburgh Botanical Society, held on January 8, I read notes on thirty New Zealand plants that had withstood the unusually severe winter of 1878–79 in my garden. The winter of 1879–80 has been still more destructive of plant life, in consequence of the greater intensity of its frost having been preceded by such an ungenial growing season, that many plants never attained to a properly matured state. I now submit the following remarks on the effects of the past winter, which for sake of references are given in the numeral succession formerly adopted.*

1. *Pittosporum tenuifolium.*—The 5 feet high plant on a south wall was reduced to 4 feet, most of its young shoots, and some older branches that stood out from the wall, having been killed. Only a few of the smaller plants in the open ground are now so far alive that they are producing shoots from, at, and below the earth's surface.

2. *Plagianthus betulinus.*—The 23 feet high plant on a south wall lost about 7 feet of its top from some unaccountable cause, but all below is in perfect health. The 15 feet high plant in the open ground was uninjured; and has now a handsome, profusely leafy top.

3. *Plagianthus divaricatus.*—Having lost fully a third of its height, the plant is now only about 2 feet, but is pushing out young shoots freely.

4. *Aristotelia racemosa* was killed to the ground on a south wall, as well as in the open borders, but all the plants are reproducing healthy shoots from above their roots.

5. *Discaria Toumatou* is perfectly free from injury, but has not flowered this season, although growing freely.

* The minimums of the seven months of winter 1879–80, in which the temperature fell below the freezing point at the Edinburgh Royal Botanic Garden—within three-quarters of a mile from Rait Lodge—were as follows: by a thermometer exposed to direct radiation, November 1879, 18°; December 1879, 1°; January 1880, 19°; February 1880, 23°; March 1880, 22°; April 1880, 27°; May 1880, 29°.

6. *Coriaria ruscifolia.*—Planted out last autumn in front of a south wall, it has been killed to the ground, but is budding from below.

7. *Edwardsia pulchella.*—A plant fully 8 feet high, which overtopped a south wall, was killed to within a foot of its base, while some small plants at the bottom of an easterly exposed wall were uninjured. *E. grandiflora*, 2 feet high, on a south wall, had only some points of its young shoots slightly hurt, and is now in healthy growth.

8. *Clianthus puniceus.*—I had no plants outside last year, but one of the variety, *C. p. magnificus*, stood the year in a cool frame, and having been planted on a south wall in March, it is now growing vigorously.

9. *Rubus australis*, and *R. a. cissoides.*—Both the species and variety were completely killed.

10. *Leptospermum scoparium.*—A number of small plants in the open ground were all much cut down, but none were entirely killed.

11. *Fuchsia excorticata*, on a south wall, was killed to the ground, but is now sending up vigorous shoots.

12. *Fuchsia procumbens* still continues to grow freely on the rockery.

13. *Aciphylla Colensoi.*—Three rockery plants in different exposures have all stood perfectly unharmed. One that flowered last year has now three strong crowns or tops, and many of its Palm-like rigid sharp-pointed leaves are over 2 feet in length; neither it nor the others have any appearance of flowering this season.

14. *Griselinia littoralis.*—In consequence of the young shoots and foliage of this handsome evergreen not having been nearly matured when subjected to the almost zero temperature of December 3 and 4, it has suffered fully as much as the common Laurustinus and Aucuba. My plant, that was 6 feet in height, as well as others of smaller size, were killed down to near the ground, but they are now sending up vigorous growing shoots.

15. *Corokia Cotoneaster.*—Two varieties on a south wall had the points of their most protruding young shoots a little injured, but both were covered with a profusion of their small yellow flowers in March and April. One plant in

the open ground was entirely killed, but another is producing young growths from its base.

16. *Olearia Haastii*, growing in the open ground, was not in the least injured.

17. *Veronica Traversii.*—My oldest plant, which is now about 2½ feet in height by fully 2 feet in diameter, had not a single leaf in the least injured; neither had a number of recently rooted cuttings that were planted out in different exposures during last November.

18. *Veronica salicifolia.*—Several plants (the largest of which had a stem 2 inches in diameter) that were injured in 1878-79 were entirely killed last winter.

19. *Veronica pinguifolia.*—Five plants in different exposures were uninjured.

20. *Veronica Hulkeana.*—A plant put out last autumn was completely killed.

21. *Muhlenbeckia complexa.*—Two old plants growing on south walls, and one in the open border, were killed to the ground, but all are now producing an abundance of rapid-growing shoots.

22. *Libertia grandiflora major.*—Of many plants growing in different exposures a few have been killed, and the growths of the others are more weakly than hitherto; nevertheless, many have flowered, and the plants generally seem to be recovering their natural vigour of growth.

23. *Libertia ixioides* seems much hardier than the last.

24. *Cordyline australis.*—Several plants that were seemingly killed when 3 to 4 feet high have put up shoots from depths of from 3 to 6 inches. Some of these have perished, but others that were covered with snow during the hard frosts of last December are still growing. The one that stood unharmed till it was cut down by the winter of 1878–79, and which the late Dr Moore, of Dublin, said was *C. callicoma*, put up a young shoot last spring which now measures 21 inches in height.

25. *Chrysobactron Hookeri*, from one-year old seedlings upwards, has stood unharmed in various exposures, and the larger plants lately produced a profusion of their beautiful yellow flowers.

26. *Phormium tenax.*—The common green, as well as

two variegated leaved varieties, had their leaves killed to within about a foot of the ground, but they have now got new leaves, and are growing freely.

27. *Carex secta.*—Of about a dozen plants three perished last winter, but all the rest are growing well.

28. *Arundo conspicua* has been entirely killed.

29. *Aspidium Richardii* is unharmed and growing freely.

30. *Todea superba.*—In a cool shaded frame on the north side of a wall this most elegant of Ferns withstood the last, as well as it did the six preceding winters, and is now growing fully as freely as ever, several of its young fronds being over 21 inches in length.

The following exotics from other parts than New Zealand have withstood the winter of 1879–80 at Rait Lodge :—

1. *Acer palmatum.*—The palmate-leaved maple of Japan. This beautiful reddish-purple-leaved shrub, growing on a westerly exposed rockery, was unharmed.

2. *Aster cabulicus.*—The shrubby starwort of Cabul. On an easterly exposed wall, and about 4 feet in height, had only two or three points of its shoots injured, and in the middle of July commenced producing a profuse succession of its pretty umbellate-like bunches of light purple flowers.

3. *Aralia Sieboldtii.*—This handsome Japanese evergreen, which has become a general favourite for house and table decoration, stood without being the least injured on a southerly exposed rockery.

4. *Azalea amœna.*—This pretty and interesting introduction from China by the late Mr R. Fortune, growing on an easterly exposed rockery, was not in the least hurt.

5. *Azara microphylla.*—On an east wall had a number of its unmatured shoot-points killed, but is now growing profusely.

6. *Bambusa aurea.*—The yellow barked bamboo cane, and the following nine kinds, have suffered no perceptible injury from either of the last two winters :—

7. *B. Fortunei argentia variegata.*

8. *B. Fortunei aurea variegata ?*

9. *B. gracilis* (*Arudinaria falcata*).—The dwarf bamboo of Upper India. A number of self-sown and other seed-

lings, from a 13 feet high plant which in 1877 flowered, seeded, and then died, have proved perfectly hardy in various soils and exposures. This bamboo is highly deserving of more general cultivation from its elegance of habit, as well as for flower sticks and other useful purposes.

10. *B. Metake.*—Two plants of this handsome Japanese species, grown for some years in different exposures, have never suffered from frost, the largest is now a somewhat spreading rooted bush, 7 feet high, with a diameter of fully 3½ feet, and sending up numerous vigorous shoots.

11. *B. nana.*—A densely bushy, somewhat spreading rooted species, with shoots of only about a foot in length, is specially suited for rockery culture.

12. *B. nigra.*—A plant with black coloured stems, which has been in the open ground for the last three years, is now rather over 3½ feet in height, and presents a graceful habit of growth.

13. *B. Rogmouskii.*—A handsome broad-leaved, rather slow-growing species.

14. *B. striata argentea* is growing freely both on the rockery and in the open ground.

15. *B. Violacea.*—Resembles No. 12, but has lighter coloured bark.

16. *Chamærops Fortunii.*—Fortune's Chusan palm. A young plant grown for three years on a southerly exposed rockery, had only the points of two unprotruded leaves injured last winter, and is now growing freely.

17. *Clerodendron Bungeanum.*—This hardiest representative of an important genus of stove and greenhouse plants, after standing the two preceding winters on a south wall, growing to a height of 4 feet, and flowering freely, was killed down to near the ground in that of 1879–80, but is now sending up vigorous growing shoots, with handsome purple shaded, deep green leaves.

18. *Colletia horrida.*—Sometimes called *C. ferox* in nursery lists. Seems the hardiest of several very spiny, evergreen bushes, which constitute this genus, having stood last winter uninjured. The names of Chilian and Peruvian whins or furze, sometimes applied to them, is most applicable to this species.

19. *Crambe cordifolia.*—This gigantic sea-kale of the

Caucasus, in each of the summers 1878 and 1879, produced flowering stems 9½ feet in height, the two lower branches having a spread from point to point of 9 feet; and when covered with myriads of small white flowers, the appearance is presented of a little tree covered with snow. The leaves, which are produced in abundance from early spring continuously throughout the summer, often measure more than 2 feet in width, and are supported on solid stems averaging about 2½ feet in length. Having withstood the severity of last winter unharmed, and being easily propagated both by seeds and division of the roots, this seems highly deserving of cultivation for cattle feeding and other purposes.

20. *Cunninghamia sinensis* has stood on a rockery without injury.

21. *Desfontania spinosa* has stood unharmed in a somewhat shaded situation, where it is partly protected from direct radiation by a small Scotch fir, and has flowered both in the present and last summer.

22. *Dimorphanthus mandshuricus.*—A ten-year old plant of this elegant foliaged shrub of North China, which is about 8 feet high, is now (12th August) producing flower panicles freely at the extremities of its thick shoots, which are clothed with many umbrageous, bipinnate leaves, some of which measure 4 feet in length by fully 3 feet in width, and bear considerable resemblance to those of the *Aralia japonica*, a plant of which, growing in near proximity, suffered in winter 1878–79, and was killed last December.

23. *Diplopappus chrysophyllus.*—This highly interesting evergreen shrubby member of the natural order *Compositæ*, has withstood the last two winters perfectly on a south wall, as well as in various parts of the open ground, and only requires to be better known to insure its general cultivation. The wall plant is 6½ feet in height by 3 feet wide, and presents a compact surface of minute foliaged spray, the golden colour of the young shoots, and under surfaces of its leaves, contrasting conspicuously with the deep shining green of their upper surfaces, and specially recommending the branchlets for bouquets and table decoration.

24. *Elymus condensatus.*—" The bunch grass of British Columbia," being found beyond latitude 58° north in Western America, this elegant as well as useful grass has never suffered from our severest frosts. A plant which was sown in 1866 is now a little over a yard in diameter at the earth's surface, composed of very close-growing, fertile or seed-bearing, and barren or leafy stalks, in about equal numbers of each. For the past ten years the average height of the former has been 9½ feet, while the latter have mostly been from 5 to 7 feet; so that in annual bulk and weight of produce it far surpasses all our so-called agricultural grasses; it is also earlier than any of them, and its young growths never suffer from spring frosts. Being highly nutritious, and greedily eaten in all stages of growth by live stock, it is difficult to account for the neglect that it has hitherto met with from cultivators.

25. *Elymus crinetum.*—Seeds brought from the American prairies some years since have produced plants that are quite hardy, and yield a heavy crop of early and nutritious herbage; but the ears, which appear about the beginning of August, are armed with long rough awns, which are an annoyance to animals that feed upon them.

26. *Eulalia japonica variegata.*—This recently introduced, handsome, variegated grass proves to be quite hardy, and must ere long take a prominent place among outdoor decorative plants.

27. *Gaultheria nummularioides* (*Vaccinium nummularifolium*).—This pretty evergreen fern-like native of Nepaul did not suffer in the least; and its graceful leaf-clad twigs are well suited to take the place of some favourite tender ferns in bouquets.

28. and 29. *Hydrangea paniculata* and *H. rosea-alba.*—Plants of these pretty little shrubs, growing on a westerly exposed rockery, were not in the least injured.

30. *Hymenanthera angustifolia.*—Plants reared many years since from Tasmanian seeds, and grown in the open ground, have only sustained slight injury in the most severe winters; and occasionally small bushes of 2 to 2½ feet in height have been thickly loaded with white mistletoe-like berries, each of which was tipped with a small dark spot.

31. *Magnolia Campbelli.*—Of this " superb tree" a plant

which is now 5 feet high has stood the last three winters on a south wall without sustaining the least injury, and in the near-at-hand stool-ground of the Lawson Company's Nurseries, it has proved equally hardy, so that this most magnificent of deciduous trees may soon become a favourite for park and villa ground decoration. In illustrations of Himalayan plants from drawings chiefly made by native artists for the late J. F. Cathcart, Esq., it is figured and described by Sir J. D. Hooker as growing in Sikkim and Bhotan at altitudes of 8000 to 10,000 feet, with straight trunks, often 80 feet high and 12 to 20 in girth, the flowers varying from white to deep rose colour or almost crimson, while each is from 8 to 10 inches in diameter, and they are abundantly produced in April while the trees are yet leafless.

32. *Mahonia gracilis.*—Of this very distinct species, which was introduced from North Mexico by M. Roezl, a plant which has grown on a south wall for the last fourteen years is now 8 feet in height, but has never flowered. Its slender stalked, light green, rigid leaves, average about a foot in length by 3 inches in width, and are highly suitable for table decoration. Plants that have been exposed in the open ground suffer less or more in severe winters, but have never been entirely killed.

33. *Melianthus major.*—This very old, but now rather scarce inhabitant of our greenhouses, has stood the last twelve winters at the base of a south wall, but it was killed to below the ground surface in that of 1879–80, and has again put up young shoots.

34. *Mutisia decurrens.*—A ten-year old plant of this very peculiar and showy American climber, stood last winter without suffering the least injury, on a southerly exposed wall. It is now (12th August) 6 feet in height, and yielding a rich display of its large, orange coloured flowers, which resemble those of the well known *Gazania rigens* in size and colour.

35. *Osmanthus illicifolius.*—An 8 feet high specimen of this holly-like tree, growing on a shaded northerly exposed wall border, is uninjured; and two of its variegated varieties, which were more exposed to the sun, had some of their leaves and shoot-points slightly hurt.

36. *Philesia buxifolia.*—This pretty diminutive shrubby inhabitant of the Chilian mountains, grown in peaty soil, has proved quite hardy in different exposures, where it freely produces its pretty Lapageria-like red tubular flowers.

37. *Podocarpus alpina*, from the mountain tops of Tasmania. This interesting little Conifer grown in different exposures, was nowhere injured, and may be deemed the hardiest of its genus. Its dwarf, spreading branched habit renders it particularly suitable for rockeries.

38. *Populus candicans variegatus.*— Of this handsome variegated tree, which originated as a branch sport in the grounds of the late Charles Guthrie, Esq., of Taybank near Dundee, an 18 feet high plant was not in the least injured; although in nurseries, &c., the species is occasionally so much hurt by winter as well as early autumn, and spring frosts, that its cultivation has considerably decreased.

39. *Primula japonica.*—Of this "Queen of the primroses," which is one of the late Mr R. Fortune's most valuable introductions from Japan, a bed containing upwards of 250 plants, which was formed in the summer of 1878, stood the two last winters without the loss of a single plant, and flowered profusely in both of the succeeding summers, although in several horticultural periodicals it has been represented as being rather tender. Like others of the genus, it has a tendency to grow out of the ground after flowering, and, guided by previous experience, I, towards the end of last winter, had the bed laid over with fresh soil, so deep as to cover the above-ground root-producing stems, which insured the perfect health and abundant second year's flowering of all the plants.

40. *Prumnopitys elegans.*—This truly elegant, lively green yew-like tree was deemed somewhat tender when introduced a few years since, but with the perfect drainage afforded by a rockery, a six-year old plant which is 4½ feet in height has never sustained the least injury.

41. *Quercus densiflora.*—A plant of this handsome Californian evergreen oak, which is over 10 feet in height, has proved quite hardy.

42. *Rhododendron anthopogon* was uninjured, and flowered freely this summer.

43. *R. argenteum* of Sir J. D. Hooker. This, in common with many of the Himalayan rhododendrons and other plants, is more capable of withstanding the severe winter frosts than those of spring, that too frequently destroy their swelling buds and young foliage, which generally escaped in consequence of the unusual mildness of last spring; and this species, although generally supposed to require greenhouse protection, suffered very little from the low winter temperature, except the loss of its most exposed large leaves by wind breaking when they were hard frozen.

44. *R. argenteum* of Major Madden. A fine bushy plant over 6 feet in height was not in the least injured.

45. *R. barbatum.*—This magnificent arborescent species was unharmed.

46. *R. campanulatum.*—Neither this species nor its variety *R. c. robustum* have been perceptibly injured.

47. *R. campylocarpum.*—This pretty little yellowish flowering species proved to be quite hardy.

48. *R. ciliatum* was unharmed.

49. *R. cinnabarinum* was unharmed.

50. *R. cinnamomeum.*—Of the variety to which this name was originally applied, a fine bush 7 feet high by 8 feet in width was not in the least hurt.

51. *R. Fortuni.*—This remarkable and very distinct free-growing Chinese species sustained no injury.

52. *R. fulgens.*—A plant which is now about twenty-five years old, and only 15 inches in height by 33 in diameter, has never suffered from either winter or spring frosts, nor has it yet flowered, but its compact growth, and the bright verdigris-green of its young leaves, render it a favourite dwarf evergreen.

53. *R. glaucum* is a good associate for, and equally proof against winter frosts, as the so-called "roses of the Alps," *R. ferrugineum* and *R. hirsutum.*

54. *R. Hodgsonii.*—This compact growing, and handsome, large leaved species, seems equally hardy with the old well known *R. catawbiense* and its varieties, and is therefore likely to become of much importance in hybridizing.

55. *R. Keysii* (*R. Blandfordiæflorum*).—A 4½ feet high

plant of this peculiar tubular or large heath-like flowered species was unaffected.

56. *R. lanatum.*—A twenty-five-year old plant which has not yet flowered, measures 3 feet in height, and being quite hardy, is admired for its habit of growth and the peculiarity of its foliage.

57. *R. longifolium.*—In habit and appearance this species is allied to *R. argenteum* of Hooker (43), and is of about similar hardiness.

58. *R. niveum*, a plant 8 feet in height, was uninjured.

59. *R. setosum.*—This pretty diminutive species, being from altitudes of 13,000 to 16,000 feet, has never been injured by either our winter or spring frosts, and produces its bright reddish flowers copiously.

60. *R. Thompsoni.*—A plant over 7 feet in height, and about twenty-five years old, has only occasionally had its buds and deep blood-red, waxy-like flowers injured by spring frosts.

61. *R. virgatum.*—This elegent dwarf slender grower has its flowers now and then disfigured by spring frosts, but is otherwise quite hardy.

62. *R.* ?—An unnamed species, from altitudes of about 14,000 feet, which flowers in the beginning of March, generally has these destroyed by frost, but they escaped last spring; their colour is of such inimitable brilliancy, that on taking a bunch to a fashionable ribbon shop for the purpose of getting the proper name of its colour, none were found that would nearly match it, and the nearest, which was termed "brilliant cerise," gave by no means a correct idea of its beauty. My bush is about twenty-five years old, 5½ feet high, by 4 feet in diameter. In a cool greenhouse, where its flowers would be safe from frost, no Rhododendron is more deserving of a place.

For the purpose of showing the relative hardiness of the preceding Rhododendrons, the following names are given of such as have either been killed or irrecoverably damaged by the unusually severe frost of last winter, viz., *R. arboreum, R. Aucklandii, R. Edgeworthii, R. Falconeri, R. Gibsoni, R. Jenkinsii, and R. Maddeni.*

63. *Rodgeria podophylla.*—This showy leaved Saxifragaceous herbaceous plant was uninjured by either of the

last two winters, but although growing freely it has not flowered.

63. *Stauntonia latifolia.*—In the course of the last ten years a plant of this delicately fragrant Himalayan climber had attained to a height of about 16 feet on a west wall, getting its shoot-points occasionally injured by severe frosts, but that of last winter killed it to within a few inches of the ground, from whence it has now pushed out vigorous growing shoots.

65. *Thea viridis assamica.*—For several years past a plant of the Assam tea stood on a rockery uninjured, but last winter it was killed to within 3 inches of the ground, and from thence it is again producing healthy shoots.

66–78. *Yucca.*—The following twelve kinds of this unique and highly ornamental genus withstood the severity of last winter, but those on the rockery, where they had perfect drainage, are now decidedly healthier than others of the same kinds that were in damper and more shaded places.

Yucca angustifolia.
Y. antwerpensis.
Y. concava.
Y. Elicombi.
Y. filamentosa vera.
Y. filamentosa spurea.
Y. filamentosa.—A distinct variety from seed.
Y. flaccida.
Y. gloriosa.
Y. gloriosa glauca.
Y. gloriosa superba.
Y. recurva.

The following were killed by the winter of 1878–79, although less severe than that of 1879–80, viz., *Yucca aspera*, *Y. filamentosa variegata* (a small plant), and *Y. Whipplei.*

79. *Cyclamen ibericum.*—Both the red and white varieties of this pretty bulb have proved perfectly hardy on a westerly exposed wall border, where their flowers appear coeval with those of the snowdrops in early spring, as profusely as do those of the red and white *C. europæum* in autumn.

80. *Eucomis punctata.*—This handsome and very peculiar herbaceous plant has stood unharmed on both southerly and westerly wall borders.

With the view of conveying still more correct ideas as to the hardiness of the forementioned, as well as of the many other unintroduced or little known New Zealand plants that are associated with them in their native habitats, I append the following remarks, showing the effects of the last two winters on a few generally well-known plants that were grown along with and under the same circumstances as the forementioned.

Asplenium marinum (the Sea Spleenwort), gathered some years since on the coasts of Arran, was killed last winter in the same cold frame where the Todea superba (30) has thriven so well.

Aucuba japonica.—Plants of the common variety lost most of their leaves, and were killed from a third to half-way down. Some of the recently introduced varieties suffered to a similar extent, while others were not at all, or very little injured.

Ceanothus azureus, *dentatus*, and *rigidus*, all well-established plants, 10 to 15 feet high. The two first species were a good deal injured by the winter of 1878–79, while the last was unimpaired; but all were killed last winter.

Euonymus latifolius, and its variegated varieties, were scarcely hurt in 1878–79, but all lost their branches and much of their main stems last winter.

Fuchsia Riccartoni, which had attained to a considerable size, was killed to the ground, but has sent up strong young shoots.

Gunnera scabra.—A fine specimen of this gigantic Chilian herbaceous plant, which had stood unharmed for about ten years, was killed, with the exception of some deeply covered portions of its roots; from cuttings of which several young plants have been reared.

Laurus nobilis.—Of two plants of the common, one

Willow-leaved, and one variegated Sweet Bay, the latter was killed, while the others remained uninjured, in 1878–79; but last winter one of the first and the second were also killed, while the other plant of the common variety only lost the points of its shoots, with a few of its small branches, and is now pushing fresh leaves and young shoots.

Lavatera arborea (the Tree or Sea Mallow).—In an essay recommending the use of a tall growing variety, which I found in Arran, as a fibre plant for paper making, for which I received the Highland and Agricultural Society's Gold Medal in 1877, I mentioned that many of the plants suffered when the thermometer fell to about 15° Fahr., and that most of them were killed when it fell below 10°; hence all of my young plants perished in each of the last winters. Sown in March of each year, the young plants of the tall variety had obtained heights of 6 to 8 feet before the winter set in, while those of the east coast or "Bass Rock" variety, were only about two-thirds of their size, but all seemed equally tender.

Passiflora cœrulea.—A fine plant, which had grown for eight years on the same wall as *Muhlenbeckia complexa* was killed in the winter 1878–79, and a young one, planted in spring 1879, was killed last winter.

Populus fastigiata.—The fastigiate or Lombardy poplar. A plant of the comparatively rare female form of this well-known tree, from the noted specimen in the University Botanic Gardens at Göttingen, was scarcely injured; while of many of the common or male form, growing in the neighbourhood, most were entirely killed, and the rest suffered more or less severely.

Roses.—Many of the hybrid perpetual and Chinese varieties, which have of late years almost superseded the old hardy sorts in cultivation, have either been killed or so much injured by the severity of last winter, that only comparatively few, weak, and unsatisfactory blooms need be looked for this year.

Veronica decussata was completely killed alongside of *V. Traversii* (17) in 1878–79, and plants that were put out in spring 1879 were destroyed last winter. The recently-introduced fine hybrid shrubby Veronicas, that withstand our milder winters, have all been killed; but in a letter recently received from General Burroughs, he mentions that a collection of those that I sent him some years since are all thriving well in the island of Rousay, Orkney, where *V. decussata* has become naturalised, and is one of the best of sea-wind resisting shrubs.

Viburnum Tinus.—The common Laurustinus has either been entirely killed to the ground, or so much cut down that only the thicker parts of the larger branches are alive.

Ulex nana (the dwarf Whin or Furze).—Fine established plants were killed on the rockery in 1878–79, as was also a young plant of the double-flowered *U. europæa;* while last winter large plants of the latter were either entirely killed or cut down to the ground, as were also those of the Irish Whin, *U. stricta*, and of the French Whin, *U. provincialis.*

On the Flowering of Yucca gloriosa, L., *in the Royal Botanic Garden, Edinburgh.* By John Sadler, Curator. (Plate II.)

(Read 13th November 1879.)

About the end of August last (1879) numerous plants of *Yucca gloriosa* or Adam's Needle showed symptoms of flowering, more especially those on the Rock Garden. By the beginning of October upwards of a score of specimens of this stately evergreen were in full flower, and formed the object of considerable attraction to the general public. All the plants, with the exception of two which were only partially developed, were very handsome, with their towering compound panicles of drooping bell-like flowers of a creamy white colour, tinged with purple on the outside. They varied in height from 8 to 11 feet—that is from the ground to the top of the inflorescence. I am not certain whether the plants in the Botanic Garden are the typical form of the species. Judging from the descriptions and figures given in botanical works of *Y. gloriosa*, I am inclined to think that the leaves of our plants are shorter and more deeply channeled, and that the lateral branching panicles do not spread so much. In this last character they resemble *Y. aloifolia*, figured in "Bot. Mag." in 1815, t. 1700, a species apparently of early introduction into this country from America, as we read of it as having been cultivated in the king's garden at Hampton Court in 1696.

Y. gloriosa was first discovered in Carolina by Michaux, growing near the sea-coast. It has long been known in the gardens of Britain, as both Parkinson and Gerard notice it. It was figured in "Bot. Mag." in 1810, t. 1260.

During the severe winter of 1878–79, the plants had their leaves much broken down by heavy snows, but otherwise they did not suffer. The species is very hardy, and ought to be more extensively planted as an ornamental evergreen, especially in town gardens, as no plant will resist better the evil influences of continual smoke and dust.

The general flowering of the Yuccas this autumn, in various parts of the country, I attribute to the favourable summer and autumn of last year (1878) for maturing their growths.

Besides *Y. gloriosa*, there were other three dwarf species in flower on the Rock Garden at the same time, viz., *Y. filamentosa* ("Bot. Mag." 1806, t. 900), which was in cultivation as far back as 1675; *Y. flaccida*, introduced in 1816; and *Y. Antwerpensis*, a beautiful species, with a panicle of about 2½ feet high of handsome cream-coloured flowers.

The accompanying plate was taken from a photograph of a portion of the Rock Garden, executed by George A. Panton, Esq. The Society is indebted to the proprietors of the "Gardeners' Chronicle" for the electrotype.

On the Septa across the Ducts in Bougainvillea glabra *and* Testudinaria elephantipes. By Professor Dickson, M.D. (Plate III.)

Owing to unforeseen difficulties the plate has been delayed, but it will appear, with description, in the next part of the "Transactions."

vascular bundles are scattered, very much as in a monocotyledon. The diameter of the stem is increased, from year to year, by the formation of secondary bundles, with intervening smaller-celled parenchyma, out of a persistent meristem, or extra-fascicular cambium, beneath the rind, somewhat as in the monocotyledonous *Dracæna*. On the inner side of the rind, just outside this meristem, long fibres, resembling bast fibres, occur, singly or in bundles of two or three together. It will thus be seen that in the rind, here, the appearance of ordinary dicotyledonous structure is curiously simulated. The cambium-like meristem and the bast-like fibres in *Bougainvillea*, however, are both *extra-fascicular*. In the fibro-vascular bundles the dotted ducts are of peculiar character. They are formed from comparatively short cells applied to each other by horizontal extremities. Most of the horizontal septa between the component cells become perforated in the ordinary way by the formation of a large round hole; but a certain number—say one in six or seven—of the septa persist as diaphragms, which exhibit thickening in the form of a very beautiful hexagonal reticulation. The spaces of the mesh-work are not perforated, but are closed by a thin membrane.

Testudinaria elephantipes.—The fibro-vascular bundles here are somewhat peculiar, in exhibiting usually from two to four isolated strands of soft bast. The ducts vary much in size; but there are usually two of very large calibre (about $\frac{1}{100}$ of an inch) in each bundle—a very common occurrence in monocotyledons. The ducts are formed of much elongated cells—fully half an inch in length—applied to each other by more or less oblique extremities, the obliquity being often so great that the septa become nearly vertical, and, of course, much elongated. In form these septa are more or less elongate-oval, with narrowed and almost pointed extremities. They are exquisitely marked, in the middle with transversely elongated pits exhibiting irregularly scalariform arrangement; this passing rather suddenly towards the extremities into very minute dotting. Like the persistent septa across the ducts in *Bougainvillea* those in *Testudinaria* are imperforate.

As I have already said, the component cells of the ducts in *Testudinaria* are fully half an inch in length. The parenchyma-cells immediately surrounding them are comparatively short (about $\frac{1}{250}$ of an inch), from which it is evident that the duct-cells must have been formed long before the adjacent cells had ceased to multiply by division.

In the ducts of the two plants above referred to, we have what appears to be a very exceptional, if not hitherto unknown, peculiarity, viz., the occurrence of imperforate septa: indeed, in *Testudinaria* the technical character of a duct as a cell-fusion is altogether absent. Something similar to the structure in *Bougainvillea* is, however, described by Sanio ("Bot. Zeitung," 1863, p. 123) as occurring in an *Avicennia.* He says "either the wide vessels of this plant, which form the greater part of the wood, exhibit as perforation a large hole sharply defined from the rest of the transverse partition, or this hole is covered across by a membrane which exhibits bordered open pitting of the most varied kind" ["*die verschiedenartigste behöfte offene Tüpfelung*"]. In this description Sanio seems to view the pits as perforations—but it may be that the case is identical with what I have described in *Bougainvillea.*

Report on Temperatures and Open Air Vegetation at the Royal Botanic Garden, Edinburgh, from November 1879 *till July* 1880. By Mr John Sadler, Curator.

In my last report, I stated that the winter of 1878-79 was the most severe and protracted that had been experienced for many years. From the beginning of November 1878 to the middle of February 1879 the ground was frozen to such an extent that no cultivation or transplanting could be carried on, the frost having entered the ground to the depth of 18 inches. The winter of 1879-80 was also very severe, and the hard frosts at the beginning of December did much injury to vegetation at the Royal Botanic Garden. This arose, I believe, from the unripened nature of the wood, owing to the summer and autumn of 1879 being cold, wet, and sunless (see p. 128).

I. Temperatures.

November 1879.—The thermometer was at or below 32° on seventeen mornings, the same number as that of November 1878; the lowest readings being on the following dates:—2d, 23°; 3d, 26°; 4th, 21°; 14th, 20°; 15th, 25°; 22d, 27°; 23d, 28°; 28th, 25°; 29th, 18°; 30th, 19°. The three lowest temperatures during the month were on the 14th, 29th, and 30th, when 12°, 14°, and 13° of frost were registered. 92° of frost were registered for the month as compared with 42° for November 1878. Last year the winter (which will be a long-remembered one) set in on the 29th November; this year it commenced on 2d November.

December 1879.—The thermometer was at or below the freezing point 23 times, and there were registered collectively during the month 230° of frost. From the 1st to the 13th there was hard frost every night, viz., 1st, 23°; 2d, 21°; 3d, 4°; 4th, 1°; 5th, 19°; 6th, 21°; 7th, 17°; 8th, 15°; 9th, 21°; 10th, 22°; 11th, 20°; 12th, 25°; 13th, 28°. On eight mornings there was no frost, although the temperatures were not high. On the 25th, the register was 35°, while on the 26th it was 20°, or 12° of frost. The temperature of the 4th is the lowest that has been registered at the garden since Monday, 24th December 1860, when the mercury fell to 6° below zero. In December 1878, there were registered 265° of frost for the month, and the thermometer was at or below freezing point 29 times; the lowest temperature being on the 14th, when 23° of frost were registered.

January 1880.—The thermometer was at or below the freezing point on 21 mornings, while, in the same month last year, it was so on 30 mornings. The following were the seven lowest readings:—12th, 23°; 14th, 23°; 19th, 19°; 20th, 23°; 21st, 24°; 26th, 19°; 27th, 24°. There were registered collectively 132°, compared with 221° in 1879. From the 1st to the 7th there was no frost, and during the day the thermometer generally ranged from 42° to 52°, but although the weather was extremely mild for the season, spring vegetation made no progress, owing to the decided check it received during December. The Christmas roses (*Helleborus niger* and *H. niger grandiflora*) were in fine flower during the month in the rock-garden.

February 1880.—The thermometer was at or below the freezing point 9 times, and in 1879, 21 times. The following were the lowest temperatures:—6th, 30°; 9th, 23°; 11th, 25°; 13th, 29°; 14th, 29°; 15th, 28°; 26th 30°. There were registered for the month 30° of frost, and in the corresponding month last year there were 98°. The mid-day temperatures ranged from 37° on the 9th to 55° on the 4th. On 19 days we had bright sunshine during the forenoon; hence upwards of 30 species and varieties of spring flowering plants came into bloom in the rock garden during the month. These included *Dondia Epipactis*, *Primula denticulata*, *Galanthus Elwesii*, *Saxifraga Burseriana*, *Leucojum vernum*, *Rhododendron præcox*, *Crocus imperati*.

March 1880.—The thermometer was at or below the freezing point on 19 occasions; in 1879, 18 times. There were registered collectively during the month 103° of frost, as compared with 50° for the same month last year. The following were the lowest temperatures:—8th, 25°; 9th, 23°; 10th, 23°; 18th, 24°; 19th, 22°; 20th, 23°; 22d, 25°; 23d, 28°; 24th, 26°; 25th, 25°; 26th, 26°; 28th, 22°; 29th, 25°. During the whole of this month there were low temperatures both night and day, principally owing to the continuance of easterly and northerly winds. On 19 days there were bright sunshine, which did much for spring vegetation. The month was comparatively dry, and most favourable for the preparation of the soil, hence horticulture and agriculture got far in advance of last year at the same date. Among the numerous species and varieties of plants which came into flower during the month were the following:—*Galanthus plicatus*, *G. imperati*, *Saxifraga oppositifolia*, and *vars.* *Crocus etruscus*, *C. biflorus*, *C. tulipæfolius*, *Primula purpurea*, *P. marginata*, *P. cashmeriana*, *P. pulcherrima*, *P. villosa*, *P. ciliata*, *Bulbocodium vernum*, *Colchicum soboliferum*, *Soldanella montana*, *Chionodoxa Forbesii*, *Iris reticulata*, *Scilla siberica*, *S. præcox*, *S. bifolia major*, *Rhododendron lapponicum*, *R. ciliatum*.

April 1880.—Throughout the month there were generally low night temperatures, with bright sunlight during the day, while the wind, with one or two exceptions, was continually either northerly or easterly. The thermometer was at or below the freezing point on 6 occasions, while in April of last year it was 13 times. The following were the 6 lowest readings:—2d, 27°; 4th, 30°; 12th, 30°; 26th, 30°; 27th, 28°; 30th, 29°. For the month there were registered 18° of frost, as compared with 19° for the corresponding month last year. During the first part of the month there was somewhat changeable weather, with bright sunshine, showers of rain and hail, and the wind in the north-east. On the 16th the wind changed to the south-west, which raised the temperature considerably. The wind gradually increased until it reached the violence of a storm, and ended in a heavy fall of rain. On the 22d it changed to the west, then to the north, and ultimately settled in the north-west, thus verifying the excellent meteorological observation of Solomon: "The wind goeth toward the south, it turneth about unto the north, it whirleth about continually, and the wind returneth again, according to his circuits." At this stage an electric condition occurred in the atmosphere, which resulted in a thunderstorm, with hail and rain. After this there were frosty nights, and during the day very bright sunshine and cloudless skies. Upwards of 200 species and varieties of plants came into flower in the rock garden during the month, including:—*Erythronium grandiflorum*, *E. Nuttallianum*, *E. giganteum*, *Dodecatheon splendens*, *Camassia esculenta*, *Trillium grandiflorum*, *Tulipa Greigii*, *Primula rosea*, *P. capitata*, *P. integrifolia*, *P. cortusoides*, *Saxifraga pulchella*, *S. spathulata*, *S. nervosa*, *S. peltata*, *S. hieracifolia*, *Arnebia echioides*, *Helonias bullata*, *Pyrus Maulei*, *Draba Mawcana*, *Podophyllum Emodi*, *Andromeda tetragona*, *Epigæa repens*.

May 1880.—The thermometer was at or below the freezing point on 4 occasions, viz.:—on the 5th, 30° (or 2° of frost); on the 8th, 29°; 9th, 32°; and on the 14th, 30°. There were registered for the month collectively 7° of frost. In the same month last year the thermometer was at or below the freezing point on eight occasions, and there were registered for the month 12° of frost. During the whole of this month the temperatures were comparatively low, and northerly and easterly drying winds generally prevailed. Although there was a good deal of bright sunshine, yet the drying winds and the want of anything like drenching rains checked vegetation considerably. During the month the rock garden was very attractive owing to the numerous alpine and herbaceous plants in flower. These included *Erigeron Roylei, E. alpinus.* Many species and varieties of *Saxifraga, Gentiana Andrewsi, Dryas octopetala, Meconopsis nepalensis, Primula japonica, Senecio speciosa, Potentilla sikkimensis, P. aurea, Ramondia pyrenaica, Papaver alpinum, Aubrietia olympica, Chlorogalum Leichtlini, Rubus arcticus.*

June 1880.—During this month the thermometer did not fall so low as the freezing point at the Botanic Garden, although it fell several degrees below it in some districts of Scotland. The five lowest morning temperatures were on the 5th, 9th, 10th, 11th, and 12th, indicating 37°, 35°, 37°, 35°, 39°; while the highest day temperatures were on the 2d, 3d, 11th, 15th, and 18th, indicating 68°, 70°, 64°, 73°, and 67°. In the early part of the month there were bright sunshine; cold, dry, easterly and northerly winds, with very little rain. About the middle of the month there were cold mists and fogs, while, towards the end of the month, there were heavy showers of rain, with west and south-west, moist, warm winds, and bright sunshine, which gave a great stimulus to vegetation. Though the weather at the end of May and beginning of June was not conducive to luxuriant growth, it was very favourable for the ripening of spring herbaceous plants, and especially of bulbs. Many trees and shrubs have produced few flowers this season,—such as Hawthorns, Lilac, Horse-Chestnut, &c.

July 1880.—During the month the 4 lowest temperatures registered were on the 9th, 42°; 11th, 43°; 12th, 42°; 21st, 42°. The highest morning temperatures were on the 2d, 55°; 6th, 54°; 24th, 53°; 29th, 53°. In the beginning of the month there were heavy rains, with frequent thunderstorms. Nevertheless, the weather was warm, with bright sunny days and westerly winds. About the middle of the month the weather was calm, with occasional hot sunshine, heavy showers, and easterly breezes; while towards the end of the month there was bright sunshine, with occasional showers and stiff breezes from the south-west and north-west. Among the more conspicuous plants which came into flower in the rock garden during the month were *Lilium auratum, L. canadense, L. colchicum, L. pulchellum, Mulgedium alpinum, Delphinium cashmerianum, Epipactis palustris ;* many species and varieties of Sedums and Sempervivums, *Orobanche rubra, Astragalus alpinus, Primula Parryi ;* many species and varieties of *Campanula, Calceolaria chelidonæfolia.* From 1st January till 31st July 700 species and varieties of plants flowered in the rock garden.

II. Record of some of the Plants Killed or Injured by Frost, during the Winter of 1879–80, at the Royal Botanic Garden, Edinburgh.

1. *Killed.*

Benthamia fragifera.
Cupressus Knightii.
Ceanothus azureus.
Chamæbatia foliolosa.
Cheiranthus cheiri, and vars.
Edwardsia microphylla.
Erica codonodes.
,, arborea.
Arbutus Unedo.
Eurybia Traversii.
Gynerium argenteum.
Iberis gibraltarica.
Iberis sempervirens.
Leptospermum scoparium.
Mesembryanthemum uncinatum.
Ilex dipyrena.
Pinus Amscensis.
,, Devoniana.
,, patula.
Olearia Haastii.
Phormium tenax.
Veronica salicifolia.
,, Andersonii.
,, Traversii.

2. *Greatly injured.*

Aucuba japonica.
Cupressus macrocarpa.
Callistemon salicifolium.
Synara Scolymus.
Cordyline australis.
Erica mediterranea.
Laurus nobilis.
Libertia formosa.
Osmanthus ilicifolius.
Fitzroya Patagonica.
Hydrangea japonica.
Prunus ilicifolius.
Tritoma Uvaria.
Pyrus vestita var. pyramidalis.
Rhamnus alaternus.
Viburnum Tinus.

3. *Slightly injured.*

Azara integrifolia.
Araucaria imbricata.
Abies bracteata.
Dacrydium Franklinii.
Robinia Pseud-Acacia.
Eurybia Gunnii.
,, ilicifolia.
Prunus Lauro-cerasus.
Piptanthus nepalensis.
Thea viridis (4 feet high).

III. Table of Register of Spring Plants showing dates of flowering in 1879 and 1880, at the Royal Botanic Garden, Edinburgh.

	1879.	1880.
Galanthus nivalis, . . .	Feb. 22	Feb. 7
Eranthus hyemalis, . . .	,, 27	,, 8
Galanthus plicatus, . . .	March 1	,, 8
Leucojum vernum, . . .	,, 3	,, 9
Tussilago fragrans, . . .	,, 5	,, 12
Corylus Avellana, . . .	,, 5	,, 11
Crocus Susianus, . . .	,, 6	,, 12
Rhododendron atrovirens, . .	,, 6	,, 5
Dondia Epipactis, . . .	,, 6	,, 2
Nordmannia cordifolia, . .	,, 6	,, 20
Tussilago alba, . . .	,, 6	,, 10
Scilla præcox, . . .	,, 6	,, 25
Crocus vernus, . . .	,, 7	,, 20
Sisyrinchium grandiflorum album,	April 6	,, 24
Aubrietia grandiflora, . . .	,, 9	Mar. 4
Scilla sibirica, . . .	March 10	Feb. 26
Sisyrinchium grandiflorum, .	April 9	,, 24
Draba aizoides, . . .	,, 7	,, 15
Daphne Mezereum, . . .	,, 7	,, 28
Scilla bifolia, . . .	,, 29	Mar. 6
Tussilago nivea, . . .	,, 26	,, 8
Bulbocodium vernum, . .	April 7	,, 1
Arabis albida, . . .	,, 7	,, 3
Iberis gibraltarica, . . .	,, 6	(Killed)
Scilla bifolia alba, . . .	,, 1	Mar. 7
,, taurica, . . .	,, 1	,, 10
Rhododendron Nobleanum, . .	March 30	,, 5
Narcissus pumilus, . . .	April 1	,, 9
Orobus vernus, . . .	,, 1	,, 8
Iris reticulata, . . .	March 30	,, 10
Erythronium Dens canis, . .	April 8	,, 11
Symplocarpus fœtidus, . .	,, 5	,, 11
Mandragora officinalis, . .	,, 7	,, 15
Ribes sanguineum, . . .	,, 8	,, 17
Corydalis solida, . . .	,, 15	,, 16
Symphytum caucasicum . .	March 30	,, 16
Narcissus Pseudo-Narcissus, .	,, 25	,, 19
Hyoscyamus scopolia (?), . .	April 23	,, 24
Fritillaria Imperialis, . . .	,, 26	April 12
Adonis vernalis, . . .	,, 28	,, 20

IV. Extracts from Correspondents as to the Effects of the Winter of 1879–80 in different parts of Scotland.

I.—IN THE NORTH OF SCOTLAND.

From Mr David Melville, *Dunrobin Gardens, Sutherlandshire.*

June 26, 1880.

The winter of 1879–80 has been a most favourable one in this district. We had a fine spell of frost and snow the first three weeks of December, quite sufficient to afford a supply of ice for storing, and to send vegetation to rest for the winter. After Christmas we had an occasional night's frost and a few snow showers, sufficient to keep vegetation in check, without interfering with out-door operations. The most severe night's frost experienced during the winter occurred on the 2nd of December, when we had 13° of frost. During the same month we had 20 frosty nights. with 82° of frost altogether. In January there were 13 frosty nights, with a total of 26° of frost. In February 6 frosty nights, with 10° of frost. In March 7 nights' frost, with 8° degrees of frost for the month.

From April 1st to May 15th the minimum thermometer only went down to 32° on three occasions. Our record of loss last winter has been almost *nil.* Two large old plants of Pampas Grass were rather disfigured, and some of our Roses succumbed in spring, the latter was partially due to the drying east winds prevalent here in March and April. Among plants which stood the winter uninjured may be noted—*Aralia Sieboldii*, *Fuchsia Riccartonii*, *Phormium tenax*, *Garrya elliptica*, *Salisburia adiantifolia*, *Arundo conspicua*, *Escallonia macrantha*, *Tritoma Uvaria*, *Veronica Andersonii*, *Laurus Nobilis*, *Viburnum Tinus*, *Acer negundo variegata*, &c. Kitchen garden stuff stood the winter well—Celery, particularly, never kept better.

We are usually free from spring frosts here after the middle of May. We commence bedding out invariably from the 14th to the 17th with Calceolarias, Geraniums, &c., and the hardier portion of the bedding plants, following with the tender sorts such as Heliotropes, Dahlias, Tropæolums, &c., from the 22nd to the 31st. Our proximity to the sea, of course, accounts for our comparative immunity from spring frosts, and also from extreme frosts during the winter.

From Mr J. Forrest, *Haddo House Gardens, Aberdeenshire.*

May, 1880.

The severe frost of last December, succeeding such a cold, wet, sunless season, did a great amount of damage to vegetation in this locality. The results would in many cases have been worse, had it not been that we had at the time nearly 6 inches of snow on the ground. Our severest frosts were on December 3d, 30° ; 4th, 28° ; and 11th, 24° below freezing point. We had also a good deal of frost during the month of January, but not nearly so severe as in December, so that all, or nearly all, the damage done was by the December frost. Among shrubs *Aucuba japonica* and Bay Laurel are killed to the ground. Portugal and Colchicum laurels are much injured. In low-lying districts several plants of *Rhododendron ponticum* are nearly killed to the ground. On walls, roses of all sorts, *Desfontainea spinosa*, *Escallonia macrantha*, *Euonymus radicans variegatus*, *Viburnum Tinus*, and species of *Ceanothus* are much cut up, though none are killed. Standard roses and H. P. roses are all killed down to the snow. Herbaceous plants, violas, &c., being covered with snow, suffered no injury. Wallflower has also stood better than in less severe winters. Among fruit trees, apricots have their young wood killed; also pears, except one or two of the hardier sorts. Fruit buds (of which there was a very limited number) have escaped injury. Globe artichokes looked for some time as if they were completely killed, but are now doing well. Brocoli nearly all killed. German greens about one-half killed. Celery and other winter vegetables, little injured. Whins and broom, except in some very sheltered situations, are killed.

II.—IN THE MIDDLE OF SCOTLAND.

From Mr George Johnston, *Glamis Castle Gardens, Forfarshire.*

June 5, 1880.

I am happy to say that the frost that was so general all over the country last winter has affected us very little. About 100 newly planted Roses were killed, otherwise very little damage has been done. The most severe nights were the 3d, 4th, and 8th of December, when the thermometer fell to 8°, or 24° of frost on the 3d, and to 9°, or 23° of frost on the 4th and 8th. We had a coating of snow on the ground which helped to preserve whatever it rested upon, but the Roses were bare and had no rest for the snow, and being newly planted and probably their wood not well ripened owing to the cold sunless weather of last summer. This is the only visible injury I observe.

From Mr W. Reid, *The Gardens, Cortachy Castle, Forfarshire.*

May 25, 1880.

Vegetation has suffered very little here during the past winter. Everything started away in spring much better than I expected after the preceding wet and sunless summer. Fruit trees, &c., promise well, however they may turn out. Our lowest temperatures were on 3d, 4th, and 11th December, when the thermometer fell to 14°, 12°, and 16° respectively; and on January 13th, 14th, and 20th, when it fell to 13°, 14°, and 20°. The average temperature here in December was 27½°, and in January 30°. I may mention that our thermometer is 3 feet from the ground and protected.

From Mr John Robb, *The Gardens, Drummond Castle, Perthshire.*

May 5, 1880.

The only plant which I see hurt, is the common Portugal Laurel, a great many of which are much *singed.* I have a few standards in the Garden here, and all have their last year's wood cut up, and, strange to say, the *Aucuba japonica,* which forms a carpet under them, is quite safe. Our vegetables, such as Brussels Sprouts, Savoys, Kale, and Leeks kept quite safe. 1878–79 hurt us much. We have great quantities of Hardy Heaths and Hardy Perpetual Roses (Standards and Dwarfs). Of the Heaths 150 very large plants were killed, and as many Standard Roses: Gloire de Dijon only escaping unhurt. Large plants of *Juniperus Hibernica* were also killed. Ceanothus of sorts were killed to the ground, but have now started away. There are plants 12 feet high on a south wall.

From Mr Wm. S. Bisset, *Moncreiffe Gardens, Perthshire.*

June 25, 1880.

In regard to your inquiry as to the effects of the past winter on vegetation, I have to mention that during the month of December the frost was very severe, the thermometer being, on two nights, a few degrees lower than in the previous winter, and registering 30° of frost. The result has proved more destructive to several plants than the frosts of 1878–79, caused principally, I presume, from the unripened state of the wood. Tea and Noisette Roses are much injured, and in some instances killed. *Viburnum Tinus* and Sweet Bays are much browned, and in some parts of the grounds Hollies have been much destroyed. From the effects of the frost, and the tremendous crop of berries, many of the plants are not expected to recover. Up to three weeks ago the plants were loaded with berries, but since that time the wood pigeons have been feeding on them, the result of which has tended to keep them from destroying Cauliflower, Peas, &c., in the Garden. The Brassica tribe have not suffered so much as during the previous winter. Brocoli were about half killed out, but Brussels Sprouts and

Savoys have come through scatheless. The injurious effects of last winter have been as nothing compared with those of the ungenial season of 1879. From the very immature state of the wood we had no flowers on outside Peaches and Nectarines. Plums flowered abundantly, but the fruit has mostly dropped off. The flowers of Pears and Apples were weakly and in many instances deformed, and consequently the crop is very deficient. Small fruits, however, such as Gooseberries, Currants, and Rasps, promise a fair crop. Strawberries look well, but the excessive dry weather we are now having is telling on them.

From Mr Francis Davidson, *The Palace Gardens, Hamilton.*

June 25, 1880.

I regret that, as it has not been the custom at this place to keep a record of the temperatures or rainfall, I am unable to give you anything like a precise report in detail of the lowest temperatures of last winter and their effects on vegetation. I can only give a general statement, and that very meagre. In our neighbourhood, so far as has come under my notice, the effects of last winter on vegetation have not been nearly as disastrous as those of 1878–79, although we had the most intense frost, the thermometer registering on two occasions 2° below zero,—an intensity of frost which we did not experience during the very protracted storm of the previous winter. Unfortunately, owing to the wet and backward summer, few vegetables for winter use (or indeed for summer use) ever came to maturity; but where Savoys, Greens, &c., were planted early, though much smaller than usual, these vegetables survived the winter in very good condition. Few Evergreens have suffered much in our locality. Roses have fared much worse, but I attribute their death more to the ungenial summer than to the severity of the winter. I intend to keep a better record next winter, and therefore expect to give you a better report in future.

Report on Arran, Buteshire.

From The Rev. David Landsborough, *Kilmarnock.*

May 1880.

The climate of Arran is very mild. The lowest markings of the thermometer last winter at the lighthouse of Pladda, on the south of the island, was on December 1st and 3d, 31°; January 12th and 21st, 31°; February 26th, 36°; March 27th, 35°: the minimum temperatures of winter being thus about 12° or 14° above those of Glasgow. The garden of Cromla at Corrie, to which my remarks, when not otherwise mentioned, are confined, is on the north-east of the island, and is separated from the high-water-mark by only the breadth of the highway. It is protected on the north and partially on the east by woods, while the high hills immediately behind, rise to the height of nearly 3000 feet. *Cordyline australis*, *C. indivisa*, and *C. Veitchii*, are injured; *Dicksonia antarctica*, untouched; *Dicksonia squarrosa*, much browned; *Cyathea medullaris*, killed; had its crown and stem been covered with leaves it would have stood, as it did the previous winter. *Thamnopteris australaica*, killed; *Todea superba*, fronds of last year killed, plant uninjured; *Todea hymenophylloides*, *Asplenium lucidum*, *Asplenium falcatum*, *Aspidium Coriaceum*, *Lomaria Sp.*, untouched. *Eucalyptus globulus*, about a third of its leaves and most of the growth of last year killed. *Eucalyptus* "pendula," untouched. Two plants of the same elegant and sweet-scented species grow at the manse of the Rev. Dr Story, Roseneath, Dumbartonshire. The leaves of this species are twice the size of those of the *E. amygdalina*, which grows at Castle Kennedy, and differ also from those of *E. viminalis* which grows at Whittinghame, Prestonkirk. Double White Camellia, untouched; Old Red Single Camellia, flowered abundantly; Double Myrtle, *Desfontainea spinosa*, *Acacia melanoxylon*, *Eurya latifolia*, *Edwardsia grandiflora*, *Coccoloba vespertilionis*, *Photinia serrulata*, *Elæagnus japonica variegata*, all untouched; *Rubus australis*, much injured; *Casuarina quadrivalvis* and *Griselinia macrophylla*, killed. At Brodick Castle, in the same island, the Cork tree (*Quercus suber*), and what appears to me to be *Cunninghamia sinensis* have grown for the last twenty years.

To the generous liberality of His Grace the Duke of Hamilton I owe the opportunity of experimenting on plant growth at Cromla.

III.—IN THE SOUTH OF SCOTLAND.

From Mr Malcolm Dunn, *Dalkeith Palace Gardens, Mid-Lothian.*

8th June 1880.

The winter began with 5° of frost on the morning of the 15th October 1879, which cut off Dahlias and other tender plants. On the 16th, 18th, 26th, 27th, and 28th a few degrees of frost were also registered. With the 1st of November slight frosts set in again for a few days, and on the 14th, 10° were registered; but the day after that thaw set in, and there was no more frost till the 22d, when the severest frost experienced here since 1860 began. On 1st December we had 10° of frost, followed by 14° on the 2d, 26° on the 3d, 27° on the 4th (the severest night since Christmas eve 1860), 12° on the 5th, 10° on the 6th, 10° on the 7th, 11° on the 8th, 5° on the 9th, 9° on the 10th, 10° on the 11th, 7°

on the 12th, when a thaw set in, which prevailed till the 18th. On the 19th frost set in keen again, 8° being registered that morning, with 12° and 11° on the 20th and 21st respectively. Three days thaw, and then three days slight frost followed; while thaw prevailed from the 28th December until the 10th of January 1880.

The frost then continued without a break until the 27th January, the severest being 14° of frost on the night of the 18th, the average being about 8° of frost nightly. From the 27th of January till the 17th of March frost was only registered on two nights—7° on the 9th of February and 3° on the 9th of March. From the 17th until the 28th March from 4° to 8° of frost were registered every night. In April there were 3° to 4° of frost on four nights—9th, 12th, 27th, and 30th. On the 8th and 9th May 2° and 1° of frost was registered. Since then we have had no frost.

In summarising the foregoing we find that October had 7 frosty nights, giving a total of 25° of frost; November, 16 frosty nights, giving 61° of frost; December, 20 nights, giving 202° of frost; January, 18 nights, giving 140° of frost; February, 1 night, with 6° of frost; March 12 nights, giving 70° of frost; April, 4 nights, giving 15° of frost; and May, 2 nights, giving 3° of frost.—This gives a total for the eight months of 78 frosty nights and 524° of frost. The two winter months, December and January, had 38 frosty nights and 342° of frost. The same two months in 1878–79 had 56 frosty nights and a total of 580° of frost, the severest night being the 14th of December, when 22° of frost were registered. However, the effects of the long-continued frost of 1878–79 were much less disastrous to vegetation than the shorter and sharper frost of the past winter.

Vegetation in the autumn of 1878 was in a thoroughly-ripened state; and, being also well protected by deep snow during the severest of the frost, suffered comparatively little injury. In the autumn of 1879, however, vegetation had already suffered a deal from the cold and wet of the previous summer, and was in the worst possible state to withstand the severities of the winter. Frost set in early, and very little snow fell while it lasted to protect the soft and badly-ripened growth of the past season, which in many instances succumbed to less than the usual amount of frost; and the unusually severe pinch on the 3d and 4th December played sad havoc among many plants that, under more favourable conditions, would probably have easily withstood it.

The gardens and grounds at Dalkeith are situated about three miles from the sea, on a light, warm soil, with a gravel sub-soil, at an altitude of about 190 feet above sea-level, the ground falling to the north, but well sheltered in all directions with heavy timber;

so that they are favourably placed for protecting vegetation from the severities of the weather. Plants in them are, therefore, not so liable to suffer from the asperities of the weather as they are in less favoured localities; still, we have a numerous list of casualties to chronicle this season among the various plants exposed to the severe frost of last December. Those killed outright are but few and of little consequence; but the injured are more numerous than they have been for the past twenty years.

The common Arbutus is killed to the ground, and some plants are dead. *Aucuba japonica* has suffered severely where exposed to the sun, and where the plants were drawn up and tender; but on dry ground, with a north or north-west exposure, they are not injured. *Bambusa Fortunei variegata* was slightly browned, but has quite recovered. Sweet Bay (*Laurus nobilis*) is cut to the ground, but is now starting freely again. *Laurus salicifolia*, on a west wall, lost its foliage and the tips of the young shoots. *Berberis Beali* killed to the ground. Common Broom killed in low-lying spots. *Catalpa syringæfolia*, planted last year, young wood killed. *Daphne pontica* killed in damp places. *Erica mediterranea*, killed. *Eucalyptus globulus*, planted last year, 25 feet high, killed. *Euonymus fimbriatus*, killed. *Elæagnus reflexa*, on wall, killed to the ground. *Escallonia macrantha*, on walls, much injured. *Eurya latifolia variegata*, killed after having safely withstood the winter of 1878–79. *Deutzia gracilis*, young wood killed. *Griselinia littoralis*, killed to the ground. *Hartogia capensis*, much injured. Common Holly, many plants lost a great part of their foliage. Common Bay Laurel, much injured, and many limbs dying off. *Viburnum Tinus*, killed to the ground, but now starting freely. Lavender, many plants killed, others uninjured. *Ligustrum lucidum*, young shoots killed. *Magnolia grandiflora*, on walls, lost most of its leaves. Common Mulberry, young shoots killed. *Paulownia Imperialis*, young shoots killed. *Pterocarya Caucasica*, young shoots killed. Common Privet, much injured. *Quercus ilex*, lost most of its foliage. *Rosmarinus officinalis*, much injured, and some plants killed. *Ruscus racemosus*, much injured. *Sophora japonica*, *Sambucus racemosa*, *Robinia pseud-acacia*, *hispid*, and *inermis; Spiræa prunifolia*, *Reevesiana*, and *Thunbergiæ* have all had their young shoots killed.

Cedrus deodara lost many of its leaves, and *Picea Pindrow* lost them all, but both are again in fine foliage. Conifers generally have not suffered at all; those introduced from Japan particularly hardy, and withstand severe frost better than many of our native plants. *Azalea Amœna* is severely injured, after standing safe through the six previous winters. Sikkim rhododendrons, a large number of which have been raised from seed sent from India a good many years ago, and are now fine plants ranging up to 10 feet high and as much through, have suffered considerably in their foliage, but few, if any of them, are killed outright, and most of them are breaking well from the old wood, and promise soon to recover their former vigour.

Ampelopsis hederacea has suffered a good deal, but *A. Veitchii* is only very slightly injured, the points of the young shoots being nipped. *Clematis lanuginosa* and others of the same delicate strain are killed, while all the *C. Jackmanii* tribe are perfectly uninjured. *Lonicera brachypoda aurea-reticulata*, and *Jasminum Wallichianum* are killed to the ground. *Hedera canariensis* lost all its leaves and young shoots, and *H. Rægeriana* had about half of its leaves destroyed. The Walnut has two-thirds of the length of last year's shoots killed; and a good many trees of various kinds are observed with an unusual number of dead points of their last season's growth, arising, no doubt, from the severity of the frost acting on the badly-matured growth of last year.

Tea and Banksian Roses, on walls, are generally killed to the ground, including Marechal Niel; but most of them are starting again from the surface of the ground. That fine Tea Rose, Gloire de Dijon, has not been injured in the slightest, and is flowering very profusely. Hybrid Perpetual Roses also suffered a good deal of injury, and many of them are dying, or so badly hurt as to be worthless. The common China or Monthly Rose has been cut to within a few inches of the ground.

Pampas Grass has suffered severely, and so has *Tritoma Uvaria*, the foliage of both being killed to the ground, and many plants of each killed outright.

Among hardy fruit plants there has not been much damage done by the frost. Peaches and Nectarines, on walls, have suffered most, a good deal of the young shoots being either killed or so badly injured as to be useless. The result is no fruit, and the trees present a very ragged appearance. Strawberry plants, where exposed to the full sun in winter, have been a good deal injured by the repeated freezing and thawing. Most kinds of fruit trees had abundance of blossom upon them this spring, especially cherries and plums; but, owing to the unmatured state of the buds last autumn, it set badly, and there will not be above an average crop of fruit as a rule. Some few trees are heavily loaded, but a great many have not a fruit upon them,—fully two-thirds of the Pear trees being a blank. Currants and Raspberries are abundant; Gooseberries and Strawberries about an average.

Vegetables stood the severe frost well. Broccoli plants, laid over in November with their heads to the north, but protected in no other way, came through without any loss, and have been plentiful and good from November till the present time. Celery stood well without any protection; and all other winter crops, except a few Curled Kale and Savoys which grew in the lowest part of the garden, only a few feet above the level of the South Esk, where they were killed right off to a height of about 20 feet above the river as the ground rises from it. Vegetable crops this season are so far very satisfactory, and fully a month earlier than at the same period last year.

A noteworthy fact in connection with the present season is the remarkable scarcity of flower on most of our hardy trees and shrubs. Early Rhododendrons flowered pretty freely, but *R. ponticum* and all the later varieties are almost flowerless. Any flowers to be seen upon them are puny and badly formed, and anything but attractive. Lilacs, Deutzias, Philadelphus, Weigelas, Ribes, and such like are, as a rule, but sparsely flowered. Many Horse Chestnuts are without a single flower-spike; and the fine old Hawthorns, for which Dalkeith Park is famous, have scarcely produced a well-flowered specimen this season. The Laburnum is almost the only flowering tree that has produced a good crop of blossom, and kept up its credit as one of the hardiest and best of our ornamental trees.

The above by no means exhausts the list of plants that have suffered from the effect of the untoward winter of 1879–80, but the damage to others is of a comparatively trifling and temporary nature, from which they will soon recover.

From Mr W. B. Boyd, *Ormiston House, Kelso.*

June 3, 1880.

The winter of 1879–80 has been the most severe and trying to vegetation within the memory of any one living. I enclose you extract from note of readings of the thermometer kept by Mr Fairbairn, my gardener, here for one week of the lowest temperatures during the winter, from which you will see that we registered during the night of Wednesday and morning of Thursday, the 3d and 4th December, 50° of frost, or 18° below zero (see p. 139). The thermometer nearly 2 feet from the ground. The amount of damage done to trees and shrubs has been very great. During the previous winter nearly all the oaks, at a lower level than 50 feet above the river Teviot, had all the young wood of the previous summer killed back, and now these trees are quite dead. Many of the trees are from 50 to 80 or 100 years old; one or two are attempting now to make a few shoots from the main trunk, but most are altogether dead. All the Spanish chestnuts are killed, also of the same age as the oaks. One or two also I notice are making a few shoots from the main stem. Walnuts are dead. Some of the *Acer pseudo platanus* are very much damaged, as also a few Ashes. Common Laburnums in exposed places are dead. *Sambucus nigra variegata* killed to the ground. Nearly all the apple and pear trees in garden are either dead or so much damaged as not worth leaving. Apricots on wall dead. Peaches on wall are mostly dead, except "Royal George," which is much damaged. *Araucaria imbricata* dead. Deodars dead. All varieties of *Cupressus Lawsoniana* dead. Common and Irish yews dead. Tree box dead. *Libocedrus decurrens* dead. Most of Hybrid Rhododendrons dead, some coming away at the root. Nearly all the Ivy killed. Privet hedges much damaged. *Ruscus aculeatus* dead. *Pernettya mucronata* dead. Beech hedges much damaged. Variegated Holly dead. *Deutzia scabra* dead. Variegated Bramble, *Clematis Jackmanii*, *Clematis viticella venosa*, Evergreen Thorn, *Escallonia macrantha*, *Jasminum nudiflorum*, all Hybrid Perpetual Roses, Gloire de Dijon and Dundee Rambler against house killed to ground; *Weigela rosea variegata* mostly killed; *Wellingtonia gigantea*, *Picea pinsapo*, *Aucuba japonica*, Tree Pæonias, Bay and Portugal Laurels, scarlet flowering currants, *Berberis dulcis*, *Berberis Darwinii*, Trumpet Honeysuckle, Common Jasmine, Quince, and *Wistaria sinensis* killed to ground; Purple Laburnum dead. All Virginian creepers killed to ground except *Ampelopsis Veitchii*, which does not appear to have suffered. Walnuts dead. There will be no blossoms on any of the flowering trees, except the Rowan tree, which looks well for bloom.

Monday, December 1, 1879.—Snow had fallen in the night and showed a depth of 8¼ inches at daybreak, with 12° of frost. At darkening, 20°; at 10 o'clock, 31°.

Tuesday, December 2.—At 2 o'clock in the morning, 32° of frost; at daybreak, 18°; at the darkening 4°, with snow which fell to the depth of 5 inches; at 10 (night), 10°.

Wednesday, December 3.—At 2 o'clock (morning), 22° of frost; at daybreak, 28°; at 9 o'clock, 32°; at midday, 24°; at the darkening, 40°; at 7 o'clock, 42°; at 10 o'clock, 44°; at midnight, 46°.

Thursday, December 4.—At 3 o'clock (morning), 48°; at 5 o'clock, 50°; at daybreak, 50°; at mid-day, 30°; at the darkening, 40°; at 7 o'clock, 41°; at 10 o'clock, 39°; at midnight 33°.

Friday, December 5.—At 3 o'clock (morning), 21°; at half-past 4, 15°, with a slight sprinkling of snow; at 6 o'clock, 18°; at daybreak, 15°; at 10 o'clock, 10°; at mid-day, 2°; at the darkening, 10°; (slight falls of snow during the day) at half-past 6, 14°; at 9 o'clock, 18°; at midnight, 12.°

Saturday, December 6.—At 3 o'clock (morning), 22°; at 5 o'clock, 30°; at daybreak, 24°; at 9 o'clock, 16°, at mid-day, 2°; at the darkening, 18°; at 7 o'clock, 22°; at half-past 9, 24°; at midnight, 26°.

Sunday, December 7.—At 3 o'clock (morning), 26°; at 5 o'clock, 18°; at daybreak, 16°; at half-past 9, 10°; at mid-day, at the freezing point; at the darkening, 17°; at 7 o'clock, 20°; at 9 o'clock, 18°; at midnight, 22°.

Monday, December 8.—At 3 o'clock (morning), 23°; at 5 o'clock, 20°; at daybreak, 28°; at half-past 9, 25°; at mid-day, 16°; at the darkening, 12°; at 7 o'clock, 20°; at half-past 9, 24°; at midnight, 18°.

From Mr David Thomson, *Drumlanrig Gardens, Dumfriesshire.*

May 21, 1880.

The lowest temperature registered here (0°) was on December 4, 1879. Its effects on vegetation proved to be much more injurious than any frost which has occurred since 1860–61. This is no doubt to be accounted for in the very immature condition of many plants, from the cold sunless summer of 1879. Many plants that passed through the long-continued low temperatures of the previous winter uninjured have been either killed or severely injured. Roses were quite green and in leaf when overtaken by the frost, and in numerous instances standard plants have beeen destroyed. Dwarfs would have shared the same fate had not the precaution been taken of shaking some litter about them. Every plant has been killed down to the litter line. Clematis, of Jackmanii type, have been in many instances cut down to the ground. Camellias, Laurustinus, and Sweet Bays, on sheltered walls, which were not much hurt last winter, have been completely destroyed. Coniferæ, which chiefly occupy high positions, have not been injured. Arbutus much blackened. *Garrya elliptica* has suffered severely. Laurels have only been a little singed, but Aucubas very severely. Vegetables suffered more severely than I have ever seen them.

These are the leading marks which the winter has made on vegetation here; but this situation is scarcely a fair example of matters in this county, as it is so unfavourably situated.

From Mr Alex. Shearer, *The Gardens, Yester, Haddingtonshire.*

May 25, 1880.

The last winter has not been so disastrous among our Laurels as it has been amongst those of our neighbours at a lower level. We had only 29° of frost or 3° above zero, and had 4 inches of snow on the ground at the same time. None of our Laurels are injured, only some old Laurustinus and Aucubas. Dwarf Roses were all killed to the ground, but are coming away again. Standards are very much injured. Apples and Pears do not look as healthy as they used to do, and very doubtful if we will have much fruit, though on early sorts there is a good deal of blossom. No Apricots, and not many plums. I attribute the failure of all more to the cold and wet summer previous, than to the amount of frost during the winter. It has affected everything more or less. Asparagus, for example, is weak to what it used to be. Globe Artichokes are nearly all killed, only a few started at this date (25th May). We require some hot and dry summers to bring our fruit trees and other things back to their normal condition.

From Mr James Whitton, *The Gardens, Thirlstane Castle, Lauder, Berwickshire.*

May 31, 1880.

The intense frost of last December, though hardly so severe or long continued as that of December 1860, has been much more injurious to vegetation. Owing to the unfavourable nature of last year plants were the less able to stand it.

Lowest Readings of the Thermometer here.

Date.	*Min. in Box.*	*Black-bulb on Grass.*
December 3, . .	4°	7°
„ 4, . .	8°	11°
„ 5, . .	1°	5°

The following plants were killed to the ground, or nearly so, viz. :—Common and Portugal Laurels, Roses of sorts in every position, Clematis, green and varigated Hollies, *Escallonia macrantha*, *Pernettya mucronata*, *Acer negundo* (*var.*), *Menziesia polifolia*, *Libocedrus decurrens*, *Cedrus deodara*, *Cotoneaster Simmondsii*, *Cotoneaster microphylla*, and *Osmanthus*.

The following have suffered *considerable* injury, some of them quite killed, viz. :—Rhododendrons, *Wellingtonia gigantea*, tree Box, Yews, Ivy, Privet, Guelder Rose, Lilac, Spiræa, Berberis, Hazel, and many of the English Elms. The young wood of peaches on walls, also many of the apple and pear buds were destroyed, while standard apple and pear trees are much hurt. A snowfall of about 7 inches on 2d December helped much to save vegetables; still we lost about one-half of Savoys and Brussels Sprouts. Of several varieties of Brocoli grown, "Knight's variegated" was the only one that stood Autumn-planted cabbages, German greens, and leeks were very little the worse.

From Mr David Murray, *Culzean Gardens, Maybole, Ayrshire.*
May 26, 1880.

The frost we had during the last winter has done more damage to plants and flowering shrubs than any winter for the last 20 years, judging from the old-established Fuchsia plants that have been killed to the ground, growing in the open borders. Hydrangeas, Euonymus of sorts, Tamarix, *Phormium tenax*, Cornels, Myrtle, and *Lonicera aurea*, have also been severely damaged. Laurustinus, Sweet Bay, Veronicas, and some Camellias for a time looked bad, but now they are getting fresh foliage, and appear to be quite safe. Of course some of the above plants were quite unprepared to withstand such a severe winter, as they were green and in a growing state when frost set in. The lowest reading of the thermometer was on the 4th of December, when we had 22° of frost.

Omitted from my Report for 1878–79.

From Mr Malcolm Dunn, *Dalkeith Palace Gardens, Mid-Lothian.*
February 13, 1879.

The autumn of 1878 was comparatively dry and mild, and highly favourable to the thorough ripening of vegetation. The first morning of November brought a sudden change to sharp frost, which put a stop to the growth for the season, and killed off the tender plants in the flower borders, such as dahlias, asters, heliotropes, &c. For fifteen weeks the frost continued almost uninterruptedly.

During fifteen nights in November we registered frost, and from the 25th of that month to the 6th February frost prevailed every night except one.

The want of heat and light during the day was most remarkable, the effect of which was very disadvantageous to the forcing of fruit and flowers in hot-houses. Any growth made was of a pale sickly colour, and for weeks on end scarcely any amount of "forcing" would cause plants to open their flowers; and vines, peaches, figs, &c., usually forced in hot-houses, were very slow to start into growth.

The injury done to vegetables is much less than the average of past seasons. Such tender subjects as Broccoli, Lettuce, Celery, &c., have not stood the winter so well for the last eight years at least, and the hardier crops, such as Cabbage, Leeks, Kale, Brussels Sprouts, &c., have suffered no injury except being a little broken down by the weight of the snow.

Fruit trees of all kinds were well ripened in the autumn, and consequently have come through the storm unscathed. The wood of peach trees on the open walls is not usually so well ripened in this country as to withstand with safety more than about 15° of frost, scarcely a killed point of a shoot can be seen.

Trees and shrubs do not appear to have suffered to any serious extent. The weight of snow has broken down a good many Laurels and Hollies, but the frost has not injured them much. The Laurestine and Arbutus have a few leaves browned, but are otherwise quite uninjured. *Magnolia grandiflora* has its leaves browned on a south wall. *Clianthus puniceus* on the same wall is killed to the ground. It stood uninjured during the three previous winters. Marechal Neil rose on walls appears to be as hardy as Gloire de Dijon. They grow alongside of each other, and are both uninjured. *Eurya latifolia variegata* proves to be perfectly hardy, and is one of the handsomest evergreen shrubs introduced from Japan. *Bambusa Fortunei* and *Azalea amœna*, growing in the open border, prove also to be quite hardy. *Erica arborea* and *Mediterranea*, especially the latter, are much broken and injured by the snow. The only conifer that shows injury is *Picea pindrow*, the leaves of which are browned.

The deep snow and hard frost sealed up the herbage from rabbits and other rodents, which were driven to commit serious ravages upon trees and shrubs, and many covers and young plantations have suffered dreadfully from their attacks.

The scarcity of early flowers in the open air during the months of January and February has been quite unprecedented. Not a single flower could be seen fully expanded during January nor till the 6th February, when I found the first fully open flower upon *Chimonanthus fragrans* growing on a south aspect. On the 8th February Viola "Cliveden Blue" opened a few flowers. Snowdrops on 8th February were observed peeping out of their sheaths, but were not fully expanded till the 12th. Besides these, the yellow Primrose, common Polyanthus, Russian Violets, and *Erica herbacea alba*, were among the first to open their flowers.

From Mr Peter Loney, *Marchmont House, Dunse, Berwickshire.*

February 12, 1879.

Lat. 55° 43′ 30″, long. 2° 25′ 20″; from sea 20 miles; altitude 500 feet. Temperature for January 1879:—Mean maximum of month 35°, mean minimum of month 22·71°; mean temperature 28·855°. Lowest temperature on the 23d and 27th, 10°. Mean maximum black-bulb of month 36°, mean minimum of black-bulb of month 15°; mean temperature 25·5°. Lowest temperature black-bulb on 27th, 3°. Rain or snow in inches, 2·08. Number of days ·02, or more full 15.

From the above it will be observed that we have had no extremely low temperatures, though the mean temperature is low. From the heavy covering of snow we had, vegetation of all sorts has suffered very little.

PROCEEDINGS

OF THE

BOTANICAL SOCIETY.

SESSION XLIV.

Thursday, 13*th November* 1879.

The following Candidate was elected a Resident Fellow:—

Alexander Fraser, Canonmills Lodge.

Dr T. A. G. Balfour, President, occupied the Chair, and delivered an Opening Address; he also read Obituary Notices of the Members which the Society had lost by death during the last Session.

On the motion of Sir Robert Christison, seconded by Dr Stevenson Macadam, a vote of thanks was given to the President for his address.

Mr Sadler gave a Report on the Open-Air Vegetation at the Royal Botanic Gardens, as well as on the Lowest Temperatures recorded during the month of October at the Garden. He placed on the table the blooms of fifty-two species of plants still in flower in the Rock Garden.

Thursday, 11th December 1879.—Dr W. Craig, Vice-President, in the Chair.

The following Office-Bearers for 1879–80 were elected:—

PRESIDENT.

William Gorrie, Rait Lodge, Trinity.

VICE-PRESIDENTS.

William Craig, M.D.
Malcolm Dunn, Pres. Scot. Hort. Assoc.
Professor Bayley Balfour.
Thomas A. G. Balfour, M.D.

COUNCILLORS.

Alexander Buchan, A.M.
Charles S. France.
Hugh Cleghorn, M.D.
C. H. Millar of Blaircastle.
Sir Wyville Thomson.
Isaac Anderson-Henry.
Sir Robert Christison, Bart.
Professor Thomas R. Fraser.
Professor Douglas Maclagan.
John Sadler, Curator, Royal Botanic Garden.

Honorary Secretary, . . . *Emeritus* Professor Balfour.
Honorary Curator, . . . The Professor of Botany.
Foreign Secretary, . . . Professor Dickson.
Treasurer, ... Patrick Neill Fraser.
Assistant-Secretary, . . . Andrew Taylor.

LOCAL SECRETARIES.

Aberdeen—George Dickie, M.A., M.D., F.L.S.
Berwick—Philip W. Maclagan, M.D.
Birmingham—George A. Panton, F.L.S., St Bennet's Hill.
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.
Dublin—W. R. M'Nab, M.D., F.L.S., Professor of Botany, Roy. Col. Science.
Dumfries—James Gilchrist, M.D.
Exeter—Thomas Shapter, M.D.
Fife—J. T. Boswell, LL.D., F.L.S., of Balmuto, Kirkcaldy.
Georgetown, Demerara—W. H. Campbell, LL.D.
Glasgow—Professor Bayley Balfour.
Greenock—Donald MacRaild, M.D.
Kilbarchan—Rev. G. Alison.
London—William Carruthers, F.R.S., F.L.S., British Museum.
London, Brixton—John Archibald, M.B., C.M., F.R.C.S.E.
Manchester—Benjamin Carrington, M.D., Eccles.
Melbourne, Australia—Baron Ferdinand von Mueller, M.D.
Nairn—William Alex. Stables.
Nashville, Tennessee—George S. Blackie, M.D.
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. 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.S.L. and E.
Wolverhampton—John Fraser, M.A., M.D.
Zanzibar—John Kirk, M.D., F.L.S

The following Candidates were elected Resident Fellows:—

George Bird, 12 Warrender Park Terrace.
William Marjoribanks, 9 Learmonth Terrace.

The thanks of the Society to Mr Sadler were ordered to be recorded in the minutes for the zeal and assiduity which he had displayed during his twenty-one years' term of office as assistant-secretary, which he had that evening demitted. The bound minute books of the Society for that period were laid on the table.

Mr Gorrie, the new President, on taking the Chair, briefly thanked the Society for the honour thus unexpectedly conferred upon him.

The following Communications were read:—

I. *On the Septa across the Ducts in* Bougainvillea glabra *and* Testudinaria elephantipes. By Professor Alex. Dickson.

II. *On the Growth of the New Zealand Flax Plant* (Phormium tenax) *in Orkney Islands.* By Dr William Traill.

III. *Notes on the Rhea Fibre Trials at Saharunpore.* By Mr William Bell, in a Letter to Dr Balfour, Emeritus Professor of Botany.

IV. *Notes of New Zealand Plants cultivated at Rait Lodge, near Trinity, which withstood the Severe Winter of* 1878–79. (Part I.) By Mr William Gorrie, President.

V. *Report for November on Open-Air Vegetation at the Royal Botanic Garden.* By Mr John Sadler, Curator.

Thursday, 8th January 1880.—Mr William Gorrie, President, in the Chair.

Dr David Christison was appointed Artist for 1880.

The following Communications were read:—

I. *On the Correct Measurement of Trees.* (Fourth Paper.) By Sir Robert Christison, Bart.

II. *Notes on New Zealand Plants cultivated at Rait Lodge, near Trinity, which withstood the Severe Winter of* 1878–79. (Part II.) By Mr William Gorrie, President.

III. *Report for December on Open-Air Vegetation at the Royal Botanic Garden.* By Mr John Sadler, Curator.

MISCELLANEOUS COMMUNICATIONS.

1. Mr George Muirhead, Paxton, Berwick-on-Tweed, sent two diseased fish from a number that he had seen in the same condition on the previous Monday, whilst walking though the policy of Paxton, in company with Sir Thomas Buchan Hepburn and Captain Milne-Home. They went first to the burn, which runs into the Tweed at the east side of the policy, and saw in it, close to the mouth of the burn, where the water stands in a long pool, about half a dozen fish covered over with white fungus. They seemed to be in a dying state, and lay quite still when the visitors approached close to the place where they were. They also found one or two dead fish. The fish they saw in the burn and the dead ones were bull trout. They then went to the Whitadder, just above Whitadder Bridge, which is about half a mile from the mouth of the river, and found the whole water filled with diseased fish, which, with two exceptions, were affected with fungus, appearing to be spotted with white in the water. They were all bull trout. The diseased fish were mostly lying in the still water at the side, with their heads under the bank or behind stones. The specimens, at the suggestion of Sir Robert Christison, were sent to Mr Stirling of the Anatomical Museum to examine.

2. Dr Paterson exhibited a fine copy of "Pomona, or the Fruit Garden," by Batty Langley, Twickenham, and dated 1729, copiously illustrated, and containing an account of the cider fruits of Devonshire, by the Hon. Hugh Stafford of Pynes, near Exeter, an ancestor of the present ex-Chancellor of the Exchequer.

Thursday, 12th February 1880.—Mr William Gorrie, President, in the Chair.

Mr T. B. Sprague, M.A., C.A., was appointed Auditor for 1880.

The following Candidate was elected a Resident Fellow:—

Alexander Hay, 16 Duke Street.

The following Communications were read:—

I. *On the Ripening of Hardy Fruits* 150 *years ago.* By Mr Malcolm Dunn, of Dalkeith Palace Gardens, Vice-President.

The paper was based on the old book exhibited at the last meeting, entitled "Pomona," by Batty Langley, of Twickenham, 1729, and its object was to inquire how far the dates when hardy fruits ripened, given by it, when compared with such dates for 1879, and generally for the past three years, bore on the vexed question of the deterioration of our climate in these later times. Mr Dunn had besides, when composing his paper, accepted and compared the evidence on the subject given in Miller's "Gardeners' Dictionary," 1768; Martyn's "Gardeners' and Botanists' Dictionary," 1807; Lindley's "Guide to the Orchard and Kitchen Garden," 1831; Hogg's "Fruit Manual," 1860 to 1875; and the "Herefordshire Pomona," just being issued.

The "Pomona" discusses the growth of open-air plants, giving the exact date when their fruits ripened at Twickenham and in the south of England. Thus, Langley describes nineteen sorts of grapes then produced in England. From his very accurate accompanying engravings we recognise many also now grown, though under different names. A few of the hardier sorts, such as Burgundy and claret grapes, appear then to have been cultivated after a limited fashion in the open vineyard—a system, by the way, which

Langley strongly advocates, though he concludes his dissertation on the vine by saying that "a full south aspect on a wall is the best for all kinds of grapes," clearly showing that then, as now, a crop of well-ripened grapes was with difficulty obtained from vines growing in an open vineyard, even with a southern aspect, in an unpropitious season; indeed, some kinds were found so uncertain in ripening in any season, that he recommends them to be grown as excellent fruit for baking when they failed for dessert purposes. Two-thirds of the sorts of grapes enumerated by Langley are now grown; and we know that they will now also ripen their fruit as early and certainly when they meet with the same favourable cultural and climatic conditions. The white sweetwater is mentioned to have ripened by August 21, as it now does in southern England in ordinary seasons; so, too, our author notes November 10 when the white raisin should be ripe, if, as he *naïvely* remarks, "the seasons are kind enough to allow it." So far, then, the dates of the ripening of grapes given at Twickenham and around London 150 years ago are without change from those known in this latter half of the 19th century.

The records of the ripening of fruit trees, such as peaches and nectarines, bear also in this direction. Langley enumerates forty sorts of both, a majority of which are still in cultivation, and ripen about the same dates as he indicates. And so, too, with regard to apples, pears, plums, cherries, apricots, and other fruits. They ripen now about the time given by Langley, and no change is indicated in the works already indicated as having been consulted, whose dates of publication nearly were intervals of thirty years—from 1768 to 1879.

Mr Dunn attributed the decadence of outdoor cultivation of hardy fruits to the great extension of cultivation under glass, not to deteriorated seasons.

In the course of the discussion following this paper, it was maintained that when proper care and culture is given, good orchard crops could be obtained even in such far northern spots, when naturally protected by tree or hill shade, as the vicinity of Cape Wrath, the Carse of Gowrie, or Cupar. The more extensive planting of hedgerows with fruit trees was advocated. Mr A. Buchan, of the Scottish Meteorological Society, said that he had consulted other records, which showed the cycle of years from 1720 to 1730, referred to in the "Pomona," was a succession of bad seasons;

three of them, in fact—1726, 1727, and 1728—years of dearth about as bad as 1877 and 1879, with this difference, that in the former years there were no facilities for importing grain such as we now possess. About 1775 there occurred six or seven years of the very finest weather, such as there had been experienced no approach to except in 1826.

II. Mr James Blaikie, F.R.S.E., one of Her Majesty's Inspectors of Schools, read an account of a Visit to the Engadine, and exhibited a fine collection of nearly 300 Alpine plants chiefly collected in that district.

III. *A Letter to* Professor Balfour *from* Mr John Buchanan, *Mount Zomba, Central Africa, was communicated by* Mr Sadler.

This locality is midway betwixt the Zambesi and Shire rivers, and is about fifty miles from Lake Shirwa, which the natives state was in October last little better than a sheet of mud owing to the aridity of the season. The district much resembles the Blantyre Mission station, where Mr Buchanan was previously located. Maize is not so extensively cultivated, but rice is grown, as well as a species of sorghum, likewise cassava, bananas, and plantains. Several species of palms grow on the mountains, one of them Mr Buchanan thinks is the wild date; also very fine tree ferns—one of them is 8 feet high, having a spread of fronds of at least 20 feet in diameter. The natives use cord for net-making apparently made from fibres of *Hibiscus cannabinus*. They cultivate a species of croton, with oil from which they anoint their bodies, without any of the effects on the system peculiar to *Croton tiglium*.

IV. *Report for January on the Open-Air Vegetation at the Royal Botanic Garden.* By Mr John Sadler, Curator.

MISCELLANEOUS COMMUNICATIONS.

1. A notice of the death of General Munro, C.B., a non-Resident Member of the Society, was laid on the table.
2. Mr Symington Grieve gave in a note on the Island of Colonsay

as a station for *Orchis pyramidalis*, which is not known to exist in any other part of the West of Scotland. Dr Lightfoot, in his "Flora Scotica," published in 1777, noticed this station, but this has been generally questioned, though Mr Grieve could now confirm it, after a lapse of a hundred years since its first discovery.

3. Mr John Stewart, W.S., exhibited some beautiful American apples, which had been extensively sold in the British fruit market as Newton pippins. The apples, though of excellent flavour, were certainly not correctly named.

Thursday, 11th March 1880.—Mr WILLIAM GORRIE, President, in the Chair.

The Treasurer submitted his Report on the financial affairs of the Society for the past Session, with the Auditor's Abstract and Report thereon.

An Abstract of the Accounts had been previously circulated with the Billet calling the Meeting.

The state of Funds was as follows:—

Amount at close of Session 1877–78, . .				£221	17	$5\frac{1}{2}$
Increase during Session 1878–79, . .				6	13	$8\frac{1}{2}$
Funds belonging to Society,				£228	11	2
Illustration Fund:—						
Balance on hand at close of Session 1877–78, . . .	£1	4	5			
Increase during Session 1878–79,	31	11	0			
				32	15	5
				£261	6	7

The following Candidates were elected Resident Fellows:—

D. M. ROBERTSON, Trinity Nurseries.
DAVID P. LAIRD, West Coates Nurseries.
ROBERT PATERSON, 47 Grange Road.

The President intimated that the first item on the billet was the presentation of a testimonial to Mr Sadler, in recognition of the way in which he had discharged the duties of assistant-secretary for twenty-one years. The testimonial had been subscribed by a large proportion of the members, and consisted of, besides a bracelet for Mrs Sadler, a time-piece and a purse of sovereigns.

Mr Dunn proposed that the thanks of the Society be recorded to Dr William Craig for the great trouble he had taken in this matter. The motion was carried by acclamation.

The following Communications were read:—

I. *On the British American Violaceæ.* By Professor George Lawson, of Halifax, N.S.

II. *Exhibition and Description of Microscopic Slides of Fungus found on Fish, already brought before the notice of the Society.* By Mr Stirling, of the Anatomical Museum.

A gift of twenty-one microscopic slides illustrative of the growth of the *Saprolegnia ferax* on salmon and other river fish, and held by Mr Stirling of the Anatomical Museum to be the cause of the recent salmon epidemics, was presented by him to the Museum of the Royal Botanic Garden. At the same time large jar specimens of fish affected by this fungus in an unmistakable way, and observable even by the naked eye, were exhibited. The various specimens had been taken from the Tweed, from the Eden twelve miles above Carlisle, and from Ightham Moat in Kent, in localities thoroughly isolated from the sources of ordinary river pollution. The further consideration of Mr Stirling's paper was deferred till the May meeting.

III. *On the Pasturage of Wester Teviotdale in Connection with the "Louping-ill" of Sheep.* By Mr A. Brotherston, of Kelso.

At the request of the local Farmers' Club the author made a botanical examination of the pasturage of a number of sheep farms in this high-lying district. On a spring visit he could not trace any poisonous plants to which to attribute this disease. On the other hand, when making another botanical inspection in autumn, he found ergot very abundant. He detailed in the communication no fewer than twenty-three species of grasses which were ergotised. The Juncaceæ and Cyperaceæ, which form a great proportion of this hill pasturage, were free from ergot, *Claviceps purpurea;* but some of the Cyperaceæ were very subject to smut. Mr Brotherston suggested the eating of ergotised grasses as a probable cause of the disease, which in this district is a spring one. He emphasised the following in this connection:—No different species of plants characterise the isolated localities infected with the disease, but much ergotised grass was found there; the toxological effects of ergot were similar to those physiological ones characteristic of the disease. In Teviotdale spring is the only time when sheep may perchance eat ergot in quantity. To eat the pastures bare appeared to be the most feasible remedy for this disease.

MISCELLANEOUS COMMUNICATIONS.

1. Dr Wm. Craig exhibited a specimen of *Botrychium Lunaria*, taken the previous week from a hill in the Upper Ward of Lanarkshire, 900 feet above the sea-level.

2. Mr Sadler read a note from Mr John Campbell, Ledaig, Oban, noticing the remarkable progress of spring vegetation. The storm of December 28 had done more damage to half-hardy shrubs, such as myrtles, *Veronica Andersoni*, *Aster argophyllus*, than all the winter's frosts.

3. Mr Peach read part of a private letter from Unst, Shetland, in which it was stated that on February 24, crocuses, snowdrops, and polyanthus were in bloom, and that the rose bushes were unfolding their leaves in the gardens.

Mr Buchan remarked that such summer-like weather had prevailed as far north as Iceland throughout the winter.

4. On the table were exhibited in bloom *Saxifraga Stracheyi*, a hardy plant, and *Soldanella montana*, a large seedling hardy form, from the forcing department of the Royal Botanic Garden. A fine stove plant from the same establishment, of a white texture and a pleasant perfume, *Posoqueria multiflora*, also excited much attention.

5. Sir Robert Christison had presented, in illustration of a previous paper, a prismatic section from the diameter of a yew 237 years old from Inch Lonaig, Loch Lomond.

6. Lord Strathmore also sent a section at 2 feet 6 inches from the roots of a larch blown down at Glamis Castle in the Tay Bridge

storm on December 28, 1879. The tree was 109 feet high. Its trunk measured 12 feet 5 inches in girth at 5 feet above roots. This section measured 12 feet 10 inches over bark, and 12 feet 4 inches round the wood. It shows 107 annual rings of wood, indicating 110 to 112 years for the age of the tree.

7. A section, taken 3 feet from the roots, of *Arenga saccharifera*, cut down in the palm-house of the Royal Botanic Garden when 60 feet in height. Owing to the quantity of the starchy matters and other vegetable juices in the stem of this palm, such a section is very difficult to make, this being the only successful one of many attempted.

Thursday, 8th April 1880.—Dr Wm. Craig, Vice-President, in the Chair.

The following Candidates were elected Resident Fellows:—

Dr Andrew Wilson, F.R.S.E., Surgeons' Hall.
John M'Laren, junior, Secretary, Scottish Arboricultural Society.
James Greig, of Messrs Dickson & Sons.
B. N. Peach, A.R.S.M., F.G.S., of Her Majesty's Geological Survey.

The following Communications were made:—

I. *Note on the Flora of Colonsay, and List of Plants Collected July* 1879. By Mr Symington Grieve.

II. *Note on some New Zealand Plants recently presented to the University Herbarium*, by Mr J. F. Cheeseman, of the Museum, Auckland, New Zealand. By Mr Taylor.

This large collection includes beautiful typical specimens of *Haastia*, *Raoulia*, and other endemic New Zealand compositæ.

III. *On the Spontaneous Introduction of Aristotelia* (*Friesia*). By Hugh Cleghorn, M.D.

Dr Cleghorn exhibited twigs of *Aristotelia* (*Friesia*) *racemosa*, raised by Mr Martin, gardener at Wester Lea, Edinburgh, from a seed accidentally deposited in the stem of a New Zealand *Dicksonia*, where it germinated three years ago between the fronds 2 feet from the ground. The seedling was transferred to a pot, and is now in a greenhouse. It has not flowered, but is a robust plant 8½ feet high. This is a remarkable illustration of the spontaneous introduction of an exotic.

IV. *Report on Temperatures and on the Progress of Open-Air Vegetation at the Royal Botanic Garden for March.* By Mr John Sadler, Curator.

MISCELLANEOUS COMMUNICATIONS.

1. *The Past Winter in Arran.*—In the light of the frequent advocacy of our western coasts as suitable localities for the extensive growth of Australasian trees and shrubs, the following observations, communicated by the Rev. D. Landsborough, of Kilmarnock, may not be uninteresting :—Arran, it is well known, is not subject to the extreme falls of temperature so deadly to plant life on our eastern coasts. Accordingly, Australian and New Zealand genera supposed to be aliens to our usual British climate, grow freely in it. Mr Landsborough reported, regarding plants grown in the Cromla garden, near Corrie, one of the Blue Gums—the most hardy of which in Arran is the *Eucalyptus pendula*—hardly touched last winter, is sadly injured by this Two other kinds of gum-tree, raised from seed obtained from the Blue Mountains, New South Wales, have been planted. The very beautiful New Zealand fern, *Todea hymenophylloides*, has proved quite hardy, though not under the spray of a waterfall, as was thought necessary for the full development of *Todea superba.* The *Todea hymenophylloides* was planted only last summer, but grew at once, and the fronds of the mature plant promise to attain perhaps to the size of *Athyrim Filix-fœmina.* The fronds now are almost as green as during summer. The cordylines, *C. indivsa*, *C. australis*, and *C. Veitchii*, are all untouched by the frost ; so, too, are *Photinia serrulata*, *Desfontainea spinosa*, *Edwardsia grandiflora*, *Elæagnus japonica variegata.* A fine plant of the old single red camellia planted last year was also untouched, and was in flower all last month (twenty-five blooms), the flowers in perfect order. A cork tree—*Quercus suber*—and a plant which Mr Landsborough takes to be *Cunninghamia sinensis*, both growing for the last twenty years at Brodick Castle, are both uninjured by this winter's frost.

2. The following plants were on the table in bloom from the forcing department of the Royal Botanic Garden :—*Anigosanthus breviflorus,* raised from seed sent by Surgeon-Major Fleming from Natal, where this Amaryllidaceous plant proved poisonous to horses of Her Majesty's troops ; an Iberis from mountains above Crasse, obtained from G. Maw, Esq.; an *Erythronium Nuttallianum;* and a new variety of seedling from *Primula ciliata,* which it is proposed to designate *P. ciliata var. Balfouriana.*

Thursday, 13*th May* 1880.—Mr WILLIAM GORRIE, President, in the Chair.

The deaths of Miss Frances Hope, a Lady Associate, and of Professor N. I. Andersson of Stockholm, a Foreign Member of the Society, were noted.

The following Communications were read :—

I. *Microscopic Demonstration of the Fungus* (Saprolegnia ferax) *of the Salmon Disease.* By Mr A. B. STIRLING, Assistant Curator of Anatomical Museum, University of Edinburgh. Communicated by Professor DICKSON.

Several of the suite of specimens lately presented by Mr Stirling to the museum of the Royal Botanic Garden, and including preparations from the fish sent for exhibition to the January meeting by Mr G. Muirhead of Paxton, Berwick-on-Tweed, were exhibited under the microscope. The mode of propagation of this *Saprolegnia,* and the way in which Mr Stirling holds that it destroys salmon and other fresh water fish in our rivers, were demonstrated. Professor Dickson, in explanation, said that the saprolegniæ were closely allied in their general structure to such algæ as *Vaucheria.* They consisted, like *Vaucheria,* of branching filaments, which, however, were continuously tubular, differing in that respect from the articulated filaments which occurred usually in fungi. Like *Vaucheria, Saprolegnia* was reproduced both sexually and nonsexually, in the latter process by Zoospores, which, when set free, were capable of moving in the surrounding water. These Zoospores were produced in enormous numbers, and must tend widely to disseminate the species.

II. *Note on the Flora of Mount Zomba, Central Africa.* By Mr JOHN BUCHANAN.

Mr Taylor exhibited 30 mounted specimens of plants from Mount Zomba, Central Africa, from a series of over 160 specimens sent to the Herbarium by Mr John Buchanan of the Church of Scotland Mission there. The collection had left Central Africa on the 6th July 1879, having previously been collected on varied sites, as on the banks of streams, and from latitudes of 7000 feet in the Shire highlands.

Professors Balfour and Dickson both spoke of the scientific value of the specimens communicated, at the same time commending the zeal and perseverance of this solitary explorer.

III. *Note on a New Method of Drying Plants.* By Mr JOHN GALLETLY, Chemist, Addiewell. Communicated by Mr TAYLOR.

Mr Taylor read a note on a new method of drying plants on paraffinised paper proposed by Mr John Galletly, chemist, Addiewell. Ordinary paper, preferably thin in texture, is dipped in a bath of liquid paraffin of a high melting point, and hung up to dry at the ordinary temperature; when so, it will assume a waxy appearance, and be ready for use. The green parts specially of the plants collected are covered by an absorbent material, and smoothed over by a hot smoothing iron, to take out their moisture. The flattened plant is next placed directly on the paraffinised paper, covered, and again pressed by the hot iron. The paraffin is thus temporarily made liquid, when it encrusts the plant in the way mosses and ferns are fossilised in mineral springs. When the paraffin cools, the plants are covered over by an enclosing envelope of paraffin, preventing atmospheric action on its constituents, and fixing it on the paper. The plant cannot suffer by this process, as paraffin melts at a lower temperature than that which destroys organic tissue.

IV. *Report on Temperatures and on the Progress of Open-air Vegetation at the Royal Botanic Garden.* By Mr JOHN SADLER, Curator.

MISCELLANEOUS COMMUNICATIONS.

1. Dr Cleghorn exhibited a fine specimen of *Aristotelia racemosa* 8½ feet high, of which twigs had been exhibited at last meeting.

The plant had been presented to the Royal Botanic Garden by Mr Charles Cowan of Westerlea, Murrayfield, in whose greenhouse it accidentally came up, and was afterwards cultivated.

2. Mr Hugh Johnstone, manager of Messrs Dickson & Son's nurseries, Leith Walk, exhibited a double spathed *Anthurium Schœrtzerianum.*

3. The Rev. Hugh Taylor, Humsheugh, Northumberland, sent a double spathe of *Calla œthiopica.*

4. Mr John Campbell of Ledaig sent a number of flower sprays from his garden. Whilst a number were in bloom also in the Edinburgh district, two represented by fine Ledaig specimens, viz., *Eurybia argophylla* and of *Escallonia macrantha* had succumbed to the severe spring weather of the east coast.

5. Mr M. Dunn, Dalkeith, exhibited a magnificent specimen of the *Morchella esculenta* picked up by Mr Foreman in the woods round Eskbank.

6. Mr Symington Grieve sent fungi picked two days previously from a cave in the island of Colonsay, 90 feet from the surface, where they grew in darkness.

7. There was also exhibited a handsome box made of cocoa-nut palm with Jack-wood lid, presented to the museum of the Royal Botanic Garden by Dr Thomson, Medical Missionary, Travancore. This had been gifted to the donor by the brother of the Dewan of Travancore.

8. On the table were numerous hardy and herbaceous plants, many Alpine, from the propagating department of the Royal Botanic Garden, including *Saxifraga M'Nabiana, Darlingtonia californica, Primula sikkimensis, P. piedmontana, Daphne striata,* and *Meconopsis aculeata.*

Thursday, 10*th June* 1880.—Mr William Gorrie, President, in the Chair.

The following Candidate was elected a Resident Fellow:—

W. C. M'Intosh, M.D., F.R.S.E., F.L.S., Murthly, Perthshire.

The following Communications were read:—

I. *Remarks on* Rheum nobile, *Hook. fil., which has flowered in the Royal Botanic Garden, Edinburgh.* Illustrated with Coloured Drawings by Miss Woon. By Dr Balfour, F.R.S., Emeritus Professor of Botany.

Dr Cleghorn had seen *Rheum emodi*, Wall., and *R. Mooncroftianum*, Meisn., when crossing the Western Himalaya. The hillmen were in the habit of using the leaf stalks as an agreeably acid and cooling salad. They shaded their eyes with the round leaves when threatened with snow blindness. The roots of both species are larger and less spongy when found on the northern aspect and in a dry climate.

Rheum nobile, Hook., is certainly a noble plant with its pyramidal stem 3 feet in height. It is quite different in habit from its congeners, and is apparently confined to Sikkim. The exposed situation it occupies in the Botanic Garden seems to suit the plant well. The flowering of this plant in Edinburgh so long after its discovery in Sikkim by Sir Joseph Hooker, and its introduction to this country, is extremely interesting.

II. *New Forestry Inquiries established by the Conservator of Forests in Oudh.* By Sir Robert Christison, Bart.

Captain Wood of the Oudh Forest Conservancy has determined to undertake an inquiry into the objects contemplated in my first paper on the "Exact Measurement of Trees," and for that purpose has sent copies of the directions for exact measurement to the whole districts under his charge, desiring his subordinate officers to make preparations for an inquiry in each.

With that view Captain Wood has issued instructions to set apart in each forest district a plot of a quarter of an acre, which is to be duly trenched all round for drainage and separation, and in which the trees are to be cut down or planted, so that each tree fixed on for observation shall be 15 feet distant from every other. Directions are also given for numbering the trees and tabulating the results, and the requisite instruments are supplied by the Conservancy Establishment. Lastly, instructions are added for noting all peculiarities of soil, climate, elevation, exposure, and treatment.

It seems to me right that, through the "Transactions" of the Society, intimation of the proceedings in the Oudh Conservancy should be made known to our numerous forest owners at home, in the hope that the example thus first shown at a distance may be speedily followed in our neighbourhood. I cannot doubt that ere long important results would thus be obtained for the advancement of tree culture.

III. *Notice of a Trip with the Scottish Alpine Botanical Club, in July* 1879, *to Killin and district.* By W. B. Boyd, Esq. of Ormiston House.

The summer excursion of this club was fixed for Killin, where we met at the Bridge of Lochy Hotel, on Wednesday, 30th of July, for the purpose of exploring the upper portion of Glen Lochy, which had never previously been visited by the members of this club.

The glen, as far as Mael Girdy on the one side, and Corrie Gouchler on the other, had frequently on previous occasions been visited, and the results recorded in the Botanical Society's "Transactions," but on this occasion it was proposed to confine our researches to the upper portion of the valley. The day of meeting was a most lovely one, and we were in great hopes that the weather would continue fine during the excursion. In this, however, we were disappointed, as Thursday, Friday, and Monday were all wet, misty, and disagreeable, the only fine day being the Saturday, which was bright and sunny, and, coming after the rain of the previous days, rendered the atmosphere so clear that the view from the heights was very extensive. Bridge of Lochy Hotel is a favourite resort of botanists, being so conveniently situated for the Breadalbane mountains, which are supposed to be more productive of botanical rarities than any other hills in Scotland, to say nothing of the careful manner in which all the wants of the botanists are supplied by the most attentive of hostesses.

Notwithstanding the wet morning on Thursday, all the members present turned out, and drove up the glen for about five or six miles to Glen Lochy Farmhouse, where we left the carriages; from this point we crossed the river to the south side and commenced the ascent of Mael Chuirn, which hill was said to have some fine rocks near its summit. The day, however, got so wet and misty, that, although we had a burn to guide us, it was with the greatest difficulty we could find the rocks, never being able to see more than fifty yards in front of us, and only reached them after a deal of searching in the mist.

Most of the plants common to the district were met with, and *Cystopteris montana* was seen in small quantity as well as *Bartsia alpina;* after a few hours of very disagreeable climbing, most of the party returned homewards to the carriages, not a little anxious at the non-appearance of two of our number, who, however, turned up later in the evening, having missed their way in the mist and landed in Glen Dochart instead of Glen Lochy, where we had started in the morning.

Friday morning was just such another day, and only one or two of the party ventured out. Another corrie on the same or south side of the glen was made for, but nothing of importance was got except a very pretty variety of *Saxifraga hypnoides*, the white petals of which were each tipped with most beautiful rose colour; this plant, however, I am sorry to say, has not retained this peculiar character to any great extent under cultivation. *Cystopteris montana* was seen in small quantity on this excursion also.

Saturday was the great day of the meeting, and a more glorious morning could not be, the sun shining out brightly, made everything look fresh and beautiful after the rain of the previous day. The drive was again to Mr Willison's farm, who, I may say, not only on this but on the previous occasion, was most hospitable, supplying everything that was nice in the shape of scones and cheese and delightful new milk, as well as a little of the wine of the country. He also very kindly provided us with a guide. The object of this day's work was to investigate the Forest of Mamlorn, which lies at the very head of the Lochy Glen to the north, and is entered near the base of Ben Challum. Craig Mhor, 3305 feet above the level of the sea, rises in the centre of the forest, and round the base of this mountain the best botanising ground was situated. After walking about five or six miles from where we had left our carriages, we reached the Forest of Mamlorn, and were not long in finding good rocks, where, to our great delight, the finest masses of *Cystopteris montana* were found; this place seems to be the headquarters of this fern, as nowhere else has it been seen in the same profusion and in such large sheets without any admixture of grass, &c., with which it is usually found mixed. At this place I saw one mass 12 feet long by 1½ foot wide, nothing but fronds, and perfectly free from weeds, and a most beautiful sight it was, for when grown (as it was here) in a shady damp situation, it almost rivals *Polypodium Dryopteris* in delicate beauty and freshness. *Bartsia alpina* was seen here also, and some of the members were fortunate in getting a few plants of *Woodsia hyperborea* at these first rocks, and *Juncus castaneus* was also gathered by more than one of the party. In wending our way upwards we reached the first ridge on Craig Mhor, from which the view was fine in the extreme—the atmosphere was so clear that we could see a distance of thirty or forty miles quite distinctly. Some of the party went to the top of Craig Mhor, from which the view was even finer. Nothing of any importance could be seen to the south-east, as the close proximity of high hills in that direction shut out the distance, but the view to the north-west was open as far as the Morven Hills, and between which and where we were we recognised Ben Doran, Ben Lui, Ben Cruachan, and all the Black Mount Forest Hills, and also a number of lochs, among them Loch Tullich, Loch Awe, Loch Etive, and Loch Linnhe; and on the south Ben More and Bunion were quite at hand. After lunch the party commenced their return along a different ledge of rock; although not nearly so steep as those gone over in the forenoon, they proved to be more productive, for here we were fortunate in finding other three different localities for *Woodsia hyperborea* in fine strong vigorous plants. *Dryas octopetala* was found over all the rocks in this part, and *Veronica saxatilis* in considerable plenty. One of the party was fortunate enough to obtain a most beautiful variety of *Veronica saxatilis* with pink petals, which I believe Mr Lindsay is cultivating in the Botanic Garden, but I am not aware whether it has flowered with him this summer or not. This forest is well worthy of further exploration, as the extent was so great that we had not time to do it justice in one day. During the return walk to the carriages several fine orchids were gathered, *Gymnadenia albida* and *Habenaria viridis* being the most important. Bridge of Lochy was reached late in the evening, after a most enjoyable day, and all were well appetised for dinner, which was waiting our arrival, and delighted with the day's excursion.

Monday, again, was wet, and some of the members began to disperse by the morning train, the others broke up the meeting and returned to town in the afternoon.

I may mention that *Arctostaphylos Uva-ursi* was gathered day during the meeting, showing its general distribution in this part of the country.

Mr Potts of Fettes Mount, showed, amongst other growing plants, a Saxifrage found on a spur of the Cairn Gorm Mountains near Dalwhinnie in 1877, which still retained its peculiar copper-orange colour under cultivation. Mr Boyd named the plant *Saxifraga azoides* var. *aurantia* of Wood's "European Tourists' Flora." It was common on certain stations on the Alps, but previously unknown in Britain.

IV. *Exhibition and Description of Plant Novelties cultivated at Hay Lodge, Trinity.* By ISAAC ANDERSON-HENRY, Esq., F.L.S., &c.

Exarrhena Lyallii.—This plant was sent to me in seeds from my correspondent in New Zealand, under the name of *Exarrhena Lyallii*, a plant allied pretty closely to the Myosotis tribe. The seeds were sent to me from the Middle Island, and two plants of it stood on my Rockery all last winter. It is one of the most manageable of New Zealand plants; and is a perennial with large panicles of white flowers.

Morina Coulteriana.—I am indebted to Sir Joseph Hooker for the specific name of this yellow-flowered species of Morina, the seeds of which, with the seeds of *M. Wallichii* and of another species of Morina, were sent to me by my niece, Mrs Augustus Johnstone, from Kashmir some three years ago. I understand that it is wholly new to this country. It has stood along with *M. Wallichii* in the open ground these two by-past winters, and so is undoubtedly hardy.

Thymus sp.—The plant I now direct your attention to is a species of Thyme, the seeds of which were sent home from Afghanistan last year as seeds of a "purple flowered Labiate." It is for you to say, now it is in flower, whether it be a new species; it is strongly perfumed.

Along with seeds of the above, I had seeds of other very interesting things from Afghanistan. In particular I had seeds of the following plants, now in fair growth with me though sown as late as November 1879, viz.:—Borago, two species, *Codonopsis ovata*, Rheum species, Liliaceæ from 12–14,000 feet, Althæa species, Wild Celery, Primula species at 9000 feet, also another yellow Morina.

Veronica Lyallii.—This pretty little shrub, which my gardener uplifted from the outside border, all studded over with flowers as you see it now, is *Veronica Lyallii.* These flowers are pure white and streaked all over with pink veins, each flower being quite circular and rather more than half an inch across. It is found growing in the Northern Island of New Zealand at a height of from 2000 to 4000 feet above the level of the sea; it seems perfectly hardy in our climate in ordinary seasons, a plant of it having stood on my Rockery all last winter. I sowed the seeds about three years ago. It is only now about 8 inches high. One plant flowered partially with me last year from a sprig of which Sir Joseph Hooker figured it in the Botanical Magazine, tab. 6456. The height he assigns to it in his "Flora of New Zealand" is 5 to 15 inches.

Veronica diosmæfolia.—This shrub, with pretty decussate foliage, and flowering at a height of some 8 inches, is stated by Sir J. Hooker, in his "Flora of New Zealand," to attain a height of from 3 to 12 feet. But it has the great advantage of flowering early; for I sowed the seed so late as July 1877. It has another valuable property of continuing very long in bloom. The true habit is best shown in the accompanying plant of the same species not in flower. The flowers you see are a pretty pink. It is also an inhabitant of the Northern island of New Zealand, but is not so hardy as *V. Lyallii.*

V. *Report on the effects of last winter on Vegetation in different parts of Scotland, and on the progress of Open-Air Vegetation at the Royal Botanic Garden from the beginning of May.* By Mr JOHN SADLER, Curator.

Mr Buchan, with reference to these reports, mentioned that at Springwood Park, Kelso, a reading had been taken at 16° below zero, which was 4° lower than any reading that, so far as he was aware, had ever been registered in the British Islands, being in reality considerably lower than that reported from Ormiston, which was obtained on an exposed thermometer, while at Kelso the instrument was protected.

Mr M. Dunn showed a branch of holly berries in full maturity. Such an extraordinary phenomenon of the season he accounted for by the death of birds,—whose winter food these berries are,—owing to the severe temperatures of the winter 1879–80.

MISCELLANEOUS COMMUNICATIONS.

1. Mrs Bain of Napier Road, Merchiston, exhibited a splendidly developed specimen of the Edelweiss grown in her garden.

2. Mr Campbell of Ledaig, Argyleshire, sent strawberries which had ripened with him in the open ground at the 29th of May.

3. The president gave to the garden specimens of the *Lavatera arborea*, two varieties; and a specimen of the variegated *Holcus mollis* got by him in Prestonkirk, Mid-Lothian.

4. The Rev. John Stevenson of Glamis, Forfarshire, sent a fine specimen of *Hypocrea parmeliodes*, Mont (*H. ricciodea*, Berk, *Sphaeri ricciodea*, Bolt) for the Herbarium. This plant is figured in "Todes Fungi Mecklenbergensis," and also in "Annales des Sciences Naturelles," by Montague, to whom it was sent from Limoges by M. Larmy. The specimen now presented had been given to the donor by Mr James M'Andrew, who had found it in New Galloway in 1878. The Rev. Mr Berkeley makes the only previous record of it in England to have been in February 1790.

5. Mr W. P. Drummond intimated that his firm were exhibiting a specimen of *Lilium giganteum* in flower about 8 feet high.

6. W. B. Boyd, Esq., of Ormiston House, showed a beautiful abnormal form of the common daisy.

7. A section of an oak 145 years old, was exhibited, which had been felled in the spring of 1879 at Cammo, at 2 feet from the roots. The centre was considerably decayed for 2 feet nearly,

The longest diameter of the wood is 37·4 inches; transverse 35·0; long radius of that diameter 19·8 inches; short 17·6; girth over bark 9 feet 3½ inches. This specimen had been presented to the Botanical Museum by Alexander Campbell, Esq., through the agency of Sir Robert Christison, Bart., who had also subjoined to the specimen a scale one-half the natural dimensions, showing the relative width of the annual layers of both radii of one diameter by decades of years.

8. Amongst the plants in pots exhibited from the garden were :—

Androsace Chamæjasme.
Dianthus alpinus.
  neglectus.
Edraianthus Kitaibeli.
Fritillaria Kamschatica.
Gypsophila cerastoides.
Hutchinsia alpina.
Linaria origanifolia.
Myosotis alpestris.
Oxytropus montanus.
Primula sikkimensis.
  mollis.
Primula scotica.
  farinosa.
  capitata.
Senecio speciosus, a magnificent new groundsell from the Cape of Good Hope.
Saxifraga cæsia.
  squarrosa.
  M'Nabiana.
  mutata.
Veronica Lyalli.

The following had been collected during the previous summer by the Scottish Alpine Botanical Club :—

Cystopteris montana.
Woodsia hyperborea.
Juncus castanea.
Purple form of Veronica saxatilis.
Red form of Saxifraga hypnoides.
Dryas octopetala.

Thursday, 8th July.—Mr Wm. Gorrie, President, in the Chair.

The following Candidate was elected a non-Resident Fellow :

The Rev. Thomas Barty, M.A., The Manse, Kirkholm.

The following Communications were read :—

I. *Further Notes on New Zealand Plants, cultivated at Rait Lodge, near Trinity, which withstood the winter* 1879–80. By the President.

II. *The Flowering Plants of New Zealand and their relation to the Insect Fauna.* By George M. Thomson, F.L.S., Dunedin, New Zealand. Communicated by Professor Balfour.

In the subsequent discussion Isaac Anderson-Henry, Esq., suggested that the reason of their failure here to cultivate many New Zealand plants, otherwise compatible with our soil and seasons, might be the lack of their corresponding insects specially necessary for their fertilisation.

With reference to Mr Thomson's observations of insects visiting certain plants just as the day was sunshiny or not, Mr Taylor called attention to M. Gaston Bonier's observations made to the Botanical Society of France. He had noted how the Hymenoptera actively visit certain plants in Norway which they desert in the latitude of Paris. The species so distinguished were *Hieracium Pilosella*, L.; *Campanula rotundifolia*, L.; *Geum urbanum*, L.; *Potentilla Tormentilla*, Nesk.

Bonier argued that the production of nectar in these plants in the north was owing to the larger amount of sunshine they experienced, caused by the greater length of the day. But in another paper he questioned if there was a necessary connection betwixt the visit of an insect and the fertilisation of a corresponding flower.

III. *Exhibition of* Geaster fornicatus. Sent by Dr Dyce Duckworth.

Dr Dyce Duckworth sent a fine specimen of the Fungus *Geaster fornicatus* to the Botanical Museum, which had been obtained at his house in Surrey.

IV. *Additional Observations on Tree Measurement.* By Sir Robert Christison, Bart.

Sir Robert Christison, Bart., made some supplementary observations to his papers on the exact measurement of trees, and which he promised to lay subsequently more at length before the Society. This season had been favourable to the growth of certain trees in the district, especially those of the coniferous order. From observations made since April 30 last, the *Cupressus Lawsonia* had increased in girth in several specimens over 1 inch to $1\frac{1}{10}$th inch; while three species of the Hungary Oak in the Royal Botanic Garden had similarly progressed to the extent of $\frac{6}{10}$ths of an inch. Some interesting details were given of an oak tree which had been thrown down by one of the sudden floods of last autumn near Cheltenham. At 3 feet from the ground it was 18 feet in girth, while the annual rings, taken by the method of De Condolle, pointed to an age of not less than 500 years. In conclusion, Sir Robert exhibited specimens from the Woods of Craigiehall near Edinburgh, showing great devastation to oaks by insect ravages. This woodman's plague, as subsequent speakers confirmed, was widely prevalent in the Edinburgh district, and had been known in some localities for three years.

V. *Report on the effects of last winter on Vegetation in different parts of Scotland, and on the progress of Open-Air Vegetation at the Royal Botanic Garden from the beginning of June.* By Mr JOHN SADLER, Curator.

MISCELLANEOUS COMMUNICATIONS.

1. The President exhibited two first and second year's plants of *Raphanus maritimus*, showing that it is at least of biennial duration. It is said by some to last for three years, although it has been questioned if it is really distinct from the strictly annual *Raphanus Rhaphanistrum*.

In Withering's "Botany" it is stated that the late Dr Walker, Professor of Natural History at Edinburgh so long ago as 1753, deemed it preferable to Horse Radish for the table, and found that cattle were fond of its herbage. When the young roots are cut into very small pieces and sparingly mixed with green salad, such as Lettuce, Mr Gorrie obtains a very decided and agreeable radish flavour. These roots are obtainable in perfection at periods when the common garden radish is not in season. One of the specimens was fully 4 feet high, and had not had room to spread. The original stock had been brought from the coast of Bute and Wemyss Bay in 1877. One of the specimens in Mr Gorrie's garden measured on August 24, 1878, 4 feet 2 inches high, while the spread of its lower branches was 8 feet 5 inches in diameter. This plant might profitably be cultivated for cattle feeding on exposed sandy coasts.

2. W. B. Boyd, Esq., of Ormiston House, exhibited a specimen of *Campanula pulchella*, displaying the change from a Gamopetalous to a Polypetalous corolla; a large branch more than a foot long of an etiolated form of the white Pelargonium, also a Campanula, showing on some of the corollas the hose-and-hose modification of structure a double headed Dandelion, and three flowers of a Calceolaria on one peduncle.

3. Isaac Anderson-Henry, Esq., exhibited and described some New Zealand plants in pots which he had just imported. They included :—

Ozothamnus selago.
nigra.
Veronica lycopoiodes.
Veronica Hectorii.
Bidiwillii.

4. P. Neill Fraser, Esq., exhibited a bottle of seeds which had come in the same ship with Mr Henry's plants, at the same time presenting a selection to the Royal Botanic Garden. He also showed a purple Foxglove which had been found in his garden at Rockville, one longitudinal row of the corollas being pure white.

5. A fine specimen of the fungus *Polyporus squamosus,* weighing 10½ lb. avoirdupois, was exhibited. It had been taken from an old Sycamore tree in the Edinburgh Arboretum.

6. Amongst the plants in pots on the table from the garden were :—

Campanula garganica alba.
Dianthus alpinus.
deltoides.*
barbatus.*
Gentiana ornata.
Gladiolus serotinus.
Orchis hircina
Primula farinosa superba.
Potentilla alchemilloides.
Petrocoptis Lagcascæ alba.
Ranunculus repens (straw-coloured variety, found last year by Professor Dickson).
Spiræa cœspitosa.
Silene quadridentata.
Saxifraga caroliniana.

ADDITIONS

TO THE

LIBRARY, HERBARIUM, AND MUSEUM,

AT THE

ROYAL BOTANIC GARDEN, EDINBURGH,

FROM 30TH NOVEMBER 1879 TO 1ST OCTOBER 1880.

I.—LIBRARY.

BOOKS.

AGARDH, J. G. Florideernes Morphologè. Af J. G. Agardh. Med. 33 Taflor. Till Kongl. Vetenskaps-Akademien inlemnad den 12 December 1877. Stockholm, 1879.—*From the Author.*

BENTHAM, GEORGE. Flora Australiensis: A Description of the Plants of the Australian Territory. By George Bentham, F.R.S., F.L.S., assisted by Ferdinand Mueller, M.D., F.R.S., and L.S , Government Botanist, Melbourne, Victoria. 7 vols. London, 1863 to 1878.—*From the Author.*

BINGLEY, Rev. W. A. M., F.L.S. A Practical Introduction to Botany ; also, a Glossary of Botanic Terms. London, 1817.—*From Dr Gilchrist, Dumfries.*

BRIGGS, T. R. ARCHER. Flora of Plymouth : An Account of the Flowering Plants and Ferns found within Twelve Miles of the Town, with Brief Sketches of the Topography, Geology, and Climate of the Area, and History of Local Botanical Investigation, with Map. London, 1880.—*From the Author.*

BROWN, JAMES, LL.D. The Forester. 4th ed. Edinr., 1871. —*Purchased.*

BURBRIDGE, F. W., and BAKER, J. G. The Narcissus ; its History and Culture. London, 1875.—*Purchased.*

ECKLON AND ZEYHER. Enumeratio Plantarum Africæ Australis Extratropicæ. Hamburg, 1835.—*From Mr Thomas Walker, Carluke.*

GERARD, JOHN. Gerard's Herbal. Edition 1597.—*From Ex-Councillor Stephen Wellstood, Edinburgh.*

GORDON, GEORGE. The Pinetum: A Synopsis of all the known Coniferous Plants. New ed. London, 1880.—*Purchased.*

HOOKER, J. D. The Flora of British India. Part 7. (*Araliaceæ to Rubiaceæ.*) London, 1880.—*From the Indian Office.*

HOOKER, W. J. The British Flora. Vol. I. London, 1835.—*From Dr Gilchrist, Dumfries.*

LILJEBALD, SAMUEL. Svensk Flora. Upsala, 1798.—*From Dr Gilchrist, Dumfries.*

LOUDON, J. C. An Encyclopædia of Gardening. New ed. Edited by Mrs Loudon. London, 1878.

——— An Encyclopædia of Plants. Ed. by Mrs Loudon. New Imp. London, 1872.

——— Trees and Shrubs of Great Britain. London, 1875.

——— Mrs. The Ladies Flower Garden of Ornamental Annuals. 2d ed. London, N.D.—*Purchased.*

MARTYN, Prof. THOS. The Language of Botany: A Dictionary of Terms. 3d edition. London, 1807.—*From Dr Gilchrist, Dumfries.*

MUELLER, FERD. VON. Eucalyptographia: A Descriptive Atlas of the Eucalypts of Australia and the adjoining Islands. Decades I. to V. Melbourne, 1879.—*From the Author.*

ORMEROD, ELEANOR A. The Cobham Journals. Abstracts and Summaries of Meteorological and Phenological Observations made by Miss Caroline Molesworth at Cobham, Surrey, in the years 1825 to 1850, with Introduction, Tables, &c., by Eleanor A. Ormerod. London, 1880.—*From Miss Ormerod.*

PICKERING, Dr CHARLES. Chronological History of Plants: Man's Record of his Own Existence. Boston, 1879.—*From Mrs Pickering.*

SARGENT, CHARLES S. A Catalogue of the Forest Trees of North America. Washington, U.S.A., 1880.—*From the Author.*

STEUART, SIR HENRY, Bart. The Planter's Guide. 3d ed. Edinr., 1868.—*Purchased.*

WALKER, RICHARD. The Flora of Oxfordshire and the Contiguous Counties; illustrated. Oxford, 1833.—*From Mr Thomas Walker, Carluke.*

WILDENOW. Principles of Botany and of Vegetable Physiology. Edinburgh, 1811.—*From Dr Gilchrist, Dumfries.*

WITHERING. British Botany. 4 vols. Birmingham, 1878.—*From Dr Gilchrist, Dumfries.*

PAMPHLETS, REPRINTS FROM SCIENTIFIC PUBLICATIONS, &c.

Agardh, J. G. Om Linnes Betydelse i Botanikens Historia Med. Anledning af Linné. Festen i Lund den 10 Januari 1878. Lund, 1878.—*From the Author.*

Balfour, Dr J. H. Remarks on some Species of Rheum cultivated in the Edinburgh Royal Botanic Garden. (Ex.—"Trans. Edin. Bot. Soc.," Vol. XIII.)—*From the Author.*

——— Remarks on a Specimen of *Rheum nobile* (Hook *fil* and Thomson) which has flowered in the Royal Botanic Garden, Edinburgh, in the summer of 1880. (Ex.—"Trans. Edin. Bot. Soc.," Vol. XIV.) Large paper, coloured plate.—*From the Author.*

——— Eleven Duplicate Copies of Accounts of Botanical Excursions with Class, principally in the years 1873 to 1875.—*From the Author.*

Lindberg, S. O. Musci Scandinavici in systemate Novo Naturali Dispositi sumptibus suis Edidit. Upsala Botaniska Bytesfirening.

——— Musci Nonnulli Scandinavici Descripti (Meddel af Societas pro Fauna et Flora feninca 5.) 1879.

——— Öfvergang af Honorgan till Hanorgan hos en Bladmossa. T. Aff. XI. (Ofversigt af Kong Vetenskaps-Akademiens Förhandligar. 1879, No. 5. Stockholm.)—*From the Author.*

Nederlandsche Maatschappij. Programma van de Nederlandsche Maatschappij ter Bevodering van Nijverliend. 1880.—*From the Society.*

Ormerod, Eleanor A. Notes of Observations of Injurious Insects. Reports 1877, 1878, 1879.

——— Notes for Observations of Injurious Insects.—*From the Author.*

Sadler, John. Report on Temperatures and on Open Air Vegetation in Royal Botanic Garden, 1878-9. (Ex.—"Trans. Edin. Bot. Soc.," Vol. XIII.) 2 Copies.—*From the Author.*

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

Adelaide.—Botanic Garden and Government Plantations.

Report of Progress and Condition during 1879.—*From Sir R. Christison.*

BERNE.—Naturforschende Gesellschaft.
Mittheilungen. 1879, Nos. 937–61.—*From the Society.*
Société Helvétique des Sciences Naturelles.
Actes. Sessions 61, 62 (St Gallen).—*From the Society.*

BERWICK.—Berwickshire Naturalists' Club.
Proceedings, Vol. IX. No. 1, 1879.—*From the Club.*

BOSTON.—Boston Society of Natural History.
Proceedings. Vol. XIX. Parts 3–4; Vol. XX. Parts 1–3.
Memoirs. Vol. III. Parts 1–3.
Occasional Papers. No. III. Contributions to the Geology of Eastern Massachusetts. By W. O. Crossby.—*From the Society.*

BRAUNSCHWEIG.—Yahresbericht des Vereins fur Naturwissenschaft zu fur Geschaftsjahr, 1879–80.—*From the Society.*

BREMEN.—Naturwissenschaftlicher Verein.
Abhandlungen. Band VI. Hefte 2 and 3.
Beilage. No. 7.—*From the Society.*

COPENHAGEN.—Botaniske Forening i Kobenhavn.
Botaniske Tidsskrift (Journal de Botanique). Series III. Vol. XII. Liv. 1.—*From the Society.*

EDINBURGH.—Botanical Society.
Transactions and Proceedings. Vol. XIII. Part 3, 1879.—*From the Society.*
Royal Society.
Transactions. Vol. XXVIII. Part 3, 1877–78; Vol. XXIX. Part 1, 1878–79.
Proceedings. Session 1878–79.—*From the Society.*
Scottish Arboricultural Society.
Transactions. Vol. IX. Part 2, 1879.—*From the Society.*

GLASGOW.—Natural History Society.
Proceedings. Vol. IV. Part 1.—*From the Society.*

HAARLEM.—Bevordering van Nijverheid.
Tijdschrift. 4e Reeks, Deel IV. Ap. to Sept. 1880.—*From the Society.*

HALLE.—Kais Leop. Carol.
Deutsche Akademie der Naturforscher, Nova Acta. Band XL. Nos. 5 and 7.—*From the Academy.*
Musée Teyler.—Archives. Vol. V. Pt. 2—*From the Corporation.*

LAHORE.—Report by the Superintendent of the Punjab Agri-Horticultural Society's Gardens, Lahore, for the year 1879–80.—*From W. Coldstream, Esq.*

LEEDS.—Yorkshire Naturalists' Union.
Transactions. Parts 1–3.—*From the Union.*

LONDON.—India Office—Forest Department.

Reports for 1878–9.—*From the India Office.*

Linnean Society.

Transactions. (Botany.) Series II. Vol. I. Part 7–9.

Journal. Nos. 104–108.—*From the Society.*

Pharmaceutical Society.

Journal and Transactions. Vols. X., XI. Nos 484, 536.—*From the Society.*

Quekett Microscopical Club.

Journal. Nos. 42, 43.—*From the Club.*

MADRAS.—Proceedings of Meetings of Committee of the Agri-Horticultural Society of Madras held at the Gardens in 1879.—*From Dr J. H. Balfour.*

MELBOURNE.—Transactions and Proceedings of the Royal Society of Victoria. Vol. XVI.—*From the Society.*

NEWHAVEN.—Connecticut Academy of Arts and Sciences. Trans. Vol. V. Part 1.—*From the Academy.*

NEW YORK.—New York Academy of Sciences.

Annals. Vol. I. Nos. 5–8.—*From the Academy.*

NORWICH.—Norfolk and Norwich Naturalists' Society.

Transactions. Vol. III. Part 1, 1880.—*From the Society.*

PARIS.—Société Botanique de France.

Bulletin. Revue Bibliographique. Tom. XXVI. C-D, E.; Tom. XXVII. A.B.

Comptes rendus. Tom. XXVI. 1–3; Tom. XXVII. 1–3.

Session extraordinaire à Aurillac, 1879.

Table des Matières, Tom. XXVI.—*From the Society.*

PETERSBURG, ST.—Hortus Imp. Bot. Petropolitanus.

Acta. Tom. VI. Fasc. 2, 1879.—*From the Directors.*

PHILADELPHIA.—Academy of Natural Sciences.

Proceedings. Parts 1–3, 1879.—*From the Academy.*

PLYMOUTH.—Plymouth Institution and Devon and Cornwall Natural History Society.

Transactions. Vol. VII. Part 2, 1879–80.—*From the Society.*

UPSAL.—Société Royale des Sciences.

Nova Acta. Ser. III. Vol. X. Fasc. 1 and 2.—*From the Royal Society of Sweden.*

WASHINGTON.—Smithsonian Institution.

Report of Board of Regents, 1878. —*From the Institute.*

U.S. Geological Survey of the Territories.

Annual Report. No. 2, 1877.—*From F. V. Hayden, U.S. Geologist.*

Watford.—Natural History Society and Hertfordshire Field Club. Transactions. Vol. II. Parts 7 and 8.—*From the Society.*

Wellington.—New Zealand Institute.

Transactions and Proceedings. Vol. XII. 1879.—*From the Institute.*

PERIODICALS.

Gaceta cientifica de Venezuela.—*From Sig. A. Ernst.*

The Garden. Nos. 411–462.—*Purchased.*

The Gardeners' Chronicle. Nos. 301–352.—*Purchased.*

Grevillea. Edited by Dr M. C. Cooke. Nos. 46–49.—*Purchased.*

The Journal of Botany. Nos. 192–214.—*Purchased.*

The Journal of Forestry.—*From the Proprietors.*

Nature. Nos. 518–570.—*From the Editor.*

The Scottish Naturalist. Edited by Dr F. B. White. Nos. 36–40. *From Perthshire Society of Natural Science.*

Curtis's Botanical Magazine. Vol. XXXV. et seq.—*Purchased.*

II.—DONATIONS TO THE HERBARIUM.

Balfour, Dr J. H. Oblong Book containing 70 specimens of Dried Plants, arranged according to the Linnean System.

Bennet, A. Three specimens of rare Chara from Filly-Broad, E. Norfolk—viz., *Chara stelligera* (Bauer), *C. obtusa* (Desv.), *Nitella stelligera* (Kütz.)—collected Sept. 1880.

Buchanan, John. A Collection of about 166 specimens of Phanerogams, collected by him in Shire Highlands and their vicinage; sent from Blantyre, Central Africa, July 6, 1879.

Christison, Dr David. Four specimens of Mio Mio—*Baccharis* sp. Herb. Kew, Gilbert, 65; poisonous to sheep; a powerful blister for horses; sent by Mr Hall, San Jorge, 1880.

Fendler, Dr. About 49 specimens of Trinidad Ferns. Set No. 17.—*Purchased.*

Gilchrist, Dr, Dumfries. Eight packages of Plants, containing nearly 500 specimens illustrative of Flora of Dumfriesshire and adjoining counties.

——— Two Packages of Mosses and Lichens from Norway. One Package of Jungermaniæ from Norway.

——— Ten Packages of Plants from English Lakes, Ireland, and other localities.

Holmes, E. H. A specimen of *Pertusaria globulifera*, found near Clayford, Devon, on 9th August 1880.

Kew Herbarium. About 150 specimens, chiefly Phanerogams, from the collections made by Officers of H.M.S. "Alert" and "Discovery" during the Arctic Expedition 1875–76.

Pipe, Miss. A fine specimen of *Vaccinium Vitis-Idea*, from Glen Affarie, Beauly. Collected 30th August 1880.

Società Crittogamologica Italiano. Erbario Crittogamico Italiano; Ser. II. Fascicolo XVIII., N. 851–900.—*Purchased.*

Stevenson, Rev. John, of Glamis. A fine specimen of *Hypocrea parmelioides*, Mont. (*H. Ricciodea*, Berk., *Sphæri riccioidea*, Bolt.)

III.—DONATIONS TO THE MUSEUM.

Campbell, Mr A., Burntisland. Walking stick made of the stem of *Verbascum Thapsus.*

Du Moulin, E. G. B. "Woody Pear" from New South Wales.

Duckworth, Dr Dyce. Specimen of Fungus (*Geaster fornicatus*).

Gunning, Dr. Collection of Leguminous and other Seeds.

Maberly, William Henry, of the Arboretum Hydropathic Establishment, Leamington. Acorns from Oaks in the Yosemite Valley, California.

——— Branch and Fruit of the "Woody Pear," from the Blue Mountains, near Sydney.

——— Bark of the *Wellingtonia gigantea*, from California.

——— Fruits and Seed of New Zealand Flax, Wellington.

——— Lichen and Cones from the Yosemite Valley, California.

——— Lycopodium, Lichen, and Alga, from near Hobart Town, Tasmania.

——— Spear Grass from near Canterbury, New Zealand.

——— Seeds of the Nisago Fruit, Honolulu, Sandwich Islands.

——— New Zealand Basket or Kit, made out of *Phormium Tenax.*

Macandrew, Herbert. A section of stem of Tree-Fern from New Zealand.

Purchas, A. C., Auckland, N. Z. Branch encrusted with Silica, from Hot Spring Country, North Island, New Zealand.

Reid, Dr. Lichen from Yosemite Valley, California.

Stenhouse, T. B., Cape Town. Leaves of the Silver Tree, from Table Mountain, South Africa.

Strathmore, Lord, per the Rev. J. Stevenson, Glamis Manse. A section of a Larch blown down at Glamis Castle in "Tay Bridge storm," 28th Dec. 1879.

Thomson, S., Travancore. Box made of skin of Coco nut Palm, with Jackwood lid.

Botanical Society of Edinburgh.

I.—GENERAL VIEWS AND OBJECTS OF THE SOCIETY.

The attention of the Society is turned to the whole range of Botanical Science, together with such parts of other branches of Natural History as are more immediately connected with it. These objects are cultivated :—

1. By holding Meetings for the interchange of botanical information,—for the reading of original papers or translations, abstracts or reviews of botanical works, regarding any branch of botanical knowledge, practical, physiological, geographical, and palæontological,—and the application of such knowledge to Agriculture and the Arts.

2. By publishing annually Proceedings and Transactions, including a List of Members and Donations.

3. By the formation in Edinburgh of an Herbarium of Foreign and British Plants, and of a Library and Museum for general consultation and reference.

4. By printing from time to time Catalogues of Plants, with the view of facilitating the study of their geographical distribution, and furthering the principle of exchange.

5. By making Botanical Excursions both in the neighbourhood of Edinburgh and to distant parts of Britain.

6. By appointing Local Secretaries, from amongst the Members of the Society, from whom, in their respective districts, all information regarding the Society's objects and proceedings may be obtained.

II.—LAWS OF THE SOCIETY.

CHAPTER I.

FUNDAMENTAL LAWS.

1. The Society shall be denominated "The Botanical Society of Edinburgh."

2. The object of the Society shall be the advancement of Botanical Science, by means of periodical meetings, publications, correspondence, and interchange of specimens amongst its Members.

3. The Society shall consist of Honorary, Resident, Non-Resident, Foreign, and Corresponding Members, who shall have the privilege of denominating themselves Fellows of the Society; also of Associates; and of Ladies, who shall be denominated Lady Associates.

CHAPTER II.

ORDINARY MEETINGS.

1. A Meeting of the Society shall be held on the Second Thursday of every month, from November to July inclusively.

2. Intimation of all papers to be brought before the Society must be given to the Secretary and submitted to the Council ten days at least previous to the Meeting at which they are to be read.

3. Any Member may transmit to the Society Papers and Communications, which, if approved of by the Council, may be read by the author, or, in his absence, by the President or Secretary at any of the Ordinary Meetings.

4. The following order of business shall be observed :—

PRIVATE BUSINESS.

1. Chair taken.
2. Minutes of Private Business of preceding Meeting read.
3. Report of Council read.
4. Applications for Admission read.
5. Members proposed at preceding Meeting balloted for.
6. Motions intimated at Previous Meetings discussed.
7. New motions intimated.
8. Miscellaneous Business.
9. Society adjourned.

PUBLIC BUSINESS.

1. Chair taken.
2. Laws signed by new Members.
3. Minutes of Public Business of preceding Meeting read.
4. Papers and Communications for next Meeting announced.
5. Specimens, Books, &c., presented.
6. Communications and Papers read.
7. Society adjourned.

CHAPTER III.

EXTRAORDINARY MEETINGS.

An Extraordinary Meeting of the Society may be called at any time, by authority of the Council, on the requisition of three or more Resident Fellows.

CHAPTER IV.

ADMISSION OF MEMBERS.

SECTION I.—HONORARY FELLOWS.

1. The Honorary Fellows shall be limited to six British and twenty-five Foreign,—by British, being understood British subjects, whether resident in the British Islands or not.

2. The Council shall have the privilege of proposing Honorary Fellows,—the names of the gentlemen proposed being always stated in the Billet calling the Meeting at which they are to be balloted for. The election to be determined by a majority of at least two-thirds of the votes, provided fifteen Fellows are present and vote.

3. Any Fellow may submit to the Council the names of individuals whom he would wish proposed as Honorary Fellows; and should the Council decline to bring these forward, he may demand that they be balloted for.

4. Honorary Fellows shall be entitled to all the privileges of Resident Fellows, and shall receive copies of the Transactions free of charge.

SECTION II.—RESIDENT FELLOWS.

1. A candidate for admission into the Society, as a Resident Fellow, must present an application, with a recommendation annexed, signed by at least two Resident Fellows. The application shall be read at the proper time during private business, and at the next Ordinary Meeting shall be determined by a majority of at least two-thirds of the votes, provided fifteen Fellows are present and vote.

2. Resident Fellows shall, on admission, sign the Laws, and pay the sum of Fifteen Shillings to the funds of the Society ; and shall contribute Fifteen Shillings annually thereafter at the November Meeting. Resident Fellows are entitled to receive the Transactions provided their subscriptions are paid.

3. Resident Fellows may at any time compound for their annual contributions by payment of Six Guineas. They shall be entitled to receive the Transactions yearly as published.

4. Resident Fellows leaving Edinburgh may be enrolled as Non-Resident Fellows, if they have paid by annual subscriptions the sum of Six Guineas, and have also paid any arrears due at their departure. By a further payment of Two Guineas they shall be entitled to receive the Transactions.

5. Fellows who are not in arrear in their subscriptions, and in their payments for the Transactions, will receive copies of the latter, provided they apply for them within two years after publication. Fellows not resident in Edinburgh must apply for their copies either personally, or by an authorised agent, to the Secretary or Treasurer.

6. The Society shall from time to time adopt such measures regarding Fellows in arrears as shall be deemed necessary.

SECTION III.—NON-RESIDENT FELLOWS.

1. Any person not residing in Edinburgh may be balloted for as a Non-Resident Fellow, on being recommended by two Fellows of

the Society, and paying a contribution of Three Guineas. From such no annual payment is required.

2. Non-Resident Fellows, by payment of Two Guineas additional, shall be entitled to receive the Transactions yearly as published.

3. Non-Resident Fellows, wishing to become Resident, must intimate their intention to the Secretary, who shall put them on the Resident list. They shall pay the annual subscription of Fifteen Shillings, or Three additional Guineas, or One Guinea if they have compounded for the Transactions.

4. Non-Resident Fellows must arrange with the Assistant-Secretary for the transmission of their copies of the Transactions; and they are requested to acknowledge receipt. Billets of the Meetings may, if desired, be also obtained.

5. Non-Resident Fellows coming to Edinburgh shall, for a period of two months, be entitled to attend the Meetings of the Society, and participate in the other privileges of Resident Fellows; after which, should they remain longer, they must pay the usual annual subscription of Resident Fellows, unless they have compounded by payment of Six Guineas.

SECTION IV.—FOREIGN FELLOWS.

1. Any person residing abroad may be balloted for as a Foreign Fellow, on the recommendation of the Council.

SECTION V.—ASSOCIATES.

1. The Society shall have power to elect by ballot, on the recommendation of the Council, Associates from those who, declining to become Resident or Non-Resident Fellows, may have acquired a claim on the Society by transmitting specimens or botanical communications. Associates have no vote in elections, or in the transaction of the business of the Society.

SECTION VI.—LADY ASSOCIATES.

1. Any Lady, whether Resident or Non-Resident, may become, on the recommendation of the Council, a Member for life, on payment of a single contribution of Two Guineas.

Note.—Diplomas may be procured by Fellows from the Vice-Secretary, the sum payable being Five Shillings, and Two Shillings for a tin case. But no Fellow shall be entitled to receive a Diploma until his contributions have amounted to Three Guineas.

CHAPTER V.

OFFICE-BEARERS.

1. The Office-Bearers of the Society may be chosen from the Resident or Non-Resident Fellows, and they shall consist of a President, four Vice-Presidents, ten Councillors, an Honorary Secretary, an Assistant-Secretary, a Foreign Secretary, and a Treasurer, who shall be elected annually, at the Ordinary Meeting in December. If a Non-Resident Fellow be elected an Office-Bearer, he must become a Resident Fellow, in conformity with Section III. Law 3.

2. The Council shall annually prepare a list of Fellows whom they propose to nominate as Office-Bearers for the ensuing year. This list shall be printed and put into the hands of Fellows along with the Billet of the December Meeting; and Fellows shall vote by putting these lists into the ballot-box, with any alterations they may think proper to make. The lists shall not be signed. Every Fellow present at the Meeting is entitled to vote.

3. All the Office-Bearers may be re-elected except the two senior Vice-Presidents, and the three senior Councillors, who shall not be re-eligible to the same offices till after the interval of one year.

4. These Office-Bearers shall form the Council for the general direction of the affairs of the Society. Three to be a quorum.

5. The Council shall nominate annually an Auditor and an Artist, to be recommended to the Society.

6. The Council shall appoint annually at the January Meeting five of their number, including the President and Honorary Secretary, to superintend the printing of the Transactions of the Society.

7. The Council may at any time be called upon by the President, Vice-Presidents, or Secretaries, to meet with them for the transaction of private business.

8. The Council shall hold a Meeting for business on the second Tuesday before each General Meeting.

CHAPTER VI.

THE PRESIDENT AND VICE-PRESIDENTS.

1. It shall be the duty of the President and Vice-Presidents when in the chair, and of the Chairman in their absence, to conduct the Business of the Society according to the order of the Business laid

down in Chapter II. Law 4, and to attend carefully to the enforcement of the Laws of the Society, and to signing the Minutes. The Chairman shall have a vote and a casting vote.

CHAPTER VII.

THE SECRETARIES.

1. The Honorary Secretary, with the aid of the Assistant-Secretary, shall give intimation of all General and Committee Meetings, shall Minute their Proceedings in Books to be kept for the purpose, and shall conduct all the Society's Correspondence in Britain. He shall also take charge of all Donations of Plants and Books, and shall see them deposited in the Herbarium and Library, in conformity with any arrangements made by the Society with Government.

2. The Foreign Secretary shall have charge of all the Foreign Correspondence.

Note.—Agreeably to an Act of the Town Council of the City of Edinburgh, dated January 8, 1839, the Professor of Botany in the University of Edinburgh is constituted Honorary Curator *ex officio*, with free access to the Society's Collection, whether a Member of the Society or not.

CHAPTER VIII.

THE TREASURER AND AUDITOR.

1. The Treasurer, subject to the inspection of the Council, shall receive and disburse all Money belonging to the Society, Collecting the Money when due, and granting the necessary Receipts. His Accounts shall be Audited annually by the Auditor appointed by the Society.

2. It shall be the duty of the Treasurer to place all Money belonging to the Society in one of the Chartered Banks of this City, unless the same shall have been ordered by the Society to be otherwise invested; and he shall never keep more than Ten Pounds of the Funds of the Society in his hands at a time. The Bank Account shall be kept in the name of the Society, and all drafts thereon shall be signed by the Treasurer.

3. The Treasurer shall, at the December Meeting, submit a certified statement of the Receipts and Expenditure of the past year, with the Auditor's Report thereon.

CHAPTER IX.

VISITORS.

Each Fellow shall have the privilege of admitting one Visitor to the Ordinary Meetings of the Society, at the close of the private business.

CHAPTER X.

ADDITIONAL LAW.

In the event of any Member acting in such a way as shall seem to the Fellows of the Society to be detrimental to its interests, the Council may recommend that the name of such Member be deleted from the roll. The recommendation shall be brought before the Society at its first Ordinary Meeting. It shall be finally decided at the immediately succeeding Meeting by ballot. If confirmed by a majority of two-thirds of the votes of at least fifteen Fellows, the name of such person shall be deleted from the roll of membership, and all his privileges connected with the Society shall be forfeited.

CHAPTER XI.

MAKING AND ALTERING LAWS.

Any motion for the alteration of existing Laws, or the enactment of new ones, shall lie over till the second Ordinary Meeting, and shall then be determined by a majority of at least two-thirds of the votes, provided fifteen Fellows are present and vote. The motion must be intimated to the Council, and shall be printed in the Billet calling the Meeting at which it is to be brought forward, and also in the Billet of the Meeting at which it is to be discussed.

Fig. 1

sa E Woon del.

RHEUM NOB

E, HOOK, FIL.

McFarlane & Erskine, Lith[rs] E

YUCCA GLORIOSA, ON THE ROCK-GA

(From a Photograph ta

DEN AT EDINBURGH, OCTOBER 1879.

by Mr G. A. Panton.)

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY.

VOL. XIV.—PART II.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY.

MDCCCLXXXII.

The Botanical Society of Edinburgh is prepared to make exchanges of plants with Foreign Botanists.

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

A complete copy of the Transactions, to Vol. XIII. inclusive, can be had for £7, 10s. from the Treasurer.

ERRATA.

Page 159, second line from foot, *read* 1867 *for* 1857.
Page xciv., the name of George Bird omitted from List of Resident Fellows.

TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

SESSION XLV.

11*th November* 1880.—William Gorrie, Esq., President, in the Chair.

The Chairman delivered the following Valedictory Address:—

On obtaining by Selection Hardy Varieties or Forms of what are usually termed Half-Hardy Plants.

The term half-hardy is here applied to such introduced exotic plants as have been found to stand our milder winters without artificial protection, but which suffer more or less in those of unusual severity, as well as to unintroduced kinds which are natives of such low temperatured climates that their successful cultivation in Great Britain may be deemed probable. The disastrous effects of the last two unusually severe winters upon many of the highly interesting ornamental and useful plants which have been introduced to our gardens and pleasure grounds from the milder temperate regions, as well as from high tropical mountain ranges, have caused such losses and disappointment to plant cultivators, that any means by which the recurrence of such disasters may be prevented or materially modified must be deemed of paramount importance, and that such desirable results are attainable by the carefully continued selection of young plants that have been grown from seeds, I hope to be able to demonstrate in the course of the following remarks.

The plants that are best suited for withstanding the vicissitudes and rigours of our rather fickle climate are those that make and mature their annual growths within that portion of the year in which frosts are altogether or nearly absent, and that, consequently, neither commence expanding their buds too early in spring, nor continue growing too late in the autumn. Hence, in selecting the hardier varieties, these essential characteristics should be carefully kept in view, unless in those occasional instances which happen when an ungenial summer and autumn, such as we had in 1879, is followed by a severe winter like the last, when highly satisfactory results may be readily obtained by merely selecting plants that have best withstood the inclemency.

In elucidation of the subject I have, in order to combine brevity with distinctness, arranged my explanatory and confirmatory, as well as suggestive, remarks under the following seven headings:—

I. *Plants that expand their Buds earlier in Spring than others.*—Among a quantity of any given species of young plants that have been reared from seeds, whether in the seed-bed, in nursery lines, or after being planted out, some will be found that expand their buds much earlier than others, and are consequently more liable to be injured by the later spring frosts. This is peculiarly characteristic of the Himalayan plants, showing that in their natural habitats, when the winter or dormant season ends, it is quickly followed by the growth-promoting warmth of spring; and that they are there free from that alternating frosty and mild weather which prevails from February till past the middle of May in our changeable climate, and which often destroys or irrecoverably disfigures the fine conifers and other plants of Upper India, even after they have passed unscathed through very severe frosts in the course of the preceding winter.

Growers of the many unsurpassably fine Nepaul and Sikkim rhododendrons are too familiar with these disappointing results, and, in order to insure the unimpaired blooming of their favourites, have to provide greenhouse protection for them in spring, although, as in the past winter, they were not perceptibly injured by a December temperature of fully 30° under the freezing point.

II. *Plants that expand their Buds later in Spring than others*, are consequently exempt from, or much less liable to be injured by late frosts. The common Sycamore (*Acer Pseudo-Platanus*) may be instanced as showing that the difference in time between the expansion of buds in the earliest and latest plants of the same species is much greater than is generally supposed, for while the leaves on some plants are fully expanded in March, other plants may be seen alongside that scarcely begin to open their buds till May. Although the sycamore is so hardy that even its earlier varieties seldom suffer from frosts, yet its large leaves are by no means exempt from being torn and disfigured by equinoctial and other early spring gales. It is admittedly one of the most suitable trees for withstanding both land and sea winds on very exposed places, but those planting it in such places would do well to select only the latest budding plants. In proof of this I may mention, that for clothing the ground about wind and sea-spray exposed marine residences, I have found young sycamores taken promiscuously from the nurseries to be quite incapable of maintaining their existence; but, having replaced them with only the latest budding plants that could be found, their success has been highly satisfactory. Having about twenty-five years since planted an arboretum in which those splendid silver firs, *Picea Pindrow* and *P. Webbiana*, were intended to form conspicuous features, their early budding habits led to frequent disappointments, till, visiting a nursery where a great number of them had been reared from Himalayan seeds, I selected a few plants of each towards the end of April, in which the buds had scarcely begun to swell, although those on many of the others were well expanded, and the after success of the former was all that could be desired.

III. *Plants that continue growing latest in Autumn* are most liable to suffer from early autumnal frosts. While unusual coldness or lowness of temperature has doubtless been the main cause of that recent plant destruction which has resulted in great pecuniary losses to nurserymen, as well as to the vexatious disappointments of plant growers, it must be kept in mind that such unwelcome results are not dependent in the case of any individual plant on the mere fall of the temperature to a stated or even an approximate low point, but that the amount of injury sustained by the said plant is largely dependent on the influence which the previous growing season may have had upon the maturation or non-maturation of its growth. Thus the Lombardy poplars around Edinburgh and in other districts were either killed or irrecoverably injured to an extent formerly unknown by the slightly above zero temperature of December 1879, happening after an unprecedentedly late and unfavourable autumn for perfecting their growths, although in previous seasons they had endured fully as low temperature without injury; and although extensively grown in America they do not there suffer from the much greater intensity of the winters. Again, orchard or standard peach trees that have had their annual growths ripened or matured by the summer and autumn warmths of Canada and the Northern United States retain perfect health and fertility, although the winter temperature is often 30° below zero, while it is only in a few of the most favoured Scotch gardens that they are occasionally so far matured on the warmest southerly exposed garden walls, as to withstand our winters and produce fair crops of fruit.

IV. *Plants that take less time than others to mature their Growths.*—It is a generally known as well as an easily confirmed fact, that plants of the same species which expand their buds earliest often do not mature their autumn growths earlier, or even so early as others which do not put forth their young leaves till all chance of injury from late spring frosts is past. Orchardists and horticulturists are familiar with the fact that varieties of pears and apples (*Pyrus communis and P. Malus*), as well as of other fruit trees which are latest in budding and blooming, are often the best growers as well as the most regular bearers; and that kinds which ripen their fruit comparatively early frequently continue growing so late in autumn that their young shoots, as well as their blossom and leaf-buds, get materially injured by the succeeding winter frosts. Confirmatory proof of these averments, as well as highly interesting and useful cultural information, may be obtained by carefully selecting a number of trees or other plants belonging to the same, as well as to different species, and recording the dates at which their buds were burst, when their leaves attained to full size, time of flowering, fruit or seed ripening, the completion of their autumn growths, as well as the autumnal tinting and falling of their leaves, which observations should be continued over at least three seasons.

V. *Chance opportunities for the selection of hardier varieties or forms*, which happen after such plant destructive winters as 1879–80, should be taken advantage of, when they occur, for selecting such plants as have retained their vitality, when others of the same kind that had been reared from seeds under exactly the same circumstances have either been entirely killed or severely injured. Such selections can now, as well as in the next two or three planting seasons, be readily made in "nursery breaks" of Araucarias, Deodar Cedars, the large-coned Cypress of North-West America, and other important trees, as well as of such shrubs as Arbutuses, Aucubas, Hollies, Rhododendrons, Roses, Sweet Bays, &c.

VI. *Natural selection of Plants.*—The trite saying that "All the trees of the wood do not grow alike," has reference to the commencement, completion, and time requisite for maturing their annual growths, and to the relative lengths or bulk of the same, in the members of any given species, as well as to trees forming a mixture of many kinds. Take, for instance, any kind of tree or other plant having an ordinary range of natural habitats, and ascending from the lower to the higher of these. Those requiring most time for making their growths will gradually disappear as the altitudes become less suitable for their maturation, leaving in the upper regions only such as have been best able to perfect their growth and ripen their seeds for the continuance, or, it may be, the extension of the species in the highest and most inclement parts; hence, if seeds or roots are there gathered, it may be fairly assumed that plants grown from them will be found much hardier than others reared from seeds or roots taken from the lower native habitats; and were collectors of exotic plants to send home only seeds gathered in their highest and coldest natural habitats, we might get many hardy forms of what are now deemed half-hardy and greenhouse plants from the mountain ranges of Southern Europe, Asia, Africa, Central and South America, Australia, New Zealand, Japan, and other parts, which would form new, valuable, and highly interesting features in our plantations, pleasure-grounds, and gardens.

Our native forests of the Scotch pine or fir (*Pinus sylvestris*) may be instanced as affording important examples of the beneficial effects of natural selection on that most important and extensively grown of timber trees. In 1874 I had an opportunity of carefully examining much of the famous Ballochbuie forest on the Braes of Mar, which since then has fortunately become the property of our Society's most respected patron, Her Majesty the Queen. And I here use the word fortunately, advisedly, as from this grand old forest having become royal property, a guarantee is afforded that it will be permanently preserved as a worthy remnant of those magnificent pine forests with which our Highland glens and mountains were once so widely clothed, but of which many have even recently been cleared away; and that it will continue to exhibit through far future generations as many noble specimens as it now does of the true valuable timbered, gigantic, smooth reddish stemmed native Scotch pine or fir, with its picturesque, horizontal branched, umbrella-like top. In Ballochbuie I observed many varieties and sub-varieties of the *Pinus sylvestris*, among which I had no difficulty in identifying the four described in the Caledonian Horticultural Society's "Memoirs," for 1814, by that renowned Scottish botanist, the late Mr George Don, as having been found by him in some plantations in the neighbourhood of Forfar, where he ascertained that the forementioned best native variety (which he called *Pinus sylvestris, horizontalis*) only existed in the proportion of about one tree to ten or twelve of the others. In those parts of Ballochbuie forest which were most favourable for tree-growth, such as in proximity to the drive from Balmoral to Invercauld, as well as in dry-bottomed hollows, &c., I found Don's *P. sylvestris*, var. *horizontalis* almost exclusively or largely prevalent, having by their more rapid and larger growth overtopped and destroyed most of the others; which were only seen in excess where the soil was surcharged with moisture or from other unfavourable causes, and where consequently they were thinner and had more room for developing their characteristic appearances. In places where all the varieties were intermingled, the greater abundance of cones on the dwarfer as well as more fastigiate or upright branching trees than on those of the horizontal variety was very marked, showing the accuracy of Don's opinions that the degeneracy of the Scotch fir in low country plantations was in consequence of the best native variety producing its cones much more sparingly than the others, while they were also less easily got at; and the seed gatherers, being paid for quantity and not for quality, seized upon those cones that were most easily obtained, which practice, having been continued throughout many generations of planted trees, has resulted in the too great predominance of the comparatively worthless "common or lowland Scotch fir."

VII. *Artificial selection of Plants.*—The concluding remarks in the last paragraph relative to the deterioration of the Scotch pine may be looked on as showing an example of the bad effects that may be attendant on artificial selection. And with the larch (*Larix europæa*) a change is also progressing, which, however, presents the appearance of being beneficial rather than otherwise, and which has led to the name of common larch being employed by arboriculturists to the produce of home-grown seeds, and native larch to that of seeds collected in the native larch forests of continental Europe. It is well known to nurserymen and foresters that plants reared from home-grown larch seeds are much hardier in their young stages than those grown from seeds that have been collected in the native larch forests, and that even when older and after being planted out, the latter are more liable to have their tops nipped and be otherwise injured by early frosts than the others. When the larch was first introduced into Britain from its congenial habitats on the northern slopes of the Alps, the Apennines, or the Carpathian Mountains, it may be assumed that native seeds produced, as they now do, a percentage of early maturing and consequently hardier plants than the others, and that continuous seed reproduction from the hardiest, and hence most prolific, of these first introduced plants and their successive progenies, has resulted in the plants that are now reared from home-grown seeds being earlier matured, and much hardier than those grown from native seeds.

Of plants that have long been the objects of artificial selection the following may be instanced as bearing upon the subject here treated of:—

It is admitted that the wild pear (*Pyrus communis*) and the crab apple (*P. Malus*) are perfectly hardy natives of Britain, and that our cultivated pears are merely improved varieties of the former, and our cultivated apples of the latter, obtained after very long-continued and careful selection of those kinds having the best flavoured and most handsome fruit, varying in their times of ripening, so that they can now be had in perfection throughout most of the year. Quality of the fruit being thus the primary object in view, little or no regard was paid by horticulturists to the hardiness of the trees, provided the fruit was possessed of first-class excellence; and in the event of not being found suitable for orchard or open ground culture, a place was allotted to it on the south face of a garden wall or other exposure, where, under the influences of higher temperature and better shelter, its growths and fruits were fully matured. Orchardists, however, and other growers for market, while also keeping size, beauty, and quality in view when raising new varieties from seed, had other requisites to consider, such as hardiness, fruitfulness, lateness in flowering, so as to escape spring frosts, wind-resisting sturdiness of growth, &c. Hence the great diversity that exists in the hardiness and other characteristics of the cultivated varieties of *Pyrus communis* and *P. Malus*—a diversity that I never saw more remarkably displayed than in the past summer, when, in some of the Carse of Gowrie orchards, I observed many varieties of pears and apples, which had hitherto been deemed quite hardy, but which were then almost fruitless, some being so much injured by the last winter that they were unlikely to recover, while by far the greater portion had suffered only in a somewhat less degree. And, as a further proof of the great difference that exists in the growth as well as hardiness in the different kinds of pear and apple trees, I may mention that the late Patrick Matthew, Esq. of Gourdiehill, who was the most extensive as well as best practically skilled orchardist in the above named district, arranged his pear and apple trees so that the finer and more delicate kinds were protected from the northerly and easterly winds by lines and masses of taller-growing and hardier sorts. Similar, and in some instances even greater, diversity exists in the hardiness of other fruit-bearing, as well as agricultural, culinary, and florist plants. Thus among our cereal grains, varieties are found much more suited for cold late exposures than others. Some varieties of the common turnip (*Brassica Rapa*), that yield the earliest as well as bulkiest crops, have to be cleared off the fields even before moderate frosts set in, while others are capable of withstanding as much as 15° of frost. All are familiar with the differences in length of time required for maturing the many varieties of potato (*Solanum tuberosum*); and most cultivators are aware that among the later ripening kinds some have their foliage blackened by early frosts, while that of others growing alongside or intermixed with them remains fresh and green. But of all the plants that have been long subjected to artificial, or, more correctly speaking, cultural selection, none have produced in their varieties and sub-varieties such diversity in forms and hardiness as the *Brassica oleracea*, from which has been derived our cabbages, kales, broccoli, cauliflower, &c., and the original form of which is found on the southern shores of Britain as well as on those of Southern Europe, but it has no place in the Scandinavian flora, although its hardiest varieties, under the names of Russian and Siberian kale, are grown as far north in Europe and Asia as cultivation extends, while the çauliflower, and even the Pomeranian cabbage, require with us the winter protection of glass structures.

In regard to flowers that have been long reputed garden favourites, the differences between them and their primitive types, both in structure and hardiness, are so well known to botanists and florists, that further remarks in regard to them are deemed unnecessary.

In treating of the acquirement of hardier varieties or forms of plants it may be supposed that allusion should be made to the acclimatisation theory which has been urged and defended by some horticultural writers, and I here do so by remarking that I have no belief in that theory, the advocates of which maintain that a plant, although only perpetuated by division, such as cuttings, layers, grafts, or buds, can be rendered more hardy by gradually exposing and inuring it to lower temperatures. The *Aucuba japonica*, of which the well-known spotted-leaved variety introduced to Britain in 1783 was the only representative till that eminent botanical collector, the late Mr Robert Fortune, sent the male and other varieties from Japan in 1861, has often been deduced as incontrovertible evidence in favour of the acclimatisation theory, the defender of it affirming that when first introduced it required hothouse protection, and although only perpetuated by cuttings or layers it gradually became so hardy as ultimately to withstand our severest winters. No proof exists, however, as to its originally requiring hothouse protection, but, like many other exotics, having been deemed deserving of hothouse treatment, it merely got it by mistake; and looking back to the three remarkably severe winters of 1837–38, 1860–61, and of December 1879, when the temperature fell to about zero, their killing effects on the old *Aucuba* were remarkably alike. And, curiously enough, the *Aucuba japonica* is now looked upon as one of the best proofs that hardier varieties can only be got from among plants that have been reared from seeds, hence in "nursery breaks;" of these, some are perfectly uninjured, while others, as wellas the old spotted-leaved variety, have been more or less severely cut down by the frost of last winter.

The older kinds of our favourite fruit trees, which have been perpetuated by budding or grafting, afford unanswerable evidence against acclimatisation; for example, the Ribston Pippin apple, which is supposed to have originated at Ribston Hall from seeds sown about 1688, and the Jargonelle pear, which has been still longer in cultivation, are both as unsuitable for growing as standards in Scotland as when they were first tried; while the Moorpark apricot, which has been grown in Britain for about two centuries; the Grosse Mignonne Peach for a still longer period; and the Elruge Nectarine, which dates from the time of Charles II., still stand as much in need of the best garden wall protection as ever they did.

The following Statement respecting the membership of the Society was read:—

Honorary Fellows.

Royal Personages, . . .	4
British Subjects, ...	6
Foreign, ...	21
Foreign and Corresponding Members, .	70

Ordinary Fellows elected during 1879–80.

Alexander Fraser.	Robert Paterson.
George Bird.	Dr Andrew Wilson.
William Marjoribanks.	John M'Laren, Jun.
Alexander Hay.	James Greig.
D. R. Robertson.	B. N. Peach.
D. P. Laird.	W. C. M'Intosh, M.D.

Non-Resident Fellow.

Rev. Thomas Barty, M.A.

Members resigned, . . .	6
Member deceased, . . .	1

Total Number on Society's Roll of Fellows.

Resident, ...	150
Non-Resident, ...	221
Lady Associates, ...	10
Associates	30

The following are the Obituary Notices of the year prepared by Mr Taylor :—

Wilhelm Philipp Schimper was born at Dossenheim, a village of Alsatia, in January 1808. He died at Paris on the 20th March last; and at the time of his death was Professor of Geology, and Director of the Museum of the University of Strasbourg. He was placed on the list of our Foreign Honorary Fellows on December 10, 1868, having been elected a Foreign Member in the previous year.

The "Bryologia Europæa," in six quarto volumes, 1836–55, describing every known species in detail, besides adding beautiful pictorial illustrations of morphological peculiarities, would alone be a sufficient monument of Schimper's enthusiasm and genius. It occupied the twenty busiest years of his life; and, though it began with him as only editor, he received so little extraneous assistance, that he is really entitled to the full merit of its plan and completion. In 1857, he published the companion volume on the "Sphagnum," a goodly quarto, also illustrated with fourteen minutely detailed plates by the author. This was followed in 1860 by an abridged edition, in one volume in Latin, of his work on "European Mosses," but elaborated in the systematic fashion of a German professor. A second and greatly enlarged edition of this synopsis of the "European Mosses," in two volumes, appeared in 1876.

Schimper's "Traité de Palæontologie végétale," published in three large volumes in 1874, is as surprising a monument of scientific industry, combined with the critical acumen only to be obtained by much practical work, as are his other books already referred to. It gives descriptions in Latin, with remarks in French of all the species of fossil plants known, with a quarto atlas of 110 plates, illustrating the more interesting vegetable types. The work more recently done by our deceased Honorary Fellow on the new "Manual of Palæontology," of which he was conjoint author with Karl A. Zittel, up to ferns, is another monument of his devotion to fossil botany. This taste had been fostered by the college course on the subject which German students attend, by intercourse with such congenial spirits as Hugo Mohl and Alexander Braun, and by the beautiful collection of fossil plants with which the Strasbourg Museum was enriched when he undertook its superintendence,—whence, indeed, Brongniart derived most of his materials for his "Végétaux Fossiles."

As his friend Lesquereux remarks: "The above enumeration cannot give an idea of the amount of work performed by this celebrated naturalist during a career harassed by the most distressing circumstances. It says nothing of the noble character of the man who, always genial, kind, and obliging to every one who needed his assistance, has left as sincere friends to deplore his loss all those who had intercourse with him." *

Dr Nils Johann Andersson, Professor of Botany at Stockholm, was elected one of our Foreign Members on December 8, 1870, he having previously enriched the European department of the University Herbarium with many valuable specimens, notably of the *Salices*, which were a special study with him, having written the monograph on this family in De Candolle's "Prodromus." Andersson was a botanist by vocation, as well as through love of the science. He prepared himself for his professional career, by university graduation at Lund in 1845 as Doctor of Philosophy, by holding the positions of assistant professor and demonstrator, by travel, whether round the world in the frigate "Eugène" in 1851 to 1853, or afterwards in an extensive European botanical tour, embracing Lapland, Norway, and England. He died on March 27, 1880, at Stockholm, after long suffering, in his sixtieth year.

Professor Dr Johannes V. Hanstein, Rector of the University of Bonn, died, after a lingering illness, on the 27th August last, in the fifty-ninth year of his age. Dr Hanstein was also Professor of Botany; and was enrolled amongst our Foreign and Corresponding Members on January 9, 1873. Vegetable physiologists set a high value on the work of our deceased coadjutor. One capital discovery of the three distinct layers in the developing embryo of *Capsella bursa pastoris*, as well as other Cruciferæ, quite identical in their further development with the formation of the embryonic membrane in animals, has been

* "American Journal of Science," No. 113, vol. xix. May 1881.

insisted on as a new standpoint in their science. The Botanic Garden at Bonn was under Hanstein's superintendence. It shows how very much may be accomplished by a scant treasury, if controlled by true artistic taste combined with science.

The career of the late General William Munro, C.B., a Non-Resident Member of the Society, may be regarded as a parallel with that of Sir Thomas MacDougal Brisbane, showing how profound scientific attainments may be acquired even amidst most active service. MacDougal Brisbane, amidst the horrid din of war, could quietly appraise the capabilities of a continental battlefield as an astronomical observatory. Munro, in the thick of the siege of Sebastopol, sent home rare botanical and archæological specimens; and during active service in East and West Indies, indeed, over half the world, so pursued his steady scientific aim of doing one thing, as to become our best British authority on grasses, though as a soldier he could write little;—and his monograph on the *Bambusaceæ*, published in the 26th volume of the "Linnæan Transactions," is his most prominent paper. He was a most obliging and laborious botanical correspondent, receiving and examining specimens of grasses from friends in all parts of the world, which, in his own words, may be counted "by tens of thousands." In the Herbarium, at the Royal Botanic Garden, are many foreign species so named by him. Such use of the faculties of quick decision and judgment did not stand in the way of professional advancement. Lieut. William Munro of H.M. 39th Regiment, Madras, joined our ranks in 1839. He was one of that early band, whose after-life careers have shown how compatible it is to be good botanists and leading men in their respective professions. The powers called out by plant diagnosis stood him in capital stead in the trying time of commanding officer and Governor of Bermuda, as well as at critical periods in India or at Sebastopol. He became lieutenant-general in 1873, and general in 1878. He had been previously nominated a Companion of the Bath (Military Division) in 1857. He was a capital gardener himself, and established soldiers' gardens wherever he was stationed.

General Munro died at his residence, Monty's Court, near Taunton, on 29th January, aged sixty-four, bequeathing his collections to the Kew Herbarium.

Miss Frances Hope of Wardie Lodge, who died suddenly on the 26th April last, was elected a Lady Associate on 13th February 1873. This deletion from that small list would alone be noteworthy, as it has long characterised the favour with which our Society has viewed the question of the higher female education. But Miss Hope bore an honoured name in the horticultural world. Her garden was as much a place of reference for plant lovers as the printed page. Her love for individual species of plants was intense. She will always be known as the introducer of varieties of the *Helleborus niger*, and of variegated Kale for winter decoration. Miss Hope was as fond of giving flowers to those who knew how to appreciate them, as in receiving such gifts. Connected with a family well known amongst our Scottish aristocracy, and a lineal descendent of two celebrated Edinburgh professors of natural sciences, Miss Hope might often be seen driving on our highways in her yellow chariot, with its accompanying postilion, yet she would also be found often working, alike in wet and dry weather, amongst her plants, along with humble servitors, and in a dress adapted rather for utility than social distinction. Another genuine type of the old lady of the true Scottish school has thus passed away. A small memorial volume of Miss Hope's horticultural writings has just appeared.

The late Dr John Sime Cowan of Dunbar was amongst the list of those students who, fired by the zeal of our veteran emeritus professor, joined our ranks, carrying their love of plants through the harassing details of a medical curriculum, and the far more annoying worries of a country practice. This silent influence of our science through wide-scattered districts is surely of value, even if not developed into learned monographs. Dr Cowan was a native of Rattray in Perthshire. He attended the Botanic Class during 1857, was a diligent student, and was admitted a Resident Member of our Society on 9th December 1869.

He graduated at Edinburgh as M.B. and C.M. in 1871. Dr Cowan was suddenly cut off in August 1880, by heart disease, at the age of twenty-seven.

The death of John Scott recalls to memory the Botanical Society of twenty years ago, with his and other faces of then young men, such as Thomas Anderson and Lauder Lindsay, now passed into the silent land. Scott was born at Denholm, in Roxburghshire, known as the birthplace of Leyden, the great Oriental scholar. His father then occupied a farm of J. Douglas, Esq. of Cavers, which, indeed, his family had done for nearly a century. Left at four years of age an orphan, Scott, with a sister now married, was brought up by an aunt, and educated at the parish school. During these early years he displayed a passionate love of flowers, which was carefully fostered by his cousin, the late Rev. James Duncan, an excellent botanist. At fourteen years of age he became an apprentice gardener; and after serving in Jedburgh and Westmoreland came to Mr M'Nab, becoming ultimately foreman in the propagating department of the Botanical Garden for seven years. Mr Scott was elected an Associate on 10th July 1862. He contributed largely to our Transactions during 1863 and 1864, and his papers show a very extensive and broad self-education, besides special knowledge. They were commended by the presidents of both years. Dr Douglas Maclagan thus speaks of Mr Scott's papers on the propagation and irritability of *Drosera* and *Dionæa*, and the narrative of experiments on the fertilisation of orchids:—"To the last of those papers in particular I listened with very great pleasure when it was read to the Society, not only because the paper was interesting in itself, but because it afforded a convincing proof of the value of the school of instruction which we possess in our Botanic Garden, where we have in valuable combination the extensive cultural establishment so ably superintended by Mr M'Nab, and the scientific laboratory and class-room of Professor Balfour. I cannot but think it highly creditable to the whole establishment, as well as most meritorious on the part of the author, that such papers should emanate from one who is engaged in the work of practical gardening." Such a successful reception of scientific research opened up to Scott, through the patronage of Charles Darwin, the wider channel of publicity of the Linnean Society, and a professional career in India. In the eighth volume of the Journal of the Linnean Society there is an elaborate paper of forty-eight pages entitled "Observations on the Functions and Structure of the Reproductive Organs in the *Primulaceæ*," communicated by his benefactor, but the experiments for which were performed in the Edinburgh Botanic Garden. Space forbids us to trace Scott's busy life in India. The splendidly illustrated monograph, "On the Tree Ferns of British Sikkim," &c., published in vol. xxx. of the "Linnean Transactions," may be looked on as its fruit. It was written when Scott was curator of the Botanical Gardens, Calcutta, serving under his friend, the late Dr Thomas Anderson, the superintendent. When holding an acting situation on the hills at Darjeeling, Scott enjoyed excellent health, but necessary exposure on low Indian plains worked havoc on a European constitution, perhaps already predisposed to disease by over-study, developing a spleen complaint. He appeared in his old garden here in May last, home on furlough, but saddening friends when they looked on the broken man, once so full of promise. He was to have attended the June meeting of our Society, but he died at his sister's house at Garvald, East Lothian, aged forty-two, on the evening of our meeting.

The name of Robert Fortune, it is said by our leading horticultural periodical, "can never be mentioned by the gardener or the botanist without feelings of respect, admiration, and gratitude."* We have in him an earlier example than Scott how well the training of mind, eye, and hands may be harmoniously combined, though on a little oatmeal. Fortune, too, was a south countryman. He was born at Edrom, in Berwickshire. After a good education in the parish school, he served his apprenticeship as a gardener, ultimately working in our Royal Botanic Gardens for two or three years, under the elder M'Nab, ere accepting the superintendentship of a department of the Royal Horticultural Gardens in London in 1842, thence to emerge

* Gard. Chron. Apr. 17, 1880.

within a year into the previously closed precincts of the Chinese Empire to do his well-known work of botanical collecting. We therefore drop a stone on his cairn. A glance at the map of Asia will show the vast area visited, comprising South and North China, Java, Manilla, Formosa, and Japan. Fortune's travels from 1843 to 1861, and the picturesque and fantastic details of those lands almost then unknown, except by the questionable details of a few Dutch travellers, given in his various books, have been appreciated by thousands of general readers. Fortune was middle sized, somewhat spare in form, and his features indicated great determination, though suavity and modesty predominated. His physiognomy reminded one that peace hath its heroes as well as war, for he was not unlike the Duke of Wellington. Mr Gorrie has furnished me with a characteristic anecdote. Meeting him on a Monday in August 1860, after his return on the Thursday previous from his American Government employ, because of the outbreak of the civil war, his old friend said—"Well, Fortune, surely home for good now!" "No," said the traveller, "I have just learned the Japanese ports are open to Europeans, and I go there on Thursday." If that visit rejoiced the hearts of European horticulturists, as well as proved most remunerative to the traveller, we can well understand why the foreman of Van Siebold's nursery should have held up his hands in horror on hearing that Fortune and Veitch were away to spoil his hitherto exclusive Japanese preserves. In a list published by himself in the "Gardeners' Chronicle," January 3, 1880, p. 11, Fortune enumerates nineteen trees, forty-nine shrubs, and nineteen herbaceous plants introduced to Britain by him from China, as well as sixteen trees, twenty-one shrubs, and twelve bulbs and roots from Japan. These include some new races of camellias, some azaleas, Moutan peonies, and Japanese chrysanthemums. Indian tea-planting claims Fortune as an early and most successful promoter; and he first made clear how black and green teas really come from the same plant.

Mr Fortune had very much retired from public life since 1866. He died at Brompton, on 13th April 1881, aged sixty-eight, leaving a wife, with two sons and two daughters, to mourn his loss. He was latterly accustomed to spend the autumn of each year at his eldest son's farm at Elphinstone Tower, East Lothian.

At our last meeting many of us were saddened by the sudden death, a few days previously, of the late Mr Frederick M. Webb, at the early age of thirty-nine. Mr Webb had devoted the last ten years exclusively to botanical pursuits. His enthusiasm as a field botanist, his wonderful aptitude for placing a specimen and exhibiting its critical characters, were admired when he was little more than a boy. Mr Webb took a prominent part in the Liverpool Naturalists' Field Club, writing in lithograph a journal circulated amongst the working members; and his knowledge was much appreciated by the botanists of the Chester Society of Natural Science. His aid is acknowledged by Mr H. C. Watson in "Topographical Botany." He entered on his duties in the Edinburgh Herbarium in 1876; and the paper, published in vol. xiii. p. 88, of our Transactions, entitled "Notes upon some Plants in the British Herbarium of the Royal Botanic Garden, Edinburgh," intended as a sort of index to the collection, shows his admirable method of work. Mr Webb contributed to the "Journal of Botany" an excellent paper "On *Utricularia neglecta* and on *U. Bremii* as a British Plant."*

Since we last met the grave has closed over the mortal remains of Dr William Lauder Lindsay, F.R.S.E., F.L.S., for many years medical superintendent of the Murray Institute at Perth, a situation he vacated about a year ago through failing health. Dr Lindsay joined our ranks in 1849, and has been a valued contributor to our Transactions. Papers on Lichenology have also appeared in the Journal and Transactions of the Linnean Society. The "History of British Lichens" and the "Contributions to New Zealand Botany," bear sufficient evidence of the good work he did. Many of us trusted that they were but the forecasts of further scientific research in the leisure secured after twenty years' worry at the head of a lunatic asylum. But in stead we mourn the loss of one of our most hard-

* "Journal of Botany," xiv. 142-147, 1876.

working members at the age of fifty-two. Lindsay's life was really that of a scientific recluse, his lichens and minerals giving needful recreation in his toilsome and depressing official position. We first remember Lindsay as a High School dux, ardent even when a boy in foreign travel, with an omnivorous appetite for all knowledge. A near relative of that distinguished bibliopole, the "Scottish book-hunter," it could not have been otherwise. But he himself latterly held that the too close application of his boyish and student years did permanent injury to his health, necessitating afterwards frequent long professional vacations of colonial and continental travel. He thought there was wisdom in even the too great rebound to cricket and football, so characteristic of middle-class education now a-days. Mineralogy was Lindsay's first scientific love. It was only when he came under the influence of Professor Balfour's teaching that he entered with equal zest on his botanical career. He was a skilful draughtsman, and characteristically neat handed. The beautiful preparations of the grasses, now in the museum at the Royal Botanic Garden, gained the prize offered by the Messrs Lawson to the University Botanical Class. And his elaborate and exquisitely illustrated monograph on the "Spermogones and Pycnides of the Higher Lichens," gained the first Neill Prize, in 1859, from the Royal Society of Edinburgh. His extensive lichen collection is to be deposited in the University Herbarium.

On the Exact Measurement of Trees (Part 5). 1. *The Growth of Wood in* 1880. 2. *The Limit of the Growing Months.* By Sir Robert Christison, Bart.

(Read 13th January 1881).

In the last observations submitted to this Society on the exact measurement of trees, I endeavoured to show that in the unfavourable season of 1879 the growth of wood, both of leaf-shedding and evergreen trees, was materially less than in the comparatively favourable season of 1878; that the depressing influence of that of 1879 affected various species in very different degrees; that most leaf-shedding trees appeared to suffer severely, and more so than evergreen trees, but the oak tribe, so far as observed, least of all. For this failure three climatic causes were assigned:—a great reduction of the mean temperature of every growing month under the average, a similar reduction of sunshine, and the loss of the greater part of one of our usual growing months in consequence of both climatic deficiencies having prevailed so seriously as to delay the development of the new leaves till near the beginning of July.

In continuation of these inquiries, I have now to state the result of measurements of the same trees for the recent favourable season of 1880.

The previous autumn of 1879 was unfavourable for the ripening of young wood. September, indeed, was not far amiss; but the month of October was ungenial. This circumstance, together with the loss of June as a growing month, was a sorry omen for the solidification of young wood, as well as for the formation of buds, and consequently for their ability to resist uninjured the customary frosts of winter. But it so fell out that in this unprepared condition they were exposed during great part of December to an asperity of climate unprecedented in this latitude, and such as it may be earnestly hoped will not be soon again paralleled. For nearly three weeks, in the country around Edinburgh, the minimum was often a little above zero F, and sometimes below it; and in other parts of the Lowlands, especially in Berwickshire and Roxburghshire, much lower temperatures were noted. A descent to -18°, and in one instance to -20° was authenticated.

I have given this general account of the weather since autumn 1879 chiefly from a diary of observations kept by myself. But since drawing it up, I have been favoured with the following confirmatory statement of the differences from the average of the previous twenty-four years in the mean temperature of each month after August 1879, kindly furnished by Mr Buchan:—

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
1879 . .	...	...	...	...	...	...	...	...	−1·0	−0·7	−0·1	−3·1
1880 . .	−1·0	+3·8	+1·3	+0·6	−0·2	−0·4	−1·0	+2·9	+2·4	...	...	...

The baneful influence of cold so unusually intense as in December 1879, must have been apparent to most ordinary observers after vegetation had made some progress in the ensuing summer. Any one might notice in this neighbourhood that on the birch, robinia, and some introduced continental oaks, many two-year old twigs were leafless because dead; in Roxburghshire six-year old branches of the common oak were similarly destroyed; in one district several oaks of large size put out no leaves at all except on spray from their trunks; and a fine holly, 150 years old, was killed outright.

These unhappy facts, which could easily be multiplied from the observation of many, might have led one to foresee something less than the usual year's growth of wood during the subsequent favourable season. But I confess I was not prepared for the great defalcation shown by the annexed measurements to have been sustained during so fine a summer and autumn as those of 1880.

The remainder of the winter of 1879–80 was by no means so severe as was threatened by its formidable opening in December. There were considerable tracts of open weather; the temperature was often above the freezing point; and the thermometer was never much or long under it. Such particularly was the character of the weather in February. There was little frost, none severe, a day temperature rising frequently to 45°, 47°, and once to 50°, with an unusual frequency of bright sunshine. Consequently early-budding trees and shrubs began to push out their green points before the close of that month. In March and April, though cool, frost was rare, and only in the morning; and there was a fair proportion of bright sun. Consequently the buds opened gradually without injury; and when the month of May set in, with temperate, though never warm, weather, and a generally unclouded sun, tree-foliage in general was matured, or nearly so, at the beginning of June. June, July, August, and September were fine months throughout Scotland generally, and August especially, when the heat was greatest. The only other meteorological circumstance requiring mention is a decided deficiency of rain from early in March till near the close of the first week of September.

I have recalled in this summary the weather in 1880 in order to show that the season was favourable for tree foliage, and consquently for the formation of wood. In point of

	1878.	Increase in		
	May 1.	1878.	1879.	1880.
	inches.	inches.	inches.	inches.
1. Birch	55·35	0·25	0·05	0·05
7. Beech	71·40	1·20	0·95	0·65
8. Beech	60·50	1·20	0·80	0·90
14. Beech, *Arboretum*	75·80	0·60	0·60	0·25
38. Beech, *Arboretum*	60·30	0·60	0·45	0·15
2. Lime	76·10	0·50	0·15	0·00
18. Lime	42·70	0·70	0·40	0·15
4. Sweet-Chestnut,	70·80	1·10	0·90	0·85
6. Tulip-Tree	75·70	1·00	0·40	0·30
9. Horse-Chestnut	48·75	0·75	0·50	0·35
16. Hawthorn	38·00	0·80	0·10	0·75
23. Flowering Ash	75·30	0·60	0·40	0·30
28. Sycamore	58·60	0·50	0·20	0·15
13. Sycamore, *Arboretum*	131·80	0·60	0·45	0·35
12. Walnut, *Arboretum*	61·00	0·50	0·40	0·00
40. Hungary Oak	23·60	1·80	1·70	1·40
43. Turkey Oak	41·90	0·60	0·65	0·35
44. American Oak, Q. rubra	30·80	0·50	0·40	0·30
33. Hornbeam	44·50	0·40	0·35	0·10
5. Douglas Pine	56·10	0·60	0·45	0·45
10. Douglas Pine	64·30	0·80	0·30	0·35
17. Corsican Pine	64·30	0·40	0·10	0·50
19. Scotch Fir	49·20	0·00	0·00	0·00
11. Scotch Fir, *Arboretum*	94·30	0·30	0·00	0·00
37. Scotch Fir, *Arboretum*	52·55	0·25	0·30	0·00
36. Scotch Fir, *Arboretum*	52·95	0·25	0·00	0·00
24. Pinus excelsa	30·90	0·35	0·20	0·05
26. Pinus excelsa	32·70	0·40	0·20	0·35
25. Sequoia gigantea	23·95	1·15	0·80	1·00
27. Sequoia gigantea	23·95	1·75	1·65	1·80
1. Sequoia gigantea	18·95	1·85	1·50	1·50
2. Sequoia gigantea	23·85	1·25	1·70	1·55
29. Deodar	26·10	1·10	0·70	0·45
30. Deodar	64·00	1·20	0·60	0·40
31. Picea Lowei	15·00	1·40	1·25	1·40
32. Picea Lowei	16·10	0·50	0·20	0·15
34. Araucaria imbricata	18·10	0·60	0·50	0·55
35. Araucaria imbricata	20·20	0·50	0·90	0·75
39. Atlas Cedar	27·55	1·65	1·40	1·75
45. Evergreen Oak	41·50	in 1879	0·30	0·80
46. Evergreen Oak	29·05		0·40	0·10
41. Yew	67·60	0·60	0·60	0·35
42. Yew	34·10	0·50	0·15	0·20
47. Yew	33·20	in 1879	0·15	0·05
48. Yew	37·50		0·60	0·40
49. Yew	23·50		0·30	0·35
50. Yew	33·30		0·45	0·40
53. Yew	32·35		...	0·15

fact the foliage of most trees was rich. There were exceptions, for in some places that of the beech and oak was defective. But this appeared to arise rather from the ravages of superabundant insects than from atmospheric inclemency; and certainly in most places, and in respect to trees generally, foliage was healthy and abundant.

In the adjoining table are re-stated from my last paper on this subject the girth of the trees in the beginning of May 1878, and the successive increments in that favourable year, and in the unfavourable year of 1879; and there is now added the increments for 1880. On comparing the columns of increments with one another, it will be seen at a glance that, with very few exceptions, the growth of wood last year was even more below the average of equally favourable years than in the bad year of 1879. Of fifteen leaf-shedding trees of various species, exclusive of the oak tribe, the average growth of trunk-girth in the three successive years was 0·80 of an inch for each, 0·45, and 0·35. For four specimens of the oak tribe it was 0·82, 0·77, and 0·54. For twenty trees belonging to the evergreen *Pinaceæ* the increments were 0·81, 0·68, 0·65. For six of the common yew the growth for 1879 and 1880 was 0·37 and 0·29 on an average; and of the only two of these measured also in 1878, the average growth in the three years was 0·55, 0·37, 0·28. The observations made on two specimens of evergreen oak (*Q. ilex*) are remarkable. One of them made 0·4 in 1879 and only 0·1 in 1880; but the other, a much finer plant, made only 0·3 in the former year and 0·8 last year. It will be seen presently how easily this apparent discrepancy may be explained.

It appears then that with few exceptions trees of all kinds failed to make the growth of wood which in ordinary circumstances so fine a season as that of 1880 might have been expected to produce; and that the defalcation was even greater than in the very unfavourable season of 1879; that leaf-shedding trees suffered most, exclusive of the oak tribe; that the evergreen *Pinaceæ* suffered least; and that the oaks, though intermediate in that respect between the two foregoing denominations, suffered decidedly more in 1880 than in 1879.

Some more special facts deserve a little notice:—

1. The beech (7) suffered less in 1879, but more in 1880,

than its neighbour. This was traced in the end of July last to its foliage having sustained serious damage from insects.

2. The hawthorn (16) alone greatly surpassed in 1880 the growth of 1879, and indeed may be said to have come up even to that of 1878, the increments being, in the order of the three years, 0·8, 0·1, and 0·75. The tree is a very fine pendulous Mary-Thorn, which last year, as usual, put out its buds and expanded its leaves very early, and was covered with dense vigorous foliage. But, though I never before observed it otherwise than richly covered in due season from top to bottom with flower, last year its blossom was confined entirely to a few twigs near the top, facing south-west, and constituting scarcely a twentieth part of the tree. Everywhere hawthorn flower was extremely poor.

3. Of the oak tribe the Hungary oak shows the best product of wood in 1880. It increased its girth by nearly an inch and a half. I may add that two younger plants of 13½ and 16½ inches in girth of trunk, measured for the first time last year, were richly leaved, and added each 1·10 inch to their girth. This beautiful species having been thus proved to defy the most ungenial of our summers, and a winter of unexampled harshness, it well deserves more attention than it has yet received as a quick-growing ornamental tree.

4. Two Douglas pines, a Corsican pine, two Araucarias, a Pinus excelsa, a Cedar of the Atlas, four Sequoias, and a Picea Lowei, notwithstanding that its top shoot had been broken off, have shown little or no backwardness in 1880. But four specimens of our indigenous Scotch fir seem to have made no progress whatever. It has been stated in the public news that this species has suffered severely in some parts of the north of Scotland. As for the four now referred to, the first, the only Scotch fir in the Botanic Garden, has not advanced for three years past at least; the last two in the table, in the east clump of the Arboretum, are also shabby trees, ill-branched, limited in spread, and thin in foliage; but the other in the Arboretum (11) was in 1878 a rather handsome tree, which in that year measured 7 feet 10 inches in girth at 5 feet from the

roots, and carried a fine leafy head. But it has evidently been severely damaged since, for the trunk made no advance last year, and in October its head was miserably defective in foliage.

5. The two evergreen oaks were not measured in 1878. In 1879 both made a little progress, but probably less in that unpropitious summer than in average years. In 1880, however, in spite of the fineness of the season, one of them made an increase of only 0·10, while the other grew actually 0·80, or fully twice as much as in the previous year. This difference supports the view that the cause of the general defalcation in the growth of wood in 1880 was not merely the want of thorough ripening of the young wood of 1879, but also the intense frosts in December of that year. For the former grew unprotected in the middle of the garden, and, in common with its species generally, lost its evergreen leaves long before the approach of spring; while the other grew about 30 feet to the south of the Palm House, being thus defended by a lofty heated house from N.E., N., and in some degree N.W.; and in consequence this tree, alone of all its species in the garden, retained its leaves green and vigorous till they withered and dropped, according to the usual rule, with the development of new foliage in summer.

6. Of two specimens of *Pinus excelsa*, apparently of the same age, growing on the terrace in front of the long line of glass-houses, near one another, and circumstanced in all respects exactly alike, both added rather over a third of an inch to their girth in 1878, and both only a fifth of an inch in 1879. But in 1880, while one was fully clothed with foliage, old and young, and again increased its trunk-girth by a third of an inch, the other showed very thin old foliage, scanty new twigs, and two years' growth of its top-shoot completely dead, and its trunk had scarcely increased in girth at all. I do not see what else will account for this difference, except a difference in individual constitution, rendering the latter more sensitive than the former to the influence of the intensely cold weather of December 1879.

Experience having given me confidence in the minute measurement of trees, it occurred to me as desirable to ascertain, by means of a few trees of vigorous growth, what is the rate of increase of wood at different periods of the growing season. That season has been already found to exclude the six winter months, from October to April, equally for evergreen and leaf-shedding trees. It now turns out, however, that, in our climate at least, the period of growth of wood in an ordinarily good season is much more limited.

For this investigation I selected the Beech and Hungary Oak among leaf-shedding trees, and the Sequoia, Araucaria, and Atlas Cedar among evergreens, as in previous years their trunks made an annual increment in girth of 1 inch to nearly 2 inches. The leading result may at first create some surprise, viz., that the growth of wood in leaf-shedding trees is confined in general to the three months of June, July, and August. This will appear from the following table, showing the girths on April 30, 1880, and

	Apr. 30.	May 31.	June 30.	July 31.	Aug. 31.	Oct. 9.
	inches.	inches.	inches.	inches.	inches.	inches.
Beech	73·50	0·00	0·25	0·50	0·10*	0·00
Beech	62·40	0·10	0·30	0·20	0·35	0·05
Hungary Oak . .	27·10	0·30	0·40	0·40	0·30	0·00
Hungary Oak . .	16·45	0·05	0·40	0·30	0·30	0·05
Hungary Oak . .	13·50	0·20	0·30	0·30	0·25	0·05
Sequoia . . .	25·9	0·40	0·25	0·40	0·05	0·00
Sequoia . . .	27·35	0·55	0·50	0·70	0·15	0·00
Sequoia . . .	22·40	0·70	0·40	0·30	0·00	0·00
Sequoia . . .	27·45	0·55	0·40	0·45	0·00	0·00
Araucaria . . .	21·60	0·40	0·15	0·15	0·05	0·00
Atlas Cedar . .	30·65	0·45	0·30	0·40	0·30	0·05

the increments at the end of each successive month. The Hungary oak is in some measure an exception, as in two specimens there was an undoubted increase during the month of May. The explanation is, that in 1880 this early species was far advanced in foliage in the middle of that month. The explanation of the generally narrow limit of growth to three months, in spite of the favourable weather last May and the still finer weather of September last,

* In the end of July the foliage of this beech was observed to be very thin, owing to the extensive ravages of an insect. The observations for August 31st were made for me in my absence by Mr Sadler.

seems to be that in May the trees are only developing their leaves, without which wood cannot be formed; and that in September they are busy forming their buds for next spring, and also ripening their new wood. More extensive observations are necessary for settling the relative rate of growth in the several months. Already, however, the table gives an indication that June and July are the most favourable.

The only other general conclusion to be drawn from the table is that evergeen trees begin to increase in girth a month earlier than leaf-shedding trees—a fact which is intelligible enough, as they have leaves ready to make use of the sap at its first rise. It is not so easy to understand why most of these made the subject of observation added little, or even nothing, during the month of August, when the weather was invariably fine.

On the Morphology of the Pitcher of Cephalotus follicularis.

By Alexander Dickson, M.D., Professor of Botany in the University of Edinburgh. (Plates V. and VI.).

In a paper on the Structure of the Pitcher of *Cephalotus follicularis*, read at the Plymouth meeting of the British Association, and published in the "Journal of Botany" in January 1878, I pointed out the remarkable difference as to the position of the lid of the pitcher between *Cephalotus*, on the one hand, and *Sarracenia* and *Nepenthes*, on the other. In *Cephalotus* the lid is placed on that side of the orifice of the pitcher *nearest* to the main axis, while in *Sarracenia* and *Nepenthes* it is on the side *farthest* from the main axis. At that time I was inclined to assume that the pitcher-lid in *Cephalotus* represented the extremity of the leaf, and this led me to suggest—although under reserve—that, while the pitcher in *Sarracenia* and *Nepenthes* appears as a pouching of the leaf from the upper surface, in *Cephalotus*, on the other hand, the pouching would, on the assumption indicated, be from the lower leaf-surface. Developmental evidence is at present scarcely attainable, requiring, as it would do, the sacrifice of many specimens of a plant not very easy of cultivation, and never very common; and in absence of this we are glad to meet with any teratological deviations which may throw light upon the subject.

Some time ago our esteemed foreman at the Botanic Garden here, Mr Robert Lindsay, told me he had once seen what appeared to him to be a pitcher springing from an ordinary leaf, and I asked him to look at our plants from time to time in hope of abnormalities presenting themselves. The result has been the detection of several very interesting and instructive forms intermediate between the ordinary foliage-leaf and the pitcher; and I have now very great satisfaction in being able to pronounce a decided opinion on the general morphological relations of the *Cephalotus*-pitcher, even although I have to admit the complete reversal of my previous conceptions of the subject.

These abnormal leaves are four in number, of small size and feeble development. I shall now describe them in order of their extent of deviation from the form of the ordinary foliage-leaf towards that of a pitcher.

Specimen A (Plate V., fig. 2).—In general form this closely resembles the foliage-leaf, presenting a somewhat ovate blade narrowed gradually below into the leaf-stalk. It exhibits, however, on the upper surface a somewhat elliptical spoon-like excavation involving the terminal two-thirds, or thereby, of the lamina. This excavation is deepest at the end next the petiole, where it is bounded by a pretty sharply defined border. On the lower surface, towards the leaf-apex, there is distinct development of a keel-like ridge in the middle line. In this specimen we have the pitcher cavity foreshadowed by the spoon-like excavation, while the keel-like ridge represents the middle dorsal wing, which is a very prominent feature in the perfect pitcher.

Specimen B (Plate V., fig. 3).—Here the excavation has advanced to the formation of a narrow somewhat elongated funnel with oblique mouth, the *far* side of the orifice, from the main axis, extending out beyond the *near*; the leaf-apex (in this case a little truncated) being at the far side of the orifice. The *near* side of the orifice, instead of exhibiting the simply rounded excision seen at the deeper end of the spoon-like excavation in the first-mentioned specimen, is here developed in the middle line into a small but distinct tooth-like projection. This lobe is the first indication of the pitcher-lid. As in the former specimen, there is here, also, a keel-like ridge in the middle line on the lower leaf-surface.

Specimen C (Plate V., fig. 4).—In this we have a still greater approximation to the pitcher-form. As in the last, we have a funnel-like structure with oblique mouth, the far side of which retains, however, more of the original pointed form of the leaf-apex. The greater advance towards the ascidium consists in the greater development of the structure representing the pitcher-lid, which is of considerable size and deeply cut into three lobes, two longer and stronger lateral lobes, and a shorter, feebler median one. Here, again, we have along the middle dorsal line a keel-like projection.

Specimen D (Plate V., figs. 5 and 6).—In this, a misthriven leaf of very small size, we have a still greater approximation to the normal ascidium. The lid is relatively larger, and exhibits two lobes separated by a considerable notch, in this respect according more with the structure of the normal lid, where we have the extremity emarginate, corresponding to the dichotomous disposition of the principal veins. Further, in addition to the middle dorsal keel or wing, which is more pronounced in this than in the other specimens, we have, on one side, a slight indication (Plate V., figs. 5 and 6, *lw*) of one of the oblique lateral wings of the normal pitcher. The far side of the orifice of the funnel has still the pointed form of the apex of the foliage-leaf.

In all these specimens it is to be noted that the tip of the middle dorsal keel or wing and the apex of the leaf are coincident. Inasmuch, however, as none of them show the slightest trace of the remarkable development of the corrugated rim, with its inflexed teeth, it may still be open to question what represents the leaf-margin in the perfect pitcher. If the lower (outer) border of the corrugated rim represents the leaf-margin, then the tip of the middle dorsal wing would represent the leaf-apex. If, on the other hand, the leaf-margin is represented by the line of the inflexed teeth, then the middle dorsal tooth (Plate V., fig. 6, *mdt*), in line with the middle dorsal wing, and conspicuous by its larger size, would represent the leaf-apex.* Of the two possibilities I am disposed to look upon the first as the more probable; partly from the coincidence of the tip of the middle dorsal keel or wing with the leaf-apex in the abnormal specimens mentioned above, and partly from the vascular distribution in the normal pitcher. In the latter, the vessels from the extremity of the petiole divide into two sets, an upper going to supply the lid, and a lower which diverge radiatingly and are distributed to the pitcher-wall. Of the last mentioned set there are three somewhat more marked than the others, viz., a lateral vein on either side curving downwards and outwards past the lower extremity of the lateral wing, and passing obliquely across the lateral glandular patch to curve upwards towards the pitcher orifice, and a middle vein which runs in the ventral wall of the pitcher to the bottom, whence it passes on to the dorsal surface, where, however, it leaves the pitcher-wall, and, passing into the middle dorsal wing, continues its course just within the curiously expanded edge of that structure. In my opinion this course of the middle vein seems to prove that the middle dorsal wing is a development of the midrib, and that its apex really represents the leaf-apex.

In the three specimens exhibiting the funnel-shaped excavation, it is to be observed that the sharp margin of the far side of the orifice of the funnel—representing, as it undoubtedly does, the margin of the leaf—is continuous with an angular ridge, or *lateral line*, as we may call it, on either side of the funnel (Plate V., figs. 3, 4, and 5, *ll*). These "lateral lines" can scarcely be anything else than the downward continuations of the leaf-margin; and if they are so, it follows that all above the "lateral lines" is *upper*, all below them *lower* leaf-surface. In this way I am led to view the pitcher-lid as wholly developed from the upper leaf-surface, with which *both* its aspects are continuous. This conclusion might, indeed, have been anticipated from inspection of Specimen A, where the portion of the margin of the spoon-like excavation next the petiole

* Somewhat similarly, the teeth in line with the lateral wings of the pitcher are also of conspicuous size.

belongs manifestly to the upper leaf-surface. In the perfect pitcher the "lateral lines" are distinctly recognisable as ridges, one on either side, running from the junction of the corrugated rim with the base of the lid down towards the extremity of the petiole, where they disappear.

To convert, in idea, one of the funnel-like structures above described into the normal *Cephalotus*-pitcher, we must imagine that side of the funnel nearest to the main axis as remaining comparatively stationary, while the far side of the funnel becomes calceolately pouched to an enormous extent, forming, in fact, almost the entire pitcher. The pitcher-leaf of *Cephalotus*, with its calceolate pouching, whereby the apex of the lamina is curved round so as to become approximated to its base, may not inaptly be compared to the well-known "hammer-headed" upper petals of *Aconitum*, where we have also petiolated leaf-organs with similar pouching of the lamina and approximation of apex to base. The interest of this comparison is further heightened by the circumstance that in both cases the internal surface is developed (although for very different purposes) as a secreting apparatus. In illustration of the parallel, I give an outline figure of the pitcher-leaf of *Cephalotus* (Plate V., fig. 6), placed in such a position—with petiole nearly vertical—as will enable any one at a glance to compare it with the nectariferous petal of *Aconitum* (Plate V., fig. 7), a figure of which I have borrowed from Prof. Asa Gray's "Text Book."

The conclusions to which I have been led may thus briefly be stated:—

1st. That the pitcher results from a calceolate pouching of the leaf-blade from the upper surface.

2d. That the apex of the leaf is on the far side of the pitcher-orifice from the main axis and from the lid, and is probably represented by the tip of the middle dorsal wing.

3d. That the pitcher-lid represents an outgrowth or excrescence from the upper leaf-surface.

In this place I must mention that Dr Masters, in his "Teratology" (p. 314), says that "in *Cephalotus follicularis* rudimentary or imperfect pitchers may be frequently met with in which the stalk of the leaf is tubular, and bears at its extremity a very small rudimentary leaf-blade." Unless there is some error of description, the cases here referred to must have been exceedingly unlike mine; but whatever they may have been, it is quite certain that they had not been sufficient to enable Dr Masters to come to any very definite opinion on pitcher-morphology. This may be gathered from his immediately following conclusions as to ascidia in general, which run thus:—"It is not in all cases easy to trace the origin and true nature of the ascidium, as the venation is sometimes obscure. If there be a single well-marked midrib the probability is that the case is one of cohesion of the margins of the leaf; but if the veins are all of about equal size, and radiate from a common stalk, the pouch-like formation is probably due to dilatation and hollowing of the petiole.* Again, when the result of a union of the margins of the leaf, the pitcher is generally less regular than when formed from the hollow end of a leaf-stalk. Further information is especially needed as to the mode of development and formation of these tubular organs so as to ascertain clearly when they are the result of a true cupping process, and when of cohesion of the margins of one or more leaves."

In conclusion, I may refer to the principal points for comparison, or contrast, between the pitcher of *Cephalotus*, on the one hand, and those of *Sarracenia* and *Nepenthes*, on the other, in both of which latter the development has been examined—in *Sarracenia* by Professor Baillon,† and in *Nepenthes* by Sir Joseph D. Hooker.‡

As regards *Sarracenia*, Baillon's observations and conclusions are briefly as follows:—In *S. purpurea* the leaf appears at first as a small convex mammilla. A little later the base of the organ becomes somewhat dilated and a little concave towards the inner surface. This dilatation is the sheathing base of the petiole, and at a later period becomes considerably developed. It has nothing to do with the formation of the pitcher. This last appears somewhat later

* To this category Dr Masters would, no doubt, relegate the case of *Cephalotus*. It seems just possible that in the monstrosities of *Cephalotus* referred to by him the rudiment of the pitcher-lid has been mistaken for a "rudimentary leaf-blade."

† "Sur le developpement des feuilles des *Sarracenia*"—(*Comptes Rendus*, lxxi. p. 630).

‡ "On the Origin and Development of the Pitchers of *Nepenthes*, with an Account of some new Bornean Plants of that Genus"—(*Trans. Linn. Soc.* vol. xxii. p. 415).

as a small depression or fossa a little to the inner side of the extremity of the cone which represents the young leaf. This fossa—the result of inequality of development in the different portions of the extremity of a leaf whose petiolar and vaginal portions already exist—he holds to be formed on the upper surface of the lamina. The fully-developed pitcher he views as corresponding morphologically to a peltate leaf like that of *Nelumbium*. The large but shallow inverted cone which forms the leaf-blade in *Nelumbium* becomes in *Sarracenia* deeper and narrower, so as ultimately to present the form of a long obconical horn. The pitcher-lid he considers as merely the terminal lobe of the peltate limb.

If Baillon is right—as probably he is—in viewing the pitcher of *Sarracenia* as a modification of a peltate leaf, it would, in this respect, seem to differ considerably from that of *Cephalotus*. In *Sarracenia* the whole outer surface of the pitcher, on the near as well as on the far side from the main axis, would represent *lower* leaf-surface; whereas in *Cephalotus* the upper surface of the pitcher-lid and the portion of the outer surface of the pitcher-wall intervening between it and the extremity of the petiole, and bounded laterally by the "lateral lines" above referred to, belong to *upper* leaf-surface.

As regards *Nepenthes*, Hooker's observations conclusively show that the pitcher-cavity is the result of a pouching from the upper leaf-surface, and that the leaf-apex is represented by the "styliform process" which projects from behind the junction of the lid and pitcher. The lid here must be viewed as an outgrowth or excrescence from the upper leaf-surface, just as in *Cephalotus*: with this difference, however, that while in *Cephalotus* the lid springs from the side of the pitcher orifice *nearest* to the main axis, the lid in *Nepenthes* springs from the side *farthest* from it.

The pitcher-leaf of *Nepenthes* presents, as is well known, very considerable difficulties to the morphologist who wishes to reduce its parts to the terms of "petiole" and "lamina." The flatly expanded portion, sometimes sessile and sometimes supported by what closely resembles a petiole, is considered by Hooker as the lamina, whose midrib is produced as a tendril-like structure somewhat after the fashion of the cirrhose prolongation of the leaf-apex in *Gloriosa.* The pitcher he views as a glandular excavation on the internal aspect of this "excurrent midrib" somewhat below its extremity.

With regard to this determination a few remarks may not be out of place.

If Hooker's representation of the early development of the leaf of *Nepenthes* be examined, and especially his figure of the first appearance of the pitcher-excavation (*loc. cit.*, Tab. lxxiv., fig. 1 *b*), one cannot but be struck with its exact correspondence with Baillon's description of the development of the *Sarracenia* leaf, where the excavation representing the future pitcher appears as a small fossa a little to the inner side of the cone which represents the young leaf, the base of which is already somewhat dilated and a little concave towards the inner surface. If the pitcher of *Sarracenia* represents a leaf-blade, it seems scarcely possible to resist the conclusion that the same must hold good for *Nepenthes.*

An apparent difficulty, however, arises as to the signification of the flat expansion below the cirrhose support of the pitcher.

At first I was disposed to look upon all the parts below the pitcher—including the flat expansion—as representing the petiole; but an examination of the remarkable leaf-forms occurring in certain *Crotons* now inclines me to adopt a view virtually identical with that of Hooker, although perhaps not exactly in the shape contemplated by him.

In the plants called *Croton interruptus* and *C. picturatus* —probably both of them monstrous forms of *C. angustifolius* —we have, in many of the leaves, the phenomenon of an interruption, or more or less sudden narrowing in the course of the lamina, which for some distance becomes reduced to the slender filamentary midrib. It happens, moreover, that in the greater number of the interrupted leaves the distal portion of the lamina—borne upon the "excurrent midrib" —is developed, peltate-fashion, into an oblique funnel of varying depth.* (Plate VI. figs. 1 and 2).

* Especially in *C. picturatus.*

The closeness of the parallel which may be drawn between this structure and the ascidium-leaf of *Nepenthes* will be at once apparent; and, although analogical reasoning of this kind must be employed with caution, it seems highly probable that in *Nepenthes* we have to deal with a leaf the lamina of which is interrupted in the middle of its course by becoming reduced to its midrib, and that, while the proximal portion of the lamina retains its typical form of a flat expansion, the distal portion becomes peltately expanded into a funnel or pitcher.

In the *Croton* leaves just referred to, it is to be noted that the proximal expansion, while sometimes simply narrowed into the attenuated portion, as in Plate VI. fig. 1, is more frequently developed towards its extremity in a peltate manner, so that the midrib appears as excurrent from the lower leaf-surface, as in Plate VI. fig. 2. This latter case is of special interest inasmuch as a similar peltation towards the extremity of the proximal expansion occurs in many of the leaves of *Nepenthes phyllamphora*, and forms one of the specific characters of Hooker's magnificent *N. Rajah.*

EXPLANATION OF PLATES.

PLATE V.—*a* = Leaf-apex. *l* = Pitcher-lid. *ll* = "Lateral line." *mdw* = Middle dorsal wing. *lw* = Lateral wing. *mdt* = Middle dorsal tooth of corrugated rim.

Fig. 1. Normal foliage leaf of *Cephalotus.*

Fig. 2. Specimen A. Leaf with spoon-like excavation on upper leaf-surface.

Fig. 3. Specimen B. Leaf funnel-shaped, with small tooth-like rudiment of pitcher-lid on the near side of the orifice of the funnel.

Fig. 4. Specimen C. Leaf funnel-shaped. Rudiment of pitcher-lid 3-lobed.

Fig. 5. Specimen D. Leaf funnel-shaped. Rudiment of pitcher-lid 2-lobed. Nearly side view.

Fig. 5 (*a*). Nearly dorsal view of same specimen. Middle dorsal wing seen with its tip coincident with the leaf-apex.

Fig. 6. Normal Ascidium-leaf, placed, with petiole nearly vertical, for comparison with the funnel-shaped abnormalities and with the accompanying figure of the petal of *Aconitum.* If the ascidium-leaf be compared with the funnel-shaped specimens, and the position of the "lateral lines" (*ll*) be noted, it will be evident that the

pitcher virtually consists of a calceolate expansion of the far side of the funnel from the main axis.

Fig. 7. Nectariferous petal of *Aconitum* (after Asa Gray), showing petiolar portion (claw) and calceolately pouched lamina.

Plate VI.—Fig. 1. Interrupted leaf of *Croton picturatus.* Distal portion of lamina peltate, forming an oblique funnel. Proximal expansion simply narrowed into the attenuated portion.

Fig. 2. Another of the same. Here, however, the upper part of the proximal expansion is peltate, so that the filamentary midrib appears as "excurrent" from the lower leaf-surface.

In Plate V. the figures are all more or less magnified. In Plate VI. they are of natural size.

On Lepidophloios, a genus of Carboniferous Plants. By John M. Macfarlane, B.Sc. (Plates VII. and VIII.)

The genus Lepidophloios was formed by Sternberg * for the reception of certain Carboniferous plant remains, which, while conforming in many respects to Lepidodendron and allied genera, were distinguishable from these by well-marked peculiarities. These specimens he described as *Lepidophloios laricinum.* To the elucidation of the life-history of this species I propose devoting the present paper. The following is a short *resumé* of the literature on the subject. Corda † described and figured parts of the stem of a species of Lepidophloios as *Lomatophloios crassicaulis.* He wrought out the minute structure of it in great detail. Though able to ascertain its internal anatomy, he erred as to its true affinities, since he regarded it as being allied to Sempervirens and Cactus.

When Goldenberg published his "Flora Saræpontæ Fossilis," he—as far as I can learn—enumerated three species of Lomatophloios and two of Lepidophloios, the differences between these two genera, in the opinion of this observer, consisting in the greater size of the foliar cushions and leaf scars in the former. In a paper "On

* Tableau des genres de végétaux Fossiles, p. 43.

† Beiträge zur Flora der Vorwelt, Prague, 1845.

Fossil Plants from the Coal-Formations of Cape Breton,"* Bunbury gives figures and descriptions of various Coal-measure plants found in that locality, one of which he names *Lepidodendron tumidum*, and remarks: "This is one of those ambiguous forms which would be referred by some to Lepidodendron and by others to Sigillaria."

Schimper incorporates this as *Lepidophloios tumidus.*

Lesquereux, in his "Palæontology of Illinois,"† records one species, *Lepidophloios obcordatus.*

In "The Coal Formation of Nova Scotia and New Brunswick,"‡ and also in "Acadian Geology,"§ Principal Dawson enumerates five species of Lepidophloios, viz., *Acadianus*, *prominulus*, *parvus*, *platystigma*, and *tetragonus*; but the third of these, as Schimper remarks, "is manifestly a Ulodendron." Dawson says, in defence of his classification: "Regarding *Lepidophloios laricinum* of Sternberg as the type of the genus, and, taking in connection with this the species described by Goldenberg, and my own observations on numerous specimens found in Nova Scotia, I have no doubt that *Lomatophloios crassicaulis* of Corda, and other species of that genus described by Goldenberg, Ulodendron and Bothrodendron of Lindley, *Lepidodendron ornatissimum* of Brongniart and *Halonia punctata* of Geinitz, all belong to this genus, and differ from each other only in conditions of growth and preservation." In the paragraph preceding that now quoted he defines Lepidophloios, including, of course, Ulodendron, as possessing "transversely elongated leaf-scars, each with three vascular points, and placed on elevated or scale-like protuberances," also "long one-nerved leaves." Now, I have numerous specimens which prove (1) that the leaf-scars of Ulodendron—and this applies equally to Bothrodendron, its inner bark—were quadrilateral and almost equilateral; (2) that the protuberances were little, if at all, elevated above the bark; (3) that only one vascular point was present; and (4) that the leaves even in thick stems were short and densely imbricated. Above all, the presence in Ulodendron of the

* Quart. Jour. Geol. Soc., vol. iii. p. 123.

† Geol. Surv. of Illinois, vol. ii. p. 457.

‡ Quart. Jour. Geol. Soc. vol. xxii. p. 139.

§ Second edition, London, 1868.

very remarkable double row of scars—completely absent in Lepidophloios—clearly mark the two genera as being distinct. But, as I shall shortly proceed to show, this eminent palæontologist has greatly advanced the line of research in asserting that Halonia is part of Lepidophloios. Schimper refers his species *tetragonus* to *Lepidodendron quadratum*, but it seems to me exceedingly probable that it is simply the second layer of the bark of *Lepidophloios laricinum*, since it assumes the appearances these authors figure.

Schimper * refers all the forms of Lepidophloios to six species.

Williamson,† in an elaborate article "On the Internal Structure of the Fossil Plants of the Coal Measures," records observations made on material from the Pettycur plant bed. He shows, by a comparison of the internal structure of numerous specimens, that the genera Lomatophloios, Lepidophloios, Diploxylon, and Leptoxylon of authors are identical. To his paper I shall have frequently to refer.

Stur ‡ completely annihilates the genera Ulodendron and Lepidophloios. The remarks which I have already made regarding Ulodendron apply equally here, but Stur destroys the last-named genus by supposing that it "is a bulbil-bearing Lepidodendron stem," that is, he considers that Lepidodendron at certain stages in its life-history develops a series of viviparous bulbs, after the manner of our recent Lycopodium Selago, and it is during this stage that the Lepidophloios form results. Though the idea is an ingenious one, in all my specimens I have not been able to discover the least evidence in its favour, and the same may be said of all other observers. Besides, there are many other points which wholly forbid the union of Lepidodendron and Lepidophloios, and one of the two species which he figures *Lepidodendron Veltheimianum* can —as I hope to show on a future occasion—be traced through all its morphological changes without the intervention of any Lepidophloios stage.

We shall regard Lepidophloios then as a Lycopodiaceous

* Traité de Palæontologie Végétale, Paris, 1870 72.

† Phil. Trans. part ii. 1872.

‡ Die Culm Flora, Vienna, 1874.

plant, quite distinct from both Ulodendron and Lepidodendron. In the strata of the Calciferous Sandstone and Carboniferous Limestone series of the Lothians and Fife, *Lepidophloios laricinum* is exceedingly common. Selecting for description typical examples of stems, say 6 inches in diameter, we find that the surface of the bark is covered with a series of leaf-cushions, broadest at their bases, slightly tapering to the cicatrix, and imbricating over one another in *a downward or reversed direction* (Pl. VIII. fig. 3). At the apex of each cushion is situated the leaf-scar or cicatrix, having a rhomboidal outline, and bearing the impressions of three fibro-vascular bundles, which proceeded out into the leaf. Though I have not been able to obtain leaves still attached to the cicatrices, they are very abundant in the isolated state ; in the limestone of Burdiehouse, for example, slabs are sometimes so covered with them as to obscure the impressions of other organisms present. They are linear acute, and traversed by a single strong well-marked midrib. Corda* figures a very fine specimen with leaves attached. We are indebted to him for a careful account of the internal anatomy of the stem, which has been further expanded by Williamson. The centre is occupied by a mass of cellular tissue forming a true pith; surrounding this is a zone of scalariform vessels, forming what Williamson designates "the medullary vascular cylinder" ; outside this is another zone, which he asserts is formed by exogenous growth ; this he terms "the ligneous zone." Piercing it we have medullary rays, while outside is a mass of cellular tissue, surrounded by prosenchyma ; and, lastly, there is a sub-epidermal and epidermal cellular tissue. I have not been able to study its microscopic structure, as, with the exception of the bed mentioned, pieces well preserved for this purpose are very rare in our district. The variations in the appearance of the bark are interesting. My esteemed preceptor, Professor Balfour,† in pointing out the changes which the bark layers of *Araucaria imbricata* may assume, very truly remarks, "There can be no doubt that in vegetable palæontology the number of species has been needlessly multiplied, any

* *Lib. cit.* tab. 1, fig. 1.

† Palæo. Botany, 1872, p. 8.

slight variation in form having been reckoned sufficient for specific distinction." Let us see how this applies in the plant before us. The leaf-cushions at their bases spread out and are attached to the stem so as to enclose a quadrilateral area, in the centre of which the impression of the rhomboidal cicatrix may appear. This I believe to be what Dawson figures as *Lepidophloios tetragonus*, while Schimper's *Lepidodendron quadratum* is, I doubt not, the same without the cicatrix. The sub-epidermal part of the bark is marked only by the elongated prominences which the leaf-bundles give rise to on passing out into the leaves. The fact already mentioned, viz., that the leaf-cushions imbricate in a downward direction is important, and will assist me in my future generalisations. Schimper seems to be the only writer who has pointed this out hitherto. That such does take place has been clearly demonstrated by my finding branches in the act of dichotomising; moreover, the leaf-cushions follow a course exactly the opposite of that pursued in the forking of the stem. From this it might be supposed that the leaves did not closely surround the stem as in Ulodendron, but that they spread out in a lax fashion, as has been shown by Corda. In all my specimens where dichotomous division is seen, the angle which the two branches form is almost exactly 90°, a divergence very much greater than most Lepidodendra, where it is only about 45°. Such then is the general structure of stems from 2 inches to 1 foot in diameter. When we pass to those of smaller size, we find that two forms are encountered, which are essentially alike in the nature and disposition of the leaf-cushions, the form of the scars, the number of vascular markings on these, the angle of dichotomy, and the final branch termination in a rather abrupt manner, but which differ in two important respects, since in the one a remarkable series of tubercles gradually appear, arranged in quincuntial order, as also the passage, according to Williamson, from the medullary vascular cylinder of a number of vascular bundles proceeding out into these tubercles. Both these peculiarities are wanting in the second. In other words, I regard Lepidophloios as undoubtedly terminating in two forms of branch, the one being what we have hitherto known as Halonia, while the other in nowise differs from a typical Lepidophloios stem, such as Schimper and others figure, except in size. I propose, for convenience sake, though perhaps arbitrarily, to name Halonia the fertile, and the latter the sterile, branches of Lepidophloios; the reason for this I will state hereafter. The latter, or so-called sterile form, gives us no trace whatever of the tubercles present in the fertile or Halonia form; it is possible, however, that such may appear at a more advanced age. Of this, however, we have no direct evidence. They usually curve towards their extremities in a graceful manner, describing at times a considerable arc of a circle, and, as already mentioned, end rather abruptly. But it is the so-called fertile part, which hitherto has been designated Halonia, that is of particular interest to us. Hitherto its relation to some other plant has been much debated, some of the older authors regarding it as the root of a Lepidodendroid plant (Wilde, "Geologist,"1863, p. 266). More recently, and especially since its internal structure has been ascertained, botanists have almost universally looked upon it as being the axis of inflorescence of some unknown genus, which, from the evidence I now advance, appears undoubtedly to be Lepidophloios. If, then, Lepidophloios does terminate thus, we should naturally wish to obtain such an example as would show the transition from it to that of Halonia by the gradual appearance of the tubercles of the latter. This we have in the specimen which I figure (Plate VII. fig. 1). Though we could have wished that the primary axis had been preserved for us a little further, enough remains to us to show that it was devoid of the tubercular cicatrices till about an inch below the point of bifurcation. There then appear on the exposed surface of the stem two of the well-known tubercles, and from that point upwards they are abundantly developed in spiral order.

As I previously stated, Principal Dawson has asserted that some Halonias, which he figures, are the fruit axes of Lepidophloios, without exactly stating his reasons for supposing so. But a strong confirmation of the idea which I have brought forward is to be found when we turn to the internal anatomy. This has been very elaborately wrought out by Dawes ("Quar. Jour. Geol. Soc." sec. iv. p. 289); Binney ("Palæont. Soc. Memoirs," 1871), as well as by Professor Williamson. It agrees in all respects with large stems of Lepidophloios, except in the absence of a ligneous zone, and the presence of a series of vascular diverticula, which differ very materially from those proceeding into the leaves. Instead of, as in the latter, being derived merely from the outside of the vascular cylinder, it is the result of a break in the continuity of the cylinder; in fact, it repeats, on a small scale, the dichotomous branching of the large stem already mentioned. But, as Williamson remarks, "instead of half the entire cylinder being split off, but a small portion of it is so separated." He infers, therefore, "that the vascular bundle thus originated proceeded to some modification of a branch, but which modification was of smaller dimensions than branches usually attained to, and which consequently required a less abundant supply of vascular tissue than ordinary branches needed. Such a modification would," he imagines, "only be found in a Strobilus, which must be regarded as a branch that has undergone an arrested development at a very early stage of its growth." Schimper, arriving at the same conclusion, says: "It is natural to suppose—so it seems to me—that they were the points of attachment of fruits." Supposing, then, this assumption to be correct, do we find specimens which would justify this conclusion? We do. Through the whole of the Calciferous and Carboniferous Limestone series a particular form of cone occurs, which, by a little study, one is able to distinguish from the cones of *Lepidodendron Veltheimianum* and allied forms. Occasionally there is attached to this cone a slender stem (Plate VIII. fig. 1), which agrees exactly in every point of its external characters with Lepidophloios and Halonia, but on a much smaller scale, and without the tubercles of the latter. Dawson figures this cone very accurately, but makes no mention of the stalk which supported it. I have been able to obtain many specimens with the cones attached, and in all stages of growth. Here I may be allowed to mention a very interesting circumstance as to the distribution of these plants among the rocks of the neighbourhood. About four years ago I commenced to work the shales overlying the sandstone quarry of Hailes. These are of a very fine-grained and foliated nature, and of a deep black colour. Admirably preserved in the foliæ of the strata I found numerous plant remains, prominent among which, for their abundance, were the isolated twigs and cones now under consideration, as also in less abundance the twigs and cones still united, but, with the exception of a thin Halonia branch, not a trace have I obtained otherwise of Lepidophloios. On the other hand, the bituminous shales of Straiton, Dalmeny, and Addiewell, have yielded me abundant examples of the larger Halonia and Lepidophloios branches, but not a scrap of the thin twigs so abundant at Hailes. Lastly, in the Calcareous shales of Grange, near Burntisland, and the limestone of Burdiehouse and Camps, we find all the forms mixed indiscriminately together. Here is a valuable lesson to the palæontological botanist. The fine shales of Hailes and the Water of Leith valley seem to have been deposited in calm waters, at a considerable distance, probably, from some river's mouth. Here delicate fern-fronds, small twigs, and light cones—floated further than the heavier and more massive stems to which they belonged—were quietly deposited and covered by fine mud. The bituminous shales were probably formed nearer land where currents were frequent, as is shown by the irregular beddings of the rock, and the large stems which they contain, and from the decay of these vegetable organisms, we have, I think, the origin of the bitumen for which these shales are famed. The Burdiehouse series of rocks again appear, at least partly, to have been laid down in lagoons or large pools teeming with Cypris, and into these were whirled large and small organs alike.

The slender cone-stalk has downwardly directed and imbricated leaf-cushions, rhomboidal or more nearly elliptical leaf-scars, each with three fibro-vascular impressions and linear leaves. These leaves are from $\frac{1}{2}$ to $1\frac{1}{2}$ inch in length, and stand out from the twigs at an angle of from 45° to 75°. The twigs or cone-bearing branches seem to have dichotomised comparatively seldom, as I have not been able, out of the hundreds of specimens which Hailes has yielded me, to obtain a single example of such, one dug out by me from the bed of the Water of Leith at Kate's Mills, and two in the collection of the Geological Survey, being all that I know of. When dichotomy did occur, the angle formed varies from 75° to 90°, and in many of my Hailes specimens the medullary vascular zone is well preserved as a thin chord traversing the middle of the twig. The twigs vary from one-tenth to one-third of an inch in diameter. The cone attains a maximum size of 4½ inches. I have obtained, principally from the shale of Hailes quarry, a very complete series of cones, differing in size and age. In the young state they are not unlike Cardiocarpa, and for such they have occasionally been mistaken. At this stage only one row of cone-scales is visible. As growth proceeds the extremities of other scales appear, and these are added to, by elongation of the cone, till the adult form is reached. The cone-scales or bracts, on the inturned bases of which the sporangia are borne, are lanceolate, and traversed by a single median rib (Plate VIII. fig 2.).

Lepidophloios laricinum is found throughout the whole of the Calciferous series, and apparently less sparingly in the Carboniferous Limestone series round Edinburgh. Mr John Henderson of the Geological Society has shown me a Halonia from beds on the east side of Kinghorn identical with that of the Calciferous series, while Mr H. M. Cadell has furnished me with cone-twigs obtained by him from "a whitish argillaceous bed, about 9 inches in thickness," * in the Borrowstounness coalfield. It is the only species occurring in the Calciferous series itself as far as my observations go. A totally distinct species is found in the Upper Coal-Measures which seems exactly to resemble Bunbury's *L. tumidus.*

I would here express indebtedness to my kind friend, Mr C. W. Peach, for permitting me to examine some of the specimens in his rich collection. The plates have been drawn and lithographed by my fellow-worker, Mr R. Kidston, whose careful and beautiful work in art is but a counterpart of the qualities he displays in the pursuit of science.

* Trans. Geol. Soc. Edin. 1880, p. 306.

EXPLANATION OF PLATES.

PLATE VII.—Portion of branch of *Lepidophloios laricinum* bifurcating. Below the point of dichotomy are two cicatrices or tubercles pretty far apart, while above there are several developed in regular order. The lower part of the branch is destitute of tubercles, and exactly resembles an ordinary Lepidophloios; the upper portion with tubercles is what has hitherto been designated Halonia.

PLATE VIII.—Fig. 1. Supposed cone of *Lepidophloios laricinum* with cone-stalk. The latter, in all probability, articulated with a tubercle of the Halonia branch.

Fig. 2. Isolated cone scale.

Fig. 3. Portion of stem of *L. laricinum* 3 inches in diameter, natural size.

Fig. 4. Portion of cone-stalk, $\frac{1}{3}$ inch in diameter, magnified.

Fig. 5, *a*, *b*, *c*. Stages in the development of the cone.

Notes on the Action of some Aniline Dyes on Vegetable Tissues. By JOHN M. MACFARLANE, B.Sc.

(Read 14th July 1881.)

The action of the aniline dyes on vegetable and animal tissues has recently been carefully studied, and the results obtained have proved satisfactory. I now propose recording some of the more important methods arrived at.

I. *Staining of Laticiferous Vessels.*—Every botanist must have experienced the difficulty of obtaining thoroughly good preparations of laticiferous vessels. Sachs* recommends boiling in dilute potash; but, while tolerably good sections may be obtained in this way, several difficulties are encountered. The points to be aimed at in preparing this tissue are (*a*) the coagulation of the latex, so that it may continue to fill the vessels; (*b*) the staining of the cut sections, so that the vessels may be distinctly differentiated from the surrounding cellular substance; (*c*) the successful mounting of these, so that the tint may be permanently retained. The first part of the process is best accomplished by obtaining, for example, a large and entire root of *Scorzonera*, so that extensive bleeding may be prevented. A suitable

* Text-book of Botany, p. 110.

sized bottle being filled with alcohol, pieces of the root from one to two inches in length are cut, and *immediately* placed in it. Coagulation of the latex is quickly effected. After lying thus for a week or longer, sections are cut with the hand, or by aid of a microtome. The second point is most important, and on its success the beauty of the object will depend. The sections are placed in alcoholic solution of saffranine, obtained by dissolving 1 part of this dye in 800 parts spirit. After eighteen to twenty-four hours they are removed from the stain and decolorised by washing repeatedly in spirit. It will be found that the stain leaves the cellular tissue rapidly, while it is retained by the latex in the vessels. We will notice lastly the best method for mounting these. While such media as balsam or dammar would cause unnatural contraction, fluids, on the other hand—especially acetic acid solution—are apt to act slightly on the dye. I have found nothing to equal glycerine jelly, as it preserves the tint and is easily worked.

II. *Double Staining of Stems, &c.*—The dyes usually recommended for this purpose are *rosaniline* and *iodine green;* but *saffranine* and *emeraldine* are preferable, as the former is, for vegetable tissues, a most permanent dye, while the latter imparts a brighter colour than iodine green.

III. *Staining of Cell Contents.*—While some aniline dyes act specially on the thickened walls of cells, others are extremely useful for demonstrating the structure of protoplasm. *Heliocin* and *naphthaline* in this respect are valuable; and *eosin*, though not an aniline dye, is equally so. For epidermis cells and ordinary parenchyma the latter is preferable. It is best prepared by dissolving 1 part, in 1200, of alcohol. The specimens are allowed to lie for five minutes in the stain, and are then washed in water and mounted in a cell with acetic acid, or Goadby's solution. The cells of *Spirogyra*, however, have their minute structure beautifully revealed by treatment with *heliocin*. The following is the best method to adopt:—Decolorise the filaments by placing them in a 1 per cent. solution of chromic acid for two days; add then to the solution 1 part, in 2000, of the dye and shake slightly, so that it may dissolve equally. In an hour the filaments will be ready for examination or permanent preparation.

The Structure and Division of the Vegetable Cell. By J. M. Macfarlane, B.Sc., Demonstrator of Botany in the University of Edinburgh, (Plates IX. and X.)

(Read April 16 and May 12, 1881.)

Introduction.

During the last six years our knowledge of the animal and vegetable cell has been greatly increased. Previously, it was held by most observers that a typical cell consisted simply of a *wall* or bounding membrane, secreted from the *protoplasm* which filled the cell, a *nucleus* formed of protoplasm of a denser consistence than the surrounding mass. Inside the nucleus a *nucleolus* was supposed occasionally to be present. It is now being gradually discovered that the cell is of a more complicated nature, and is the centre of more complicated changes than had once been imagined. Admirable summaries of the advances made prior to 1878, especially those of Strasburger, have been given* by Priestley and Klein. To summarise briefly their papers, it may be said that a network of fibres can be seen permeating the substance of the cell attached on the inner surface to the nucleus, and that these are merely continuations of a similar network within the nucleus. The former has been termed by Klein the *intra-cellular network*, the latter, the *intra-nuclear network*. It is further stated by Klein that Eimer, Flemming, and himself consider that in the animal cell a *nuclear membrane* is present surrounding the nucleus.

As it is specially with the vegetable cell that I will deal, a more detailed account of Strasburger's investigations is necessary.† This author shows that in division of the cell the nucleus undergoes a series of peculiar changes. At first of a rounded or oval outline, the denser material aggregates to form a dark band—the *nuclear plate*—crossing a clear fusiform area—the *nuclear disc.* The former splits up, each part retreating along the clear area to its extremity, and there form the *daughter nuclei.* These are again united by a fibrous bridge, and in the middle of this a row of granules appear—forming the *cell-plate*—which

* Quart. Journ. Micro. Soc. vols. xvi. and xviii.

† Ueber Zellbildung und Zelltheilung.

in turn eventually split up; and between them the cellulose wall is formed. He does not attach any special significance to the nucleolus. This idea is shared by Klein, who says, referring to the animal cell:—"To every experienced student of histology it must have become apparent that if there is one thing unsatisfactory, unreliable, puzzling, and inconstant about the nucleus of vast numbers of cells, it is this very nucleolus." He concludes that the so-called nucleoli are either thickenings of the intra-nuclear network, or result from "shrivelling up and intimate fusion of a part of the network."

More recently Flemming, Treub, Schmidt, and Hegelmaier have contributed some important observations. Schmidt has shown * that in the cells of the *Siphoneæ* and *Siphonocladeæ* among Algæ, as also in *Saprolegnia* and the *Myxomycetes* among fungi, instead of one nucleus, many may be present; amounting in the genus *Valonia*, for instance, to several hundreds. He has further proved that various of the simpler algæ and fungi, formerly supposed destitute of a nucleus, possess such a body; and he concludes that in all Thallophytes the cells contain one or more nuclei, organisms destitute of a nucleus being unknown. Treub† points out that not only in Cryptogams do a plurality of nuclei occur, but that in the bast fibres and laticiferous cells of various Phanerogams a like condition is found.

Hegelmaier ‡ records observations on the cells of the suspensor in various leguminous plants, and states that in these, numerous nuclei may be present, to the number of twenty, thirty, or more, embedded in a parietal layer of protoplasm. Inside each is a clearly-marked nucleolus; and in old nuclei two nucleoli may be found. He then advances the important fact, which I had previously verified for myself in various plants, that division of the nucleus is always preceded by that of the nucleolus, which elongates, assuming a dumb-bell shape, and then divides. The nucleus next divides, and one nucleolus goes with each half. He notices that while the nucleolus is sharp and clear in outline, the nucleus at its periphery seems to fuse with

* S. B. Niederrhein, "Geo. Natur-u Heilk." Bonn, 1879.

† *Comptes Rendus*, lxxxix. 1879, page 494.

‡ Bot. Zeit. xxxviii. page 513.

the protoplasm. An article by Flemming,* which has recently appeared, will be referred to shortly.

My attention having been given for some time to the study of the vegetable cell, I found on examining the epidermal cells of *Ornithogalum pyramidale*, L., with Hartnack's No. 4 eyepiece and No. 7 objective what seemed a well-marked body inside the nucleolus of a cell. The idea suggested itself to me, Might this be constant? and on carefully examining the others, such was found to be the case. The epidermis was quite fresh, and had been stained in alcoholic solution of eosin—an excellent stain for demonstrating minute structure. Through the kindness of Professor Dickson, I submitted them to a Hartnack's No. 10 immersion objective, and the new structure was well seen. Numerous other flowering plants were examined, and in the whole of these it was found to be present in the cells of the epidermis, lamina, petiole, stem, and root, as also in Cryptogams such as *Equisetum limosum*, *Chara*, *Spirogyra*, &c. All the plants enumerated below show the new structure well; though in some, it is larger and more marked than in others.

DICOTYLEDONS.

Phaseolus multiflorus, stem, petiole, and lamina.
Veronica gentianoides, leaf epidermis.
Polemonium cæruleum, petiole cells.
Rheum officinale, stem, petiole, and lamina.
Rumex acetosella, leaf epidermis.
Asarum Europæum, leaf epidermis.

MONOCOTYLEDONS.

Orchis mascula, leaf epidermis.
Vanilla, sp., leaf epidermis, stem, and aerial root.
Pancratium rotatum, leaf epidermis.
Pancratium caribæum, leaf epidermis.
Eucharis candidissima, leaf epidermis and petiole cells.
Narcissus Pseudo-narcissus, leaf epidermis.
Hyacinthus, leaf epidermis.
Scilla Peruviana and *bifolia*, leaf epidermis, &c.
Allium sativum, leaf epidermis.
Fritillaria imperialis, leaf epidermis.

* Arch. für Mikr. Anat. xviii.

Ornithogalum pyramidale, various.
Colchicum autumnale, leaf epidermis and parenchyma cells.
Pothos, sp., leaf epidermis.
Saccharum officinarum, cells from young stem.

CRYPTOGAMS.
Equisetum limosum, cells from young stem.
Chara fragilis.
Spirogyra nitida.

The cells of the stem and leaf-epidermis of *Fritillaria imperialis* show the largest examples of the new structure, but it is very distinct in *Ornithogalum pyramidale*, and *Narcissus Pseudonarcissus*. In the cylindrical cells of *Spirogyra* there is a difficulty, at times, to demonstrate it owing to their roundness, but in Plate X. fig. 1, it is very evident. Usually there is only one, but it is by no means uncommon to find two, and even three or four. When more than two are present, however, the cells are generally old; and this is a significant fact. The new structure is round or slightly oval in outline, and exhibits a clear bounding-wall differentiating it from the substance of the nucleolus. Aqueous solution of logwood reveals its outline well, still better is a solution of iodine; but I prefer to either of these a $\frac{1}{4}$ per cent. solution of eosin in common methylated spirit.

After verifying its apparent invariable presence in the plant cell, a preparation of cerebellum, which I had made in Professor Rutherford's class of Practical Physiology, was submitted to the microscope. In the large multi-polar nerve-cells a nucleolus has long been known to exist, but inside many nucleoli this new structure was quite visible. Dr Priestley informs me that it has been mentioned before casually, but no importance was attached to it. On looking over various zoological works one finds that it is figured repeatedly; as to its presence in the animal cell we may for the time neglect it. To this new factor in the vegetable cell I propose applying the term *nucleolo-nucleus*. My investigations led me strongly to the conclusion that the nucleolus is also an invariable element; in fact all the tissue systems of every plant, which have come under my notice in the present connection, are provided invariably with a nucleus, nucleolus, and nucleolo-nucleus, *if the cell is still active.* To ascertain, if possible, the function of these, and their *rôle* in division of the cell, I set about examining various plants. The results obtained have been highly interesting.

Structure and Division of the Cells of Ornithogalum pyramidale, *L.*; Scilla bifolia, *L.*

Ornithogalum pyramidale has a much stronger growth than *Scilla bifolia,* and the cells are very much larger, consequently the former has most engaged my attention. By obtaining bulbs in which the young ascending axis had not attained to a great size, and by splitting up these so as to expose the pale actively growing parts, admirable examples were obtained, showing all the stages of cell division. As the epidermis is well suited for study, owing to the largeness of the cells and their local development of stomata, this tissue has principally been chosen. If we carefully strip off a piece of epidermis, say 2 inches long, from the point of union of a leaf with the short underground axis and upwards, and stain with logwood, iodine, or eosin, all the changes in division and new formation of cells can be traced. At the basal part of the preparation will be seen cells quite resembling each other in size and structure, and not as yet indicating any differentiation into stoma mother cells, and cells of the epidermis. The interior is generally filled with protoplasm, containing a nucleus, nucleolus, and nucleolo-nucleus. While in many nucleoli only one nucleolo-nucleus is present, others may be seen with two. Some of the nuclei again, as we pass up the preparation, have two nucleoli with a nucleolo-nucleus in each. Lastly, nuclei may be dividing, or nearly divided, to form two cells, each daughter nucleus carrying with it a nucleolus and nucleolo-nucleus.

One of the two cells thus resulting, we will suppose, elongates to form an epidermal cell, while the other is destined to form a stoma. We will meanwhile trace the latter, superficially distinguished from the former by its increasing little in length, but significantly distinguished by its subsequent history. At first, having only one nucleus, nucleolus, and nucleolo-nucleus, the latter soon divides. Though, owing to its small size, I have only once seen what appeared to be a median constriction, there can be little doubt that this is the course of events, for two distinct ones can often be discerned in cells about this period. The nucleolus next elongates, and this almost invariably parallel to the plane of the former cell-division. Sometimes it may form an acute angle with it, or even may elongate at right angles, the first, however, is by far the commonest method. A constriction is then carried through the centre of it, which deepens till complete separation into two results, each carrying with it a nucleolo-nucleus (Plate IX. figs. 1 and 2). That increase in its size goes on at this time cannot be doubted, since the two new nucleoli are each nearly of the same size as was the parent one at its initial period of division. The nucleus next elongates slightly in the same plane as did the nucleolus, the protoplasm collects considerably around it; next, by movement of what seems the denser material of the nucleus towards the two poles, a narrow but elongated clear space, traversed by very delicate fibrils stretching from its two halves, appears running at right angles to the plane of elongation of the nucleus, this may be called the nuclear barrel. Shortly, in the middle of it, there can be distinctly seen a double row of close-set dots which, on focussing, seem to change their position, almost giving one, at first glance, the idea of three parallel rows. This results from different parts of the cell-plate being seen as the focus is altered. Along this cell-plate the new cellulose septum is deposited, and after a considerable interval it splits up to constitute the aperture of the stoma. Even before the nuclear disc is visible the two nucleoli take up positions on opposite sides of its area (Plate IX. fig. 3). Such is the course of development as far as I have been able to follow it. Strasburger gives a very similar account, as far as nuclear division goes, of the formation of a stoma in *Iris pumila*. In *Ornithogalum*, however, elongation of the nucleus is not nearly so pronounced as in it.

We may seem now to have exhausted the complete history of stoma development, but in many instances this is not so. Even during the nuclear division one can often observe that the nucleolo-nucleus of each half has again divided, and by the time that complete separation of the two cells of the stoma has been brought about, the nucleolus also may have divided, giving us two nucleoli in each guard-cell, and this condition may be permanently retained. This may seem an unimportant fact, but it helps us to make a broad generalisation as to division of the cell generally, viz., that the nucleolus, or more probably the nucleolo-nucleus, is the centre of germinal activity, and that as we pass outwards to the periphery of the cell, this reproductive activity becomes less and less. In no other way, to my mind, can the number of nucleoli and nucleolo-nuclei at different ages in the cells of any plant be explained; but regarding this as the true explanation many difficulties vanish. If such, then, be the case, we should expect to find that, occasionally at least, each guard-cell nucleus should split up, and, by formation of a septum, give rise to two cells. Were this morphological change to take place, the physiological function of the stoma would necessarily be destroyed. This interesting pathological change has thrice come under my notice. Ordinarily, as the guard-cells become aged, the nuclei may get shrivelled, and protoplasm, with chlorophyll bodies and starch, greatly fills the interior. They would seem in truth to have played out their important function.

The whole of the above changes have also been seen in *Scilla bifolia*, except the strongly marked dumb-bell shape assumed by the nucleolus before division. Let us return now to the epidermal cell. When newly cut off it exactly resembles the stoma mother-cell, but is soon distinguished by the great elongation which follows. In some specimens a very pretty alternate arrangement of epidermal and stoma cells, on the principle, so to speak, of the nodal and internodal cells of *Chara*, prevails over the surface, except where fibro-vascular bundles traverse the leaf. If this be the fundamental constitution it is only exceptionally met with, as, by repeated transverse division of the epidermal cells, two or more of these may intervene between two stomata. These divisions are carried out in exactly the same way as in the stoma, only that nucleus, nucleolus, and, I should imagine also, nucleolo-nucleus, elongate, not parallel, but at right angles to the former plane of division, the new partition running, not as in the stoma, from base to apex of the leaf, but transversely. Though failing to obtain in *Ornithogalum* a good instance of nuclear division, this has been afforded by *Scilla bifolia*, the nuclear disc, when fully established, being nearly as large as either of the elongated daughter-nuclei. In the surface growth of the leaf epidermis, however, it is, to a far greater extent, by elongation of cells which had been cut off in a young state, rather than by actual multiplication, that a greater extent of surface is produced. Now, as these cells, after multiplication and elongation, pass more and more into the permanent state, division of the nucleus, with subsequent formation of a cell-plate, is correspondingly rare ; but just as in the guard-cells of the stoma, so here also the nucleolus and nucleolo-nucleus still display a greater reproductive activity, and, as a result, we may find all stages in the dumb-bell shaped division of the nucleolus, which seems now to pass through this change much more sluggishly than in embryonal cells. We therefore find many cell nuclei with two well-marked nucleoli, and one, two, or more nucleolo-nuclei in each. This exactly coincides with the cells of the suspensor of some *Leguminosæ* at a certain period, as described by Hegelmaier ; but, whereas, in all the examples of *Scilla* examined only one nucleus was in each cell, in those of the *Leguminosæ* the nuclei were still able to divide, each resulting daughter nucleus carrying with it a nucleolus. This latter state of affairs is, I think, simply a progression on the first, in which the nuclei, as well as nucleoli, go on dividing, without, however, being seemingly able to form septa.

I will now deal very shortly with the ordinary pallisade parenchyma cells of the leaf, as in all essential points they do not differ from those already described. If we take a portion of young epidermis to which patches of these cells are adhering, we immediately notice all steps in the cycle, such as has already been discussed. Some of these cells will contain a nucleus, nucleolus, and nucleolo-nucleus ; others a nucleus, nucleolus, and two nucleolo-nuclei, others, again, a nucleus, two nucleoli, with a nucleolo-nucleus in each, while nuclear division may be seen proceeding or completed, each daughter nucleus carrying with it a nucleolus (Plate IX. figs. 12–15). This is therefore identical with those previously dwelt upon, and need not further concern us.

A few words now on the nucleus, as to its surface and contents outside the nucleolus. Of recent years it has been regarded by most as possessing a distinct covering, to which the term nuclear membrane has been given. In very young cells of *Scilla*, where the nucleus is densely surrounded by protoplasm, it is difficult to make out a double contoured bounding wall; but as vacuolation goes on, and the protoplasm gets stringy, in like degree does this membrane make itself evident. In epidermal cells of *Scilla*, stained with eosin, it is of a pale homogeneous colour, and doubly refractive, contrasting well with the stringy and granular nuclear substance. In a few cells of *Scilla* treated with alcoholic solution of eosin I have seen it quite detached from the nuclear substance, over the greater part of its surface; the nuclear substance had apparently shrunk from it or the latter had swollen out. In my observations on *Spirogyra* an experiment will be explained whereby the presence of this membrane can be positively demonstrated in one plant at least.

The stringy and granular aspect of the nucleus has lately given rise to much discussion. Butschli, Schwalbe, Hertwig, Eimer, Klein, Flemming, and others, have recently insisted on there being in the animal cell a homogeneous network of fibrils, traversing the nuclear substance, and attached to the inner side of the nuclear membrane. In the young state of *Ornithogalum* and *S. bifolia* one can plainly discern little filaments on the inner surface of the still thin nuclear membrane, which have the same clear homogeneous appearance as it. It is exceedingly difficult, however, to trace the fibrils for any length, since they seem to form a dense plexus. If, however, a piece of pretty old epidermis in which the nuclei are large and well formed be selected, and stained in solution of eosin, or, better still, in a $\frac{1}{4}$ per cent. solution of chromic acid, to which 1 part in 2000 of heliocin is added, this, when submitted to a Hartnack's No. 10 immersion, displays most beautifully a dense reticulum of clear homogeneous fibres, stretching inwards from the equally clear homogeneous nuclear membrane. If, then, the piece of epidermis be subjected to teasing and rolling with a needle handle, so as thoroughly to set free all loose protoplasmic material, it will still be found that many of the nuclei remain, though broken up, a fibrous network being still discernible, and, what is noteworthy, the nucleoli almost invariably are present as if moored to the nucleus in a definite way.

I would now notice the results at which Flemming has arrived in studying the animal cell. In a paper published in 1879 * he considers that two forms of division have been described—the direct and indirect. In the former, "supposed until recently to be the normal one, the nucleolus first divides, then the nucleus, and finally the cell. In the indirect method, the nucleus, first of all, undergoes metamorphosis, separating into a network of highly-refracting filaments, and an intermediate substance not affected by staining fluids. The nuclear network goes through a definite series of changes, and finally divides," † these masses then representing the two daughter nuclei. Flemming at that time did not believe that direct division ever took place. In a more recent paper ‡ he is inclined to suppose that both kinds of division may occur, though the indirect, in his estimation, is by far the commoner. In using these terms he regards them merely as provisional. He further, after describing most carefully the metamorphosis which the nuclear fibres undergo, comes to the conclusion that forces seated in the achromatic, or the nuclear substance component, of the nucleus, are the real initiators and directors of division. But he then propounds the thesis that the function of the nucleoli has in this respect been greatly mistaken, since he supposes that better methods may show that they are not even morphological constituents, but mere thickenings or deposits. It has been my aim to show that it is neither the plan of direct or indirect division, so called, that goes on, but a process compounded of the two, and requiring both of these supposed distinct ones to explain it. Moreover, Flemming himself very beautifully suggests that, to account for the peculiar changes of the nuclear fibres, we require only two

* Archiv Path. Anat. u. Phys. (Virchow) lxxvii. 1879, p. 181.

† Abstract Roy. Micro. Journ. vol. iii. 1880, p. 51.

‡ Arch. für Mikr. Anat. xviii.

agents or forces acting in different directions in the interior of the nucleus; and what can more naturally supply those than the nucleolus after division has taken place, since each daughter nucleolus now acts as a new centre of influence. It may be asked, have I not been able to observe this most characteristic series of movements in the nuclear fibres of *Ornithogalum* during division? I have not; but this can be easily explained when we remember that these fibres in young cells are exceedingly delicate; and, besides, it is not by observing these movements *only* that we can arrive at a right knowledge of the whole process—a fact this acknowledged by Flemming himself, who confesses that the most obvious phenomena of division which he so carefully discriminates have in all probability the least significance.

We will see how well all these propositions can be demonstrated in dealing with *Spirogyra*.

Structure and Division of the Cells of Spirogyra nitida, *Kg.**

The fresh-water alga *Spirogyra* is very convenient for studying the structure and division of the cell, since in its cells the nucleus is isolated from the protoplasm, and is connected with the latter only by delicate radiating strands. The particular species which has been chosen for observation is *S. nitida*, the commonest form in the neighbourhood of our city, and possessing, moreover, a large nucleus, nucleolus, and nucleolo-nucleus.

1. *Structure of the Cells.*—Like all the species of the genus it is a filamentous alga, made up of a large number of simple cylindrical cells, joined end to end. Each cell-wall has the usual homogeneous appearance. Immediately inside it, and forming a complete interior lining, is a thin layer of pale, homogeneous, or but slightly granular protoplasm. Embedded in this are four spirally-arranged bands of chlorophyll. Thanks to the researches of Pringsheim † we are now well acquainted with the structure of these. Each band is studded at intervals with rounded, hollow, or cup-shaped structures, which hold in the cavity a smaller

* Kützing, "Species Algarum," 1849.

† Annals and Mag. Nat. Hist., v. 1880. Pringsheim's "Jahrbücher," xii. heft 3.

body—a starch centre. Certain of the cup-shaped structures are continuous with, and apparent expansions of, the fibres which suspend the nucleus in its place (Plate X. fig. 1).

Occupying the centre of the cell is a large oval or spherical nucleus, quite free, ordinarily, from the peripheral protoplasm, but moored in its position in the way already described. Inside is a large spherical nucleolus. Let us now study the structure of the nucleus a little more closely. The surface of it is seen to be bounded by a clear hyaline zone exhibiting a double contour. With the outside of this the radiating threads *seem* to be fused ; but the strong probability is—judging from homologies with animal cells, and their behaviour, as subsequently brought out—that these *pass through, and are continuous with*, those inside the nucleus.

A most remarkable and instructive result was obtained on trying the effect of endosmosis and simultaneous staining on the cells. A fresh filament was adjusted under the field of the microscope near the edge of the cover glass, so that the nucleus of a particular cell was well defined. A few drops of alcoholic solution of eosin were then allowed to fall on the slide at the edge of the glass, care being taken that in the currents set up the definition of the nucleus remained clear. Endosmosis was very speedily effected, the elongated cylindrical cells swelling out notably, while by the action of the stain the nucleus and nucleolus became more distinctly visible ; owing to the swelling out of the protoplasmic lining, and the carrying with it of the chlorophyll bands, a strong tension was set up in the connecting threads. This became so great that these suddenly ruptured simultaneously or in rapid succession, one or two remaining attached on one side only to the bands, and towards this side the nucleus, after tumbling about in a confused manner, settled down. The broken and curled-up ends of the threads could, for a moment or two, be noticed surrounding the hyaline zone, but soon the latter detached itself with a sudden jerk and swelled out, forming a translucent sphere attached on one side to the nuclear substance, which now took on rather a shrivelled outline (Plate X. fig. 2.) To the swollen and spherical zone, which goes on increasing till three or four times the diameter of the nucleus, most of the curled-up threads could be seen adhering. This experiment was so novel and magical, if I be allowed the expression, that I repeated it frequently, and in the presence of various gentlemen who were quite satisfied with it; and subsequent repeated trials have given unvarying results both on isolated nuclei and aggregate masses. Anyone can verify the facts for himself, by attending merely to the points mentioned.

The structure, thus demonstrated in so positive a manner, clearly corresponds to the nuclear membrane of animal cells as described by Klein * and others. Now Klein has asserted that in cells from the stomach of the newt the "nuclear membrane is composed of an outer thicker portion, which is the limiting membrane proper, and, closely connected with it, of an inner—more or less incomplete, probably because reticular—delicate layer, which is, properly speaking, a peripheral condensation of the intranuclear network." The cells of the alga, now under consideration, are identical in their anatomical details, for after the outer nuclear membrane has detached itself and increased considerably, one can plainly see a clear but rather irregular band enveloping the nucleus. A matter, however, rather difficult of solution now suggests itself. Why, on rupture of the radiating threads, does the outer membrane detach itself? If we suppose that these threads really pierce the latter, and are continuous with the intranuclear fibres, on rupture of them the nucleoplasm would probably incline to shrink, endosmosis setting in would expand the outer membrane and at the same time contract the apertures in it through which the threads pass; on the membrane swelling out then some of the threads at least would tend to snap and be carried with it in expanding. This attempted explanation is given as the only one which seems feasible, and in harmony both with the phenomena here observed and those accompanying division of the cell. In treating of cell division the nature and origin of the nuclear membrane will further be discussed.

The nuclear substance of cells which have been stained with logwood, eosin, chromic acid solution of heliocin, or

* Quart. Micro. Jour. 1878

iodine solution, when looked at with a power of 300°, is granular; consisting of clear spots, not distinguishable optically from the nuclear membrane; and of intervening parts more deeply stained; but when magnified 450°, these appearances are seen to be due to the presence of an interlacing network (intranuclear network of Klein), the meshes of which are filled by the more deeply stained "ground substance." One can further notice the fibres stretching inwards from the inner nuclear membrane with which they seem to fuse; while from the outer surface of the nucleolus like processes pass outwards. Professor Rutherford, who has thoroughly examined the nuclei of animal cells, confirms the preceding observation. But even though unable to demonstrate directly the existence of an intranuclear network, the behaviour of the nuclei and nuclear contents would lead to such a conclusion; for in nuclei which have been isolated, torn, and split asunder, the nucleolus may protrude prominently without any indication of passively separating; shreds of the intranuclear network are also encountered adhering to the nuclear membrane. Now, even although the nuclear substance is hardened by the decolorising or staining agent, this hardening could not alone account for conditions such as have been mentioned; I therefore strongly incline to the opinion that the filaments of the intranuclear network stretch inward from the inner layer of the nuclear membrane, and are finally attached to the outer surface of the nucleolus, thus holding the latter in position. Further proof of this will be adduced in studying the division of the cells.

The nucleolus of *Spirogyra* is very large, and is a morphological entity, not in any way to be confounded with a local thickening of the intranuclear network. A nucleolar membrane, quite as evident, but scarcely equal in width to that of the nucleus, surrounds it. With the outer surface of this the nuclear fibres *seem* to fuse. Its inner surface is smooth, and does not show that it gives off processes into the interior. Instead of having a granular or reticulated aspect like the nucleus, it gives the impression that it is a pretty homogeneous body.

The nucleolo-nucleus, as before mentioned, is sometimes obscured, owing to the rotundity of the cell, nucleus, and nucleolus, but in the great majority of cells it is very apparent, and attains a much larger size than in any other plant, excepting *Fritillaria*, which has come under my notice.

Finally, I would speak of the result of staining agents such as those already referred to. The whole of these, if the solution be not too strong, stain the peripheral protoplasm scarcely at all; the nuclear substance is slightly stained, the nucleolus rapidly absorbs and soon assumes a brilliant hue, while the nucleolo-nucleus has a deeper tint imparted to it. The general character of these, in fact, when treated chemically, lead to the conclusion that each is a more richly differentiated mass of protoplasm than that by which it is surrounded.

2. *Cell Division.*—My study of cell division in *S. nitida* has been carried on wholly by chromic acid preparations slightly stained with heliocin. The material was obtained in a state of division, by placing quantities of it in 1 per cent. solution of chromic acid, during different hours of the night, that gathered at 3 A.M. giving the best results.

Taking as our starting-point a typical cell just initiating the dividing process, the first change observable is the aggregation, on two opposite sides of the nucleus, and in a line with the long axis of the cell, of a quantity of pale, slightly granular protoplasm, which seems to be derived from the peripheral layer, and to travel along the radiating threads, for during aggregation little masses can be seen here and there along the course of the threads in addition to that already massed. Coincident with this, or soon thereafter, a very curious movement is set up in the nucleolus, the exact course of which it is rather difficult to follow; one or two very clear preparations, however, made by Mr Jackson, a senior member of the University Practical Botany Class, as also several of my own, have helped me to gain a definite idea of what now goes on.* The nucleolus swells out on opposite sides into two protuberances, in line with the aggregating protoplasm; these do not seem to

* I would here express my indebtedness to Mr Jackson for the use of about two dozen slides—prepared in connection with the class—of nuclei quite isolated from their cells, and remarkably fine for exact definition.

represent the denser material of the nucleolus, since it forms a bridge-like connection between (Plate X. figs. 3*a* and 3*b*). It will be noticed that in fig. 3*b* two nucleolo-nuclei are visible on opposite sides of the dense portion; further, the nucleolar membrane has, *as far as can be seen*, disappeared, but, as stated below, this again makes itself visible; I therefore think it probable that these swollen sac-like expansions are inflations of the nucleolar membrane, and that during this period division of the nucleolo-nucleus is carried out, since, in all subsequent changes, two nucleolo-nuclei are present. The nucleolus again assumes its normal shape, its membrane reappearing, and as well defined as in a resting state. After this it increases markedly in size, as if an abundant nutrient supply were being handed on to it; and this may furnish an explanation of, and reason for, the aggregation of the protoplasm, since there would then be provided a source of nutritive material immediately round the centre of increase and action.

The next step in the process of division is a very striking one, and enables us somewhat to realise how little is our knowledge of the vital energies which reside in living matter, while it teaches us that in bodies *apparently* structureless profound molecular changes may be going on. The nucleoplasm is forced through the nuclear membrane, and aggregates itself on the two opposite sides, where the protoplasm had already accumulated, giving the idea, now no longer, of two pale masses of almost homogeneous protoplasm, but of dark and closely packed amœboid-looking lumps; *and to these* (not to the nuclear membrane) *the radiating threads are attached.* These sides we may now term the poles of the nucleus. The nucleoplasm of the poles is still connected with the nucleolus by fibres, which pass through the nuclear membrane (Plate X. fig. 4). The question may now suggest itself, Why do we believe that the nucleoplasm is forced, rather than pulled out? To this we reply that the only *visible* agents by which this could be effected, are the radiating threads; but at this time, instead of being tense, they are loose and flaccid. The whole after behaviour of the nucleolus, moreover, confirms the supposition, that it now is the centre of two opposing forces, acting along the long axis of the cell; in fact, that from this point onward the nucleolus presides over, guides, and impels the movements of the nucleus. Owing to Strasburger's attaching no special importance to the nucleolus, and his observation of the cells with rather a low power, he, while figuring pretty correctly the phenomena already described, does not fully appreciate their importance. Probably also, from the latter reason, he has not noticed the formation of the beautiful nuclear barrel, and succeeding cell plate, which is, however, only a confirmation of his renowned researches on other plants. But he describes and figures very carefully the evolution from the peripheral protoplasm, of what is at first a single row of minute spots or granules, as seen in Plate X. fig. 6, but which increase afterwards so as to form a double row, or even an irregular belt. These granules, first seen when the nucleoplasm is forced out, but frequently not appearing till a later stage, mark the area where subsequent folding in of the protoplasm takes place, with coincident formation of the cellulose septum.

As in *Ornithogalum*, so here also the nucleoplasm is densest on the sides away from the nucleolus.

Hitherto the nuclear membrane has not in any way altered, but soon at the two poles a solution of its continuity becomes apparent, while, as indicated in Plate X. fig. 5, a slight elongation of it is also effected; this breaking up at the poles goes on till the nuclear membrane is undistinguishable. After dissolution at the poles is accomplished, the appearance is such as is represented in Plate X. fig. 6; the polar masses are, especially towards the outer sides, dark, compact, fibrous, amœboid-like lumps, giving off on their inner sides fibrous strands which run to the nucleolus, while above and below are two darker strands—the remains of the nuclear membrane. This fibrous area constitutes, from this period onwards, the *nuclear barrel*.

The nucleolus next splits into two daughter nucleoli, each of which seems to carry along with it a nucleolo-nucleus, since one at least is usually to be made out in each sister form. It is important to notice now how completely these regulate the movements of the polar masses and nuclear barrel. As they retreat from each other they drive the polar masses before them, thereby elongating the nuclear barrel; this is pretty well brought out in Plate X. figs. 7 and 8; but the repulsive influence now acts, not in a straight line only. It radiates out all round, driving asunder the fibres of the nuclear barrel, so that widening as well as elongation occurs at the same time. In fig. 7 the elongation is very pronounced, but the widening has just begun; in figs. 8*a* and 8*b* the process is continuing, while in fig. 9 it has reached its maximum. It should here be noted that the nuclear barrel of figs. 8*a* and 9, while of an average size, is not to be compared with figs. 8*b* and 10; but these and some succeeding ones are on the whole exceptionally large specimens. For the clear and telling preparation from which the drawing of fig. 8*b* was made, I am again indebted to the ingenuity of Mr Jackson. The nucleoli at length advance to the polar masses and bury themselves in the nucleoplasm of these. A redistribution of nucleoplasm now takes place; from being heaped up or compacted on the sides away from the centre of action, it now spreads round and covers in the nucleoli.

Though up to this point not the least trace of a cellulose septum is visible, changes in the peripheral protoplasm have not been wanting. The row of spots before mentioned, and delineated in fig. 6, has increased to a double series, or may form a strong band of irregularly disposed granules as in Plate X. fig. 9. But after this three important and simultaneous actions are induced,—(*a*) the polar masses, or, as we may now term them, the daughter nuclei, have a new membrane secreted round them; (*b*) the cellulose septum is faintly foreshadowed by a delicate ring of cellulose deposited in the middle of the granules; (*c*) the nuclear fibres in the middle of the barrel are sundered, or separate, and at a slightly later period develop a double row of small discs—the cell-plate, between which still later the cellulose septum will grow in. All these conditions are fairly illustrated in fig. 10, and we will now handle them in detail.

(*a*) By botanists the nuclear membrane, even when believed in, has been regarded, and perhaps naturally so, as a pellicle that has formed on the exposed surface of the nucleus. My preparations show that it is laid down inside a quantity of protoplasm which envelopes it; and we can scarcely imagine two substances of similar chemical constitution, the denser of which had a pellicle formed round it while inside the lighter. The nuclear membrane, in truth, in *Spirogyra* at least, must be considered to be something as carefully constructed as any other part of the cell; in other plants, or in cells whose nuclei are always more or less surrounded by protoplasm, it may not be found requisite thus to view it, but in the case before us its importance is too great to be lightly estimated.

(*b*) The cellulose septum in being laid down is earliest seen as a clear pale thread of more highly refractive material than the protoplasm, running through the middle of the granules, and compassing the entire circumference of the cell. As I shall afterwards proceed to prove, it results as a secretion from the protoplasm, the edge of it when formed being laid up against the cell-wall all round, and plastered on to it by some agency unknown. Growth is carried on centripetally, so that as additions are being made to it the protoplasm bends in all round, and thereby carries inwards the granules as well as the chlorophyll bands. The septum, therefore, from being a mere thread, soon deepens into a ring, and next into a shelf or ledge running round the interior of the cell, the edge of it now touching the cell-plate (fig. 11*a*), the consideration of which we will now take up.

(*c*) About the time that the first faint indication of the commencing septum is visible, it can occasionally be seen that a splitting is taking place in the middle of the fibres of the nuclear barrel; in others again further advanced there are two lines of granules separated from each other by a clear space. How these granules are formed I am unable to say. It may be that the broken ends of the fibres coil up, or even have material accumulated at their ends to assist in forming the septum; however it be, I am strongly inclined to think, both from their appearance, time of formation, connection with the septum, and optical properties, that they perform in the cell-plate exactly the part played by the granules in the protoplasm, in the formation of the septum; in other words, that the granules in the cell-plate are present for the same end as are those in the protoplasm.

Here we may appropriately notice the result of the growth of the septum on the chlorophyll bands. These, along with the protoplasm, bend inwards for a certain length, their continuity not being at all interfered with, so that, on focussing down, one can catch a clear image of the outer edge of the septum, and also many of the chlorophyll bands, but one or more are indistinct as they approach the septum, and further focussing must be resorted to ere their complete course is traced (Plate X. fig. 12). About the time that the septum has grown in to meet the cell-plate they are severed in a very inexplicable way, the severed edges giving the impression that they are neatly cut or gnawed through, not at right angles to the bands, but obliquely, though quite in a line with the advancing septum. These cut ends must continue to grow, since, later on, instead of their being opposite each other, one may be considerably prolonged round the interior of the cell.

The nuclear barrel, as far as we have yet considered it, may be said to have passed through the *waxing phase*, but henceforth it gradually diminishes in width, and may appropriately be described as assuming the *waning phase*. We for the time left studying the septum, after watching it till it had grown in to meet the edge of the cell-plate all round. As growth in width proceeds, it passes into the clear band between the granules of the cell-plate, and these, as I suppose, taking on the function of the protoplasmic granules, advance centripetally with the growing edge of the septum, causing thereby a waning of the barrel. The first part of this condition of things is brought out in Plate X. fig. 11*b*, copied from a most beautiful isolated nucleus in one of Mr Jackson's slides. Here we see the part of the septum, formed by infolding of the peripheral protoplasm, protruding on each side, as viewed optically, or projected flat, though it is in reality a circular projecting rim. From its being projected flat, it is of course impossible to bring out—what is easily accomplished by gradual focussing down—the appearance of a centripetal development of it. In Plate X. figs. 13 and 14, this is partially successful, as by compression the cells are pressed slightly to one side. Waning of the nuclear barrel and deepening of the septum continue till the two daughter nuclei are connected only by a narrow band, a small spherical part in the centre of the septum being yet in process of formation (Plate X. fig. 14). Finally, when the septum is completed, the two perfectly-formed sister nuclei—each suspended in its own cell—may indicate their relationship by a connecting protoplasmic strand exactly like those which moor the nucleus in its place (Plate X. fig. 15).

An interesting question is here opened up. Whence are these threads or strands derived, and what is their functional value? From the examination of a large number of my preparations, I can scarcely resist the conclusion that they are fibres of the nuclear barrel, and therefore—to trace back their parentage further—fibres of the intranuclear network, which, as the barrel wanes, are detached from it, and in some way or other become united to the chlorophyll bands. Certain it is that new ones do originate, and it is possible that they may be formed by splitting or bifurcation of the older ones, this being continued to the base of attachment of the filament. At the same time it is equally probable that their origin is to be traced in the manner previously indicated. Would these threads then constitute the intracellular network of Klein? In working at vegetable cell-structure I confess that the idea of a distinct series of fibres permeating the cell has appeared to me scarcely tenable, the apparent network in many cases resulting from mere vacuolation of the protoplasm. In *Spirogyra*, however, one cannot quite get rid of the fact that these threads do not result thus, and that they play so important a part in the life history of the cell; in truth, it seems that here an intracellular network exists. Some rather novel views have recently been propounded as to the function of this network in animal cells. In *Spirogyra* I can only say that these seem to be (*a*) to moor the nucleus in the centre of the cell; (*b*) to supply it with nutrient matter when in the ordinary resting state; and (*c*) to convey a plentiful supply when division is going on.

I would now revert to the formation of the cell-septum by the protoplasm, and the attaching or plastering of this to the cell-wall. In *Spirogyra* it has generally been accepted that the septum arises as a process inwards from the latter, and that its ingrowth is probably fed by the protoplasm mantling its edge. What one sees after ingrowth has proceeded to a considerable extent is a circular shelf, *as thin, or even thinner*, at its point of junction with the wall as throughout its free part. But this of itself is not enough, for there are often figured in our botanical manuals drawings of this, and allied mesocarpous algæ, with the protoplasm retracted, but still retained to the free edge of an apparent ingrowth of the cell-wall. The reagents in these cases which retract the protoplasm, such as alcohol, do so comparatively gently, and as a consequence it shrinks from the cell-wall generally, and masses round the area of division, where it is attached to the ingrowing septum. It will thus be seen that no special strain acts on the septum to rupture it. On the other hand, by such reagents as chromic acid the cell contents are fixed as in the living state. Preparations then, which have been thus treated, on being teased and twisted about, invariably have one or more cells with a forming septum and the protoplasm displaced. *In such a case the latter unfailingly carries the former with it.* One from many such preparations in my possession is represented in Plate X. fig. 17. Again, if an undisturbed cell which has been in chromic acid have its walls subsequently expanded by endosmotic action, the protoplasm and chlorophyll bands will likewise swell out; but if a forming septum be present, it—instead of swelling out—detaches itself from the wall, and forms a clear annular constriction in the middle of the swollen cell (Plate X. fig. 16).

Even while the protoplasm is rendered firm by the acid, one would still expect, according to the generally-accepted theory, that the septum would part from it rather than from the cell-wall, but this is not so. In *Spirogyra*, therefore, a familiar and demonstrable proof exists, of the formation of cellulose by protoplasm, and the fusing of this with the pre-existing cellulose of the wall.

Having now passed in review the phenomena attendant on division, there are some broad questions which we might with advantage linger on. That the nucleolus and—very probably—the nucleolo-nucleus are invariable cell-factors has already been postulated. While of recent years the nucleus has gained in importance, in like ratio, we might say, has the nucleolus declined. Some patent reasons can be given for this course. I have already asserted of *Ornithogalum* and *Scilla* that the nucleus is the last of the three factors to divide, and—though at first sight it might not strike one—the same is true of *Spirogyra*; further, that an influence radiates from the centre outwards, and this influence is placed in the nucleolus. It may be that the nucleolo-nucleus has a phylogenetic rather than a functional interest; but, granting this, the nucleolus remains. We have seen that previous to its fission the nucleoplasm was repelled on each side; that on these sides the nuclear membrane first dissolved; that on division the nucleoplasm still further retreated; that as the daughter nucleoli moved apart a radiant repelling influence originated the broad nuclear barrel; and that only after these had buried themselves in the polar masses of nucleoplasm did the latter close up and subsequently form an encircling membrane. It may be said that agents simultaneous with, but separate from those in the nucleolus were at work in the protoplasm forming the granular aggregations first noticed by Strasburger, but not a trace of these is observable when the changes shown in Plate X. figs 3*a* and 3*b*, are progressing; as well, therefore, may an impulse travel out setting up a series of movements in the protoplasm, as does the aggregation along the threads towards the nucleus indicate a similar impulse in the opposite direction, propagated, in all probability, originally from the centre.

Though the nucleolus is a smaller body than the nucleus, we must not on that account throw it aside. Nothing, in truth, has struck me more than the firm solid consistence it has when stained, compared with the latter, and quite different from the staining of the intranuclear network. Still more in *Spirogyra* the nucleolus is not insignificant, as it occupies from one-fourth to one-sixth of the area of the nucleus. We can, therefore, no longer regard it as a trifling factor in the life of the vegetable cell, and I hope soon to point out that the same holds true of the animal cell.

It must have been observed that in the foregoing descriptions of cell-division no phase corresponding to Strasburger's nuclear plate and nuclear spindle is mentioned. In *Ornithogalum* and *Scilla*, if such exists, I have not seen it; in *Spirogyra* it is certainly wanting. In *Equisetum limosum*, however, all these phenomenal stages are passed through, and we will now shortly notice them.

Structure and Division of the Cells of Equisetum limosum, *L.*

The study of *E. limosum* was made from specimens gathered about 11 A.M. in June of last year, and preserved in alcohol. Longitudinal sections were made of young growing shoots which had just appeared above ground.

The hypodermal and fundamental cellular tissue round the nodes abounded with dividing cells in all stages, four or six sometimes being in the field at once. The cells of the hypodermal tissue were quite filled with protoplasm, containing a nucleus at least half the size of the cell, with nucleolus and nucleolo-nucleus. They were closely packed, and seemed to be multiplying rapidly. On the contrary, the fundamental tissue cells, even at the upper or lower parts of the nodes, were considerably or greatly vacuolated, and had a nucleus not more than one-fourth the size of the cell, with two to four nucleoli. Essentially the same appearances were seen in both kinds at the same stage of division, though in the fundamental tissue-cells certain important steps were traced which were absent from the others. On this account they have been chosen for a short description. The first movement that has been noticed is a massing of the nucleoplasm to form a clear, broad, hyaline band across the centre of the nucleus, the poles of which are left as pale conical projections from the sides of the band (Plate IX. fig. 21). The nucleoplasm thus aggregated is very pellucid and highly refractive, so much so, contrasted with neighbouring nuclei not dividing, that one can easily, after shifting the preparation under the field, find it again by this property. That it is the surface alone which thus refracts, is proved on attempting to focus so as to examine the contents, the result being that a general glairy indistinctness takes the place of the former brilliance, so that if definable structures were in the interior at this time it is impossible to see them. This pellucid band is Strasburger's *nuclear plate*, while the pale poles together are his *nuclear disc.* This latter is a pale area traversed by delicate threads meeting at the opposite ends. The central band then breaks up, and flows irregularly towards the two poles (Plate IX. fig. 22) along the pale threads, and there aggregates to form the masses of the two daughter nuclei (Plate IX. fig. 23). These have the same shining surface which the nuclear plate had, and only in some cases have I managed by staining to reveal nucleoli in the interior. Connecting the daughter nuclei is a fibrous bridge, the *nuclear barrel*, and there early appears in this one or two rows of granules, the *cell-plate* (Plate IX. fig. 24). The nuclear barrel, from being about one-third the width of the cell, is expanded till it completely spans the latter, or nearly so (Plate IX. figs. 25–29), the cell-plate keeping pace with it. Along the cell-plate the new septum is laid down, after which the halves of the nuclear barrel fuse with the surrounding protoplasm, and two sister nuclei in sister cells now bring the cycle of change to a close.

Though on first formation of the daughter nuclei they are pellucid and difficult to resolve, as increase of the nuclear barrel goes on this passes off; and then it is seen that frequently two nucleoli are in each nucleus (Plate IX. figs. 25–29). In the hypodermal cells only the steps from formation of daughter nuclei onwards are traceable; these cells therefore correspond to those of Spirogyra, Ornithogalum, and Scilla, in having no nuclear plate phase. How then is this difference in the two kinds of cell to be accounted for? As yet I do not venture to reply, since my study of the plant is not completed.

Looking now at the four plants passed under review, the general results as to division, applicable in all, may be summed up as follows:—

(*a*) In division of the cell the nucleolo-nucleus probably divides first.

(*b*) The nucleolus undoubtedly divides next, and this is followed by division of the nucleus.

(*c*) During division of the nucleus a nuclear plate with nuclear disc is formed occasionally.

(*d*) If a septum is laid down, this is always preceded by formation of a nuclear barrel and cell-plate.

The general facts which have been advanced as to cell-structure and division have also been verified in Chara, an account of which will be given in a future paper.

These investigations have been carried on in the Botanical Laboratory of the University under the direction of Professor Dickson. I am indebted to Mr Geddes for various kind helps readily given, to Professor I. B. Balfour of Glasgow for explanations and references, and last, though perhaps not least, to Mr Sadler, for liberty to obtain fresh specimens, which have been plentifully supplied to me by Mr Lindsay.

The Society's thanks are due to Mr Kidston, for his faithful transference to stone of the drawings which make up Plates IX. and X.

EXPLANATION OF PLATES.

PLATE IX.—Figs. 1–3. Epidermis of *Ornithogalum pyramidale*, × 400. Fig. 3 is a patch of cells which show not only normal stoma phases, but also several interesting from a teratological and pathological aspect.

Figs. 4–8. Cells from epidermis of *Scilla bifolia*, × 900, showing successive division of the nucleolo-nucleus, nucleolus, and nucleus of the stoma mother cell. In fig. 8 the nucleoli of each daughter nucleus have re-divided.

Figs. 9–11. Cells from epidermis of *Scilla bifolia*, showing division of the ordinary epidermal cells, × 450.

Figs. 12 and 13. Parenchyma cells from leaf of *Ornithogalum pyramidale*, × 400.

Figs. 14 and 15. Parenchyma cells from leaf of *Ornithogalum pyramidale*, × 900. Explanation in text, p. 200.

Figs. 16–20. Ordinary epidermal cells from rather old leaf of *Ornithogalum pyramidale.* Stages in division of the nucleolus; the process not proceeding further. The nucleus exhibits a very clear nuclear membrane and intranuclear network.

Figs. 21–29. Fundamental tissue-cells of *Equisetum limosum* dividing. Explanation in text, × 400.

PLATE X.—Fig. 1. Single cell from filament of *Spirogyra nitida.* This one is exceptionally large, having been drawn in winter when many seem to have a tendency to extreme elongation without division. The filaments connecting the nucleus with the chlorophyll bands are very evident.

Fig. 2. Single cell from filament of *Spirogyra nitida.* The nucleus alone is represented as showing the effect of endosmosis on it.

Figs. 3*a*, 3*b*. Nuclei isolated, and exhibiting changes preparatory to division. At this time the nucleolo-nucleus probably divides. From Mr Jackson's cabinet.

Fig. 4. Single cell, with nucleus, &c., alone shown. The nucleoplasm has been expelled on each side of the nucleolus through the nuclear membrane, but is still connected with the nucleolus by delicate threads.

Fig. 5. Single cell, with nucleus, &c., alone shown. The nuclear membrane has fused with the nucleoplasm at the poles.

Fig. 6. Single cell, with nucleus, &c., alone shown. The nucleolus is now dividing, the forming daughter nucleoli being still connected by delicate threads. Crossing the diameter of the cell is a row of granules embedded in the peripheral protoplasm of the cell.

Fig. 7. Single cell, with nucleus, &c., alone shown. The daughter nucleoli are now retreating along the nuclear barrel, and in their course scatter its filaments.

Fig. 8*a*. Single cell. The daughter nucleoli have now reached the polar masses of nucleoplasm, which for a time had been driven before them.

Fig. 8*b*. Isolated nucleus showing appearances at this period. From Mr Jackson's cabinet. It will be observed that a nucleolo-nucleus has been detected in most of the nucleoli hitherto.

Fig. 9. Complete cell with peripheral protoplasm, chlorophyll bands, &c. The single row of granules has now increased to an irregular band, and among the granules the septum will soon form. The barrel has greatly increased in width.

Fig. 10. The septum is now laid down as a narrow circular rim inside the wall, and the peripheral protoplasm is infolding as growth of its edge continues.

Fig. 11*a*. The septum has now grown in and united with the outer edge of the nuclear barrel, and will pass in between the halves of the cell plate.

Fig. 11*b*. Isolated nucleus septum with attached and projecting. The nuclear barrel is now about to wane. From Mr Jackson's cabinet.

Fig. 12. Portion of cell with ingrowing septum. The chlorophyll bands, previous to fission, are being slightly pushed in.

Fig. 13. The septum has increased to a deep shelf, while a coincident waning of the nuclear barrel has taken place.

Fig. 14. The septum is nearly completed, the nuclear barrel being now reduced to a narrow irregular band.

Fig. 15. The septum is here completed, and only a filament or two remain as relics of the nuclear barrel.

Fig. 16. Cell from a filament, the walls of which have been swollen by endosmotic action. The nearly completed septum has been detached from the wall, and is held in position merely by the cell contents.

Fig. 17. Cell which has been tumbled about, and whose contents have been crushed. The chlorophyll bands are not represented. Here also the septum has been displaced from the walls by contraction on crushing of the protoplasm.

Notes on the Flora of the Islands of Colonsay and Oransay. (Part II.) By Symington Grieve.

(Read 14th July 1881).

When we read our first notes on the flora of these islands, which commence at page 66 of this volume, we expressed the hope that we might be able during future visits to complete the list of plants. We have now had four other collecting excursions, and it is probable we have got a comparatively complete note of the whole flora, though doubtless some plants have escaped notice; but if any visitors to this interesting locality should find plants not on our lists, we should esteem it a favour if they will send us specimens.

Those we have noted have been most carefully verified; and we have to acknowledge, with our best thanks, the aid we have received in this work from Mr Charles P. Hobkirk of Huddersfield, and Mr Andrew Moffat of the Edinburgh Naturalists' Field Club. But we must also place on record the kindly interest manifested, and assistance given, by two eminent botanists now dead. We refer to the late Mr H. C. Watson, of Thames Ditton, and Mr F. M. Webb, of the Edinburgh Herbarium.

We have made detailed remarks regarding a number of the plants upon the appended lists; but let us add that none are specially rare, though some are not very common in Scotland, and we believe here reach nearly their extreme northern limit. Such plants as *Hypericum elodes*, *Scutellaria galericulata*, and *S. minor* are quite abundant; and we have discovered on Oransay a new station for *Orchis pyramidalis*, which was previously only known to exist in the west of Scotland at one station on Colonsay. At neither of these stations does it appear to have an opportunity of reaching maturity, as the rabbits have a particular liking to its leaves and stem, eating them down until not a vestage of the plant is to be seen above ground.

Near the entrance to Ardskinish Glen, Colonsay, grows the *Inula Helenium*, where it was long known in its naturalised state, until its attractive appearance caused several of the residents to dig up roots, which they planted in the vicinity of their houses. The place where it grows was probably at one time near the beach, though now three quarters of a mile inland; for at this part of the island great encroachments upon the sea are taking place. We have enlarged on this item in the accompanying list.

The *Ulex europæus* is most luxuriant in its growth, and at several places is 10 to 12 feet high. When in flower it adds a most striking feature to the landscape; but this year many of the bushes are in a dying state, and we conjecture they have been seriously affected by last winter's intense frost.

It is to be regretted that, owing to the death of the late Mr H. C. Watson, we are unable to say how many of the plants have been noted in this district of Scotland for the first time, but probably this may yet be ascertained. The same gentleman informed us that one of the grasses mentioned in our last list as having been found by Dr Lightfoot should be deleted, as it was a mistake of the author of the "Flora Scotica," who seems to have been dubious when he named it *Bromus arvensis*, and it was probably a dwarf specimen of *Bromus mollis*.

The mosses are worthy of notice, as some are rather rare, and many are seldom met with in the neighbourhood of Edinburgh; but for further particulars reference may be made to the list.

Almost all the trees of any size are confined to the immediate neighbourhood of Kiloran; and, with the exception of some of the pines, are in a healthy state. The Alder thrives especially, and in the grounds of Colonsay House are a number of Himalayan shrubs that are growing well, and numbers of garden plants are allowed to remain out all winter, which on the mainland would require to be removed under cover or otherwise protected. Along the shores of Loch Fada are to be seen the stumps *in situ* of immense trees, and these probably are all that remain to indicate the existence of a considerable forest, for we find abundant evidence of the probable use of this wood as fuel in the cave dwellings and "kitchen middens." To what tribe these large trees belong we have not yet discovered, but we hope to make out their identity from specimens of the wood in our possession.

Peat is not plentiful or of good quality on Colonsay, and on Oransay is so scarce that the only family constantly resident there use mostly coal, which has first to be shipped to Scalasaig on Colonsay, and then carted a distance of five miles.

In conclusion, we may just add that the climate makes these islands suitable as a sanatorium for many invalids; and, if an index as to the health of the inhabitants is wanted, we would mention the great age of some, and that a population of nearly four hundred persons finds no necessity for a resident medical practitioner.

The water is of excellent quality, and bubbles up from splendid springs, many of them situated near the sea-beach, where they are almost invariably fringed with most delicious water-cresses.

The shores, laved with the tepid waters of the Gulf-stream, the balmy air, and the refreshing Atlantic breezes, suggest that we have within the limits of Scotland a locality as suitable for patients as Bournemouth or Torquay.

Flora of Colonsay and Oransay (Part II.), collected May and August 1880, *June and September* 1881. *Named and arranged according to the London Catalogue.*

RANUNCULACEÆ, 1.

Ranunculus trichophyllus, *Chaix.*
hederaceus, *L.*
bulbosus, *L.* Kiloran Bay and Oransay.
Ficaria, *L.* Very plentiful.

FUMARIACEÆ, 4.

Fumaria officinalis, *L.* Common.

CRUCIFERÆ, 5.

Cochlearia officinalis, *L.* Common.
Draba verna, *L.*
incana, *L.*

VIOLACEÆ, 8.

Viola tricolor, *L.*
Do. var. arvensis, *L.*
lutea, *Huds.*

CARYOPHYLLACEÆ, 12.

Lychnis vespertina, *Sibth.*
Honkeneja peploides, *Ehrh.*
Sagina maritima, *Don.*
subulata, *Wimm.*
nodosa, *Meyer.*
Spergularia rubra, *Fenzl.*

PORTULACACEÆ, 13.

Montia fontana, *L.*

HYPERICACEÆ, 16.

Hypericum perforatum, *L.*
tetrapterum, *Fries.*
elodes, *L.*

LINACEÆ, 18.

Radiola millegrana, *Sm.*

GERANIACEÆ, 20.

Geranium sanguineum, *L.*
dissectum, *L.*

ILICACEÆ, 21.

Ilex Aquifolium, *L.*, *C. & O.*

LEGUMINIFERÆ, 25.

Trifolium minus. *Relhan.*
Astragalus hypoglottis, *L.*
Orobus tuberosus, *L.* Common.

ROSACEÆ, 26.

Prunus spinosa, *L.*
Potentilla fragariastrum, *Ehrh.*
Rubus. There are several varieties but unidentified.
Rosa canina, *L.*
Cratægus Oxyacantha, *L.*
Pyrus malus, *L.*

ONAGRACEÆ, 28.

Epilobium palustre, *L.*

UMBELLIFERÆ, 33.

Heloscadium inundatum, *Koch.*
Chaerophyllum sylvestre, *L.*
Conium maculatum, *L.* Near Scalasaig, and Ruins, Oransay.

RUBIACEÆ, 38.

Galium uliginosum, *L.*

VALERIANACEÆ, 39.

Valeriana officinalis, *L.* Ardskinish Glen.

DIPSACEÆ, 40.

Scabiosa succisa, *L.*

COMPOSITÆ, 41.

Carlina vulgaris, *L.*
Matricaria inodora, *L.*, var. maritima.
Chamomilla, *L.*
Tanacetum vulgare, *L.* Kiloran and Ardskinish.
Achillea ptarmica, *L.*
Artemisia vulgaris, *L.*
Gnaphalium uliginosum, *L.*
Senecio vulgaris, *L.* Ruins, Oransay.
Saracenicus, *L.* Near Kiloran.

Near the spot where this plant is found is said to have existed a house in which the celebrated chief, Col. Keitoch, lived, and prior to his time a community of monks resided near the same spot, and it is most likely to them it owes its introduction to Colonsay.

Inula Helenium, *L.*

This plant is evidently introduced, and was originally only to be found at one place in Colonsay, viz., in Ardskinish Glen. As we believed it indicated that at one time it had been planted where it grows, possibly by some monk, we carefully examined the spot, and, though almost no trace of any buildings were left, we found that at one time there was at this place a "Mullan Dubh," or Black Mill, and that in a field, only a few yards off, had been a burying ground, attached to which would be a chapel, and probably one or more cells. It is interesting to find a plant thus giving a clue to matters of antiquarian interest, and recalling to memory the presence of holy men at a place where their existence had been long forgotten.

Aster tripolium, *L.*
Solidago virgaurea, *L.*
Petasites vulgaris, *Desf.*
Lapsana communis, *L.*
Leontodon autumnale, *L.*
Souchus oleraceus, *L.*
arvensis, *L.*
Crepis virens, *L.*
Hieracium pilosella, *L.*

There are also several other varieties of *Hieracii*, but as we were unable to identify them with certainty, we have thought it better not to note them at present.

CAMPANULACEÆ, 42.

Jasione montana, *L.*

JASMINACEÆ, 44.

Fraxinus excelsior, *L.*

APOCYNACEÆ, 45.

Vinca minor, *L.* At ruins of priory Oransay, evidently introduced.

GENTIANACEÆ, 46.

Gentiana campestris, *L.* This plant is very common at some parts.

CONVOLVULACEÆ, 48.

Convolvulus sepium, *L.*

SCROPHULARIACEÆ, 50.

Mimulus luteus, *L.*

This plant is evidently an escape from the garden at Kiloran House, but now is thoroughly established along the edges of the stream which flows to Kiloran Bay, where it is also found growing upon the beach.

Bartsia odontites, *Huds.*

OROBANCHACEÆ, 51.

Orobanche rubra, *Sm.* Growing upon Thymus serpyllum, Kiloran Bay.

LABIATÆ, 53.

Lycopus europæus, *L.*
Scutellaria galericulata, *L.*
minor, *L.*

Stachys palustris, *L*
 ambigua, *Sm.*

BORAGINACEÆ, 54.

Myosotis palustris, *With.*
 collina, *Reich.*
 versicolor, *Reich.*
Anchusa officinalis, *L.* Seemingly introduced.

PRIMULACEÆ, 56.

Anagallis arvensis, *L.*

This plant is most plentiful upon ground which has been at one time under cultivation, both at Machrins, on Colonsay, and Lochan Buy, Oransay.

Glaux maritima, *L.*

PLANTAGINACEÆ, 58.

Plantago major, *L.*
 lanceolata, *L.*
 coronopus, *L.*

CHENOPODIACEÆ, 61.

Suæda maritima, *Dum.*
Salsola Kali, *L.* Found at Baleromin-more and other parts of coast.
Chenopodium album, *L.* Common.
Atriplex angustifolia, *Sm.*
 Babingtonii, *Woods.*

POLYGONACEÆ, 62.

Rumex obtusifolius, *Auct.* Kiloran.
 crispus, *L.*
Polygonum hydropiper, *L.*
 persicaria, *L.*
 amphibium, *L.*
 Do. var. terrestre.

ELEAGINACEÆ, 63.

Hippophae rhamnoides, *L.* Introduced but grows most luxuriantly.

EUPHORBIACEÆ, 68.

Mercurialis perennis, *L.*

URTICACEÆ, 71.

Ulmus suberosa, *Ehrh.*

AMENTIFERÆ, 72.

Quercus Robur, *L.* There is a stunted form near Scalasaig, and on other parts of Colonsay, but principally on the northern half of the island.
Fagus sylvatica, *L.* Kiloran.
Corylus Avellana, *L.*
Alnus glutinosa, *L.* Of very large size near Kiloran.
Betula alba, *L.*
Populus alba, *L.* introduced.
Salix repens, *L.* var. argentea.

CONIFERÆ, 73.

Pinus sylvestris, *L.*

LEMNACEÆ, 76.

Lemna minor, *L.*

ALISMACEÆ, 78.

Triglochin maritimum, *L.*
Alisma ranunculoides, *L.*

ORCHIDACEÆ, 80.

Orchis incarnata, *L.*
Gymnadenia conopsea, *Brown.*

AMARYLLIDACEÆ, 82.

Narcissus biflorus, *Curtis.* Quite established in a wood at Kiloran evidently introduced.

JUNCACEÆ, 86.

Luzula pilosa, *Willd.*
 campestris, *D. C.*
 multiflora, *Koch.*
Juncus acutiflorus, *Ehrh.*
 bufonius, *L.*
 compressus, *Jacq.*
 squarrosus, *L.*

CYPERACEÆ, 87.

Blysmus compressus, *Panz.*
Scirpus palustris, *L.*
 cæspitosus, *L.*
 maritimus, *L.*
Eriophorum vaginatum, *L.*

CYPERACEÆ, 87.

Carex pulicaris, *L.*
 vulpina, *L.*
 glauca, *Scop.*
 limosa, *L.*
 præcox, *Jacq.*
 ampullacea, *Good.*

GRAMINÆ, 88.

Anthoxanthum odoratum, *L.* Oransay.
Psamma arenaria, *R. & S.*
Phragmites communis, *Trin.*
Holcus lanatus, *L.*
Molinia cærulea, *Moench.*
Poa annua, *L.*
Lepturus filiformis, *Trin.*

FILICES, 89.

Asplenium Ruta-muraria, *L.* At one or two stations, but not common.
Cystopteris fragilis, *Bernh.*, var. Dickieana. Rocks near New Cave, Colonsay.
Nephrodium Oreopteris, *Desv.*
Polypodium phegopteris, *L.*
Botrychium lunaria, *Sw.*

LYCOPODIACEÆ, 90.

Lycopodium selago, *L.*

EQUISETACEÆ, 92.

Equisetum arvense, *L.*
 palustre, *L.*

CHARACEÆ, 93.

Chara fragilis, *Desv.*

Moss Flora of Colonsay and Oransay (*Part II.*).

SECTION I.—ACROCARPI.

SPHAGNACEÆ. Tribe 1.

Sphagnum, *Dill.*
cuspidatum, *Ehrh.*

WEISSIACEÆ. Tribe 3.

Dichodontium, *Schpr.*
pellucidum, *L.* On moist ground near Loch Fada, Colonsay.
Dicranella, *Schpr.*
heteromalla, *Hedw.*
Dicranum, *Hed.*
fuscescens, *Turn.*
Campylopus fragilis, *B. & S.*
Do. do. var. densus, *B. & S.*

POTTIACEÆ. Tribe 7.

Pottia, *Ehrh.*
Heimii, *Hedw.* Growing in crevices of rocks near Loch Fada, Colonsay.
Ditrichum, *Timm.* (Leptotrichum, *Hampe*).
flexicaule, *Schwg.*, var. densum.

This sub-variety does not appear to have been given in any of the British Moss Catalogues until the second edition of the London Catalogue was published this spring, where it is noted, and is mentioned as being found in several of the Watsonian districts in Britain, but it does not seem to have been observed in the West Highland district previously. We found it growing in crevices of the rocks near the shore, upon a soil composed of minute fragments of sea shells, but it did not appear to be abundant, and was without fruit.

Barbula, *Hedw.* (Tortula.)
ruralis, *Schwg.*, var. rupestus.
intermedia, *Brid.*

Usually found growing upon limestone walls, but here it is growing among the loose sand, which is composed of comminuted sea shells; and upon this peculiar form of lime it finds the conditions that enable it to exist.

Ceratodon, *Brid.*
purpureus, *L.*

GRIMMIACEÆ. Tribe 9.

Racomitrium, *Brid.*
aciculare, *L.*
canescens, *Hedw.*
Zygodon, *H. & T.*
viridissimus, *Dicks.*

This moss is found growing in semi-darkness upon the walls of the Crystal Spring Cavern, Colonsay, along with *Eurynchium pumilum.*

Zygodon viridissimus, var. rupestris, *Lindb.*

Found on the wet rocks at the side of waterfalls, on a small stream that runs into Loch Fada (east side).

Ulota, *Mohr.* (Orthotrichum).
phyllantha, *Brid.*

Is very plentiful, growing upon the bark of ash trees near Colonsay House, but is also found growing on old walls and rocks. Its peculiarity is that its fruit is unknown, and that it propagates its species by "Gemmæ" that cover the apex of the stems, which are generally exserted; this gives the appearance of a black speckle on each, its character only being distinguishable to the eye after a very close and careful inspection, but with the aid of a pocket lense the "Gemmæ" are easily seen.

FUNARIACEÆ. Tribe 11.

Physcomitrium, *Brid.*
pyriforme, *L.*
Funaria, *Schreb.*
hygrometrica, *L.*

BRYACEÆ. Tribe 13.

Bryum, *Dill.*
pendulum, *Hornsch.* (Cernuum).

Growing in crevices of rock near Loch Fada.

Bryum alpinum, *L.*

This moss is rare in fruit, but we found splendid specimens on Colonsay in fructification. It is common on both islands; but on wet rocks, near Scalasaig, its velvety masses are so beautiful during spring that even the most unobservant person must remark them. The islanders sometimes use it for dyeing purposes, and they say it gives a most beautiful dark brown colour.

POLYTRICHACEÆ. Tribe 16.

Pogonatum, *P. Beauv.*
nanum, *Neck.*
aloides, *Hedw.*

SECTION III.—CLADOCARPI.

RIPARIACEÆ. Tribe 21.

Fontinalis, *Dill.*
antipyretica, *L.*

CRYPHÆACEÆ. Tribe 22.

Hedwigia, *Ehrh.*
ciliata, *Dicks.*

SECTION IV.—PLEUROCARPI.

HYPNACEÆ. Tribe 28.

Camptothecium, *Schpr.*
lutescens, *Huds.*
Brachythecium, *Schpr.*
velutinum. *L.*
Eurynchium, *Schpr.*
myosuroides, *L.*
striatum, *Schreb.*
Hypnum, *Dill.*
aduncum, *Hedw.* Non. Bry. Brit.
Do. var. Kneiffii, *Bry. Eur.*
molluscum, *Hedw.*
palustre, *L.*
polygamum, *B. & S.*
stellatum, *Schreb.*

On a Curious Form of Kohl Rabi. By JOHN SADLER, Curator, Royal Botanic Garden. (Plate XI.)

(Read Nov. 11, 1880.)

In the beginning of October 1880 I received from Mr George Pollock, nurseryman and seed merchant, Stirling, a peculiar specimen of the common purple *Kohl Rabi* which he had met with in a garden in the neighbourhood.

At first I had the plant placed in a shallow basin of water —the water just covering the roots. In this position the plant continued to increase in size, so that many of the swollen lateral branches, of which there were eighteen, were by 11th November 1880 about the size of turkeys' eggs. At that date I had it photographed, and then planted in a flower-pot amongst good soil and placed in a cool frame, in the hope that it would flower and produce perfect seed next summer.

In August 1881 I measured the plant, which was now growing in the open air. There were eighteen side tuberous branches, ten of which had leafy shoots varying from $2\frac{1}{2}$ to 3 feet in length, and bearing abundance of flowers and fruit. The largest tuberous branch was $4\frac{1}{2}$ inches in circumference. I had some of the ripe seed sown and placed in the green-house, where they soon germinated. I had also cuttings from the leafy shoots put in at the same time, which struck freely. The seedlings and cuttings which were planted out under "hand-lights" are now (3d February 1882) very healthy, but whether they will perpetuate the peculiarity of the parent it is very doubtful. If this, however, could be accomplished it would be a decided addition to the kitchen garden, representing, as it does, exactly what the Brussels sprout is to the common cabbage. The *Kohl Rabi* of Ger.; *Brassica Caulo-rapa communis* of D.C.; *Chau-rave* of Fr.; turnip-cabbage and turnip-borecole of British authors, is a hardy biennial, and can withstand the severest frost and drought. It is a plant which is seldom met with under cultivation in British gardens, although it is extensively grown in some parts of Germany, and is also frequently "forced." In these times of agricultural depression it is worthy of a trial on light soil, where in some seasons it is difficult to rear turnip, although I doubt if ever *Kohl Rabi* will supersede turnip for nourishing qualities. The best sorts of *Kohl Rabi* are the early white and early purple Vienna.

Note.—The Society is indebted to the proprietors of the *Gardeners' Chronicle* for the plate, and to Prof. Dickson for the photograph from which it is taken.

I. *Report on Temperatures and Open-Air Vegetation at the Royal Botanic Garden, Edinburgh, from August* 1880 *till July* 1881. II. *Record of some of the Plants Killed or Injured by Frost during the Winter of* 1880–81, *at the Royal Botanic Garden.* III. *Table of Register of Spring Plants showing dates of Flowering in* 1880–81, *at the Royal Botanic Garden.* IV. *Extracts from Correspondents as to the Effects of the Winter of* 1880–81 *in different parts of Scotland.* By JOHN SADLER, F.R.Ph.S., Curator of the Royal Botanic Garden.

In my reports for 1878–79 and 1879–80, I stated that these winters were the most protracted and severe that we had experienced for many years. That of 1880–81, however, has proved to be the longest and severest winter that we have experienced since that of 1860–61. The autumn of 1880 was very favourable for the maturing of the year's growth of trees, shrubs, and plants generally, which enabled them to withstand the rigours of the season. The winter set in about the middle of October, and lasted almost without a break until the middle of March 1881. The lowest temperature at the Garden occurred in the middle of January, when the thermometer fell to 0° on the 17th. Much lower temperatures, however, were registered in several parts of Scotland, especially in the south. At Blackadder, in Berwickshire, the thermometer fell on the 17th January to 22° below zero, and on the 23rd to 24°. (See correspondence.)

I.—TEMPERATURES.

August 1880.—During the month the lowest temperatures were on the 2nd, 45°; 3rd, 47°; 7th, 45°; 21st, 43°; 22nd 47°. The highest day temperatures in the shade were on the 8th, 74°; 10th, 73°; 11th, 88°; 13th, 76°. The weather during the month was remarkably dry, calm, and bright, and accordingly was most favourable for the maturing and ripening of fruits and seeds, as well as of the young wood of the past summer's growth. The winds were mostly from an easterly direction, but their force was so light as only to render the air genial and summer-like. There were several bright displays of Aurora Borealis, and also unusually heavy falls of dew. The month well illustrated Professor Smyth's "wave of solar heat." Fifty-four species and varieties of plants came into flower in the Rock Garden, making a total of 754 for the season. Amongst the plants in bloom were *Montbretia Pottsi*, *Calceolaria chelidoniæfolia*, *Yucca filamentosa*, *Colchicum striatum*, *Convolvulus Scammonia*, *Cyananthus lobatus*, &c.

September 1880.—The lowest temperatures registered were on the 8th, 40°; 9th, 39°; 12th, 42°; 18th, 38°; 19th, 36°. The highest day temperatures in the shade were on the 1st, 72°; 2nd, 72°; 3rd, 75°; 28th, 70°; 30th 70°. During the first week of the month the fine weather of August was continued, but during the second week heavy showers and easterly winds caused a falling of temperature, and there was a decrease of bright sunlight. This continued until the 26th, when the weather again became bright, settled, and dry by day, but cold during the night. The rains acted beneficially on all plants still capable of growth, while the dry weather and bright sunshine in the latter part of the month did much in ripening late fruiting plants. Twenty-six species and varieties came into flower in the Rock Garden, making a total of 780 for the season. These included *Lobelia lutea*, *Lilium longiflorum*, *L. auratum*, *Colchicum maximum*, *Gaultheria carnea*, &c.

The favourable nature of the weather during the past two months so matured the wood of trees and shrubs as to give promise of a great display of flower next season. The Rhododendrons, for instance, set their flower-buds in a way that has not been seen for the past three years.

October 1880.—The first frost experienced since the 14th May last was on the morning of the 4th, when the thermometer stood at 30°, or 2° of frost. During the month the thermometer was at or below the freezing-point on eleven occasions (in 1879 nine times). The lowest temperatures were on the 12th, 27° (or 5° of frost); 19th, 26°; 20th, 22°; 22nd, 22°; 28th, 26°. There were registered collectively for the month 48° of frost, as compared with 36° in 1879. The highest day temperatures in the shade were on the 1st, 54°; 3rd 52°; 7th, 58°; 14th, 53°; 17th, 54°. The first three days of the month were warm and genial; on the 4th the temperature fell below the freezing-point, and up to the 12th there were storms of wind, rain, hail, and cold blasts from the north-east. From the 12th to the 18th the weather was again mild, with soft westerly and southerly breezes. From the 18th to the 24th the weather was very inclement, and intensely cold, 10° of frost being registered on the 20th and 22nd, and violent gales from the north-east, with storms of hail, rain, snow, sleet, and thunder.

The temperature once more freshened for a day or two, and then again assumed its frosty nature. On the 28th a tremendous wind storm with incessant rain swept over the country for twenty-four hours, and committed considerable havoc amongst trees and shrubs in some places. The Botanic Garden, however, escaped without injury. Only one species came into flower during the month in the Rock Garden, viz., *Merendera caucasica*, thus making in all 781 species and varieties since 1st January 1880.

November 1880.—The thermometer was at or below the freezing-point sixteen times (in 1879 seventeen times). The lowest readings were on the 2nd, 19°; 3rd, 23°; 4th, 26°; 15th, 22°; 16th, 25°; 18th 22°; 20th, 17° (or 15° of frost); 21st, 9° (or 23° of frost); 22nd, 17°; 23rd, 17°. 136° of frost were registered for the month as against 92° in 1879.

The month began with sharp frost, and during the 2nd and 3rd the thermometer was below the freezing-point (in the shade) the whole of both days, with north and north-east wind. On the evening cf the 3rd there was a bright display of Aurora Borealis. On the 4th the frost gave way and was followed by two or three days of enjoyable sunshine, which terminated in a south-westerly gale with rain. On the 8th there was again a sharp frost, which continued throughout the day; on the 9th it disappeared, and returned on the 14th, when there was frost every night until the 23rd. On the morning of the 19th there was a fall of about 3 inches of snow which did not wholly disappear until the 24th, when a complete thaw set in, with a south-west wind, which continued more or less until the end of the month. Notwithstanding the severity of the weather little injury was done to vegetation in the Garden. During the storm several refugees came to the Garden, viz., two water hens, a brace of pheasants (cock and hen), and a beautiful specimen of 'Reynard the Fox.' Of course the last devoured the first.

Up to about the middle of the month there were a few plants in flower in the Rock Garden, including—*Lithospermum prostratum*, *Veronica rupestris*, *V. spicata*, *Arabis decurrens*, *Helleborus niger*, *Erica vagans rubra* and *alba*, *Calluna vulgaris* (several varieties), *Menziesia polifolia versicolor*, *Diplopappus chrysophylla*, *Aubrietia purpurea*, *Linum alpinum*, *Crocus medius*, *Primula Cashmeriana*, and *Merendera caucasica*.

Several of these were recorded in the spring report, when they came into flower, thus *Crocus medius* was recorded as being in flower on 1st January, and now again as flowering on 5th November; *Arabis decurrens* on March 1, and again in October; *Primula Cashmeriana* on March 4, and again November 8; *Helleborus albicans major* on February 5, and again November 2; while *Helleborus niger maximus*, which usually opens its flowers about the end of

November or beginning of December, has been in flower the whole autumn.

December 1880.—During the month the thermometer was at or below freezing-point on eighteen occasions as against twenty-three in 1879. The lowest readings were on the 17th, 16°; 18th, 21°; 21st, 24°; 26th, 25°; 27th, 20°; 28th, 30th, 31st, 25°. There were registered collectively for the month 106° of frost, as against 230° in the corresponding month of last year.

The early part of the month was comparatively mild, which continued until the 14th, when there were 6° of frost. On the 17th the frost was very severe, the register standing as low as 16°, showing 16° of frost. A slight improvement took place about the 22nd and 23rd, when only 1° of frost was registered. On the 27th the thermometer fell to 20°, showing 12° of frost.

A special feature in the Pinetum as well as in the Rock Garden during the past two months, was the deep russet-brown tints of the foliage of the several varieties of *Arborvitæ*. Amongst the plants that were in flower during the early part of the month in the Rock Garden were the following:—*Helleborus niger*, *H. niger maximus*, *Veronica rupestris*, *Diplopappus chrysophylla*, *Arabis decurrens*, *Crocus pulchellus* or *medius*, *Lithospermum prostatum*, *Sedum ibericum*, *Menziesia cœrulea*, *Calluna vulgaris vars.*, *Erica carnea alba*. Among the weeds in flower were *Lamium purpureum*, *Senecio vulgaris*, *Leontodon Taraxacum*, *Stellaria media*, *Capsella bursa-pastoris*, and *Poa annua*.

January 1881.—During the month the thermometer was at or below the freezing point on twenty-seven occasions as against twenty-one in the corresponding month of last year. The lowest readings were on the following ten mornings, viz., 12th, 14°; 15th, 12°; 16th, 10°; 17th, 0°; 18th, 12°; 20th, 11°; 22nd, 12°; 24th, 7°; 26th, 4°; 27th, 13°. There were registered 369° of frost collectively for the month as compared with 132° for January 1880.

The month began with four days of pleasant spring-like weather, which gave rise to the hope that winter was gone, but on the morning of the 5th the thermometer fell to 22°, and there was a continuance of frost every night until the 31st, when the thermometer rose to 33°. Notwithstanding the severity of the weather vegetation at the Garden suffered comparatively little—thanks to the past good summer and autumn in ripening the season's growth; moreover, all low growing plants were well protected for a considerable time with a thick covering of snow, this snow-covering at its greatest depth measuring from 10 to 15 inches.

February 1881.—During the month the thermometer was at or below freezing-point on twenty occasions as against nine in February 1880. The lowest readings were on the 7th, 23°; 12th, 29°; 13th, 23°; 24th, 24°; 28th, 15°. Collectively, there were 100°; of frost as compared with 30° in the same month last year.

Vegetation, on the whole, was quite a month later than last year. The following plants came into flower in the Rock Garden during the month :—*Galanthus Elwesi*, *Helleborus albicans major*, *H. angustifolius*, *Primula vulgaris*, *Dondia Epipactis.*

The late storm proved very fatal to many of the feathered tribe; this was principally owing to the scarcity of haws and fruit—even the holly yielded no berries. The following birds were found dead in the garden :—Thrush, redwing, blackbird, chaffinch, wood-pigeon, and common rook.

March 1881.—During the month there were twenty-one frosty nights as compared with nineteen in 1880. The lowest readings registered were on the 1st, 15°, 2nd 20°, 3rd 20°, 15th 26°, 21st 26°, 22nd 19°, 23rd 25°, 26th 21°, 27th 25°, 30th 18°, 31st 20°. There were registered collectively for the month 132° of frost as compared with 103° in the corresponding month of last year. We had during the past five months three different winters—firstly, a November winter; secondly, a December and January winter, with fresh days between; and lastly, a February and March winter.

The following plants flowered during the month in the Rock Garden :—*Galanthus imperati*, *Leucojum vernum*, *Crocus imperati*, *C. etruscus*, *Hepatica angulosa*, *Primula pulcherrima*, *P. integrifolium*, *P. marginata*, *Draba aizoon*, *D. cuspidata*, *Daphne mezereon*, *Bulbocodium vernum*, *Saxifraga oppositifolia*, *Corbularia nivalis*, *Chionodoxa Luciliæ*, *Scilla præcox*, *S. sibirica*, *Rhododendron præcox*, *Merendera soboliferum*, *Corydalis angustifolia.*

April 1881.—During April the thermometer was at or below the freezing-point on twelve occasions as compared with six in the same month of last year. The lowest readings were—1st, 21°, 2nd 31°, 3rd 28°, 4th 22°, 5th 25°, 6th 21°, 7th 26°, 8th 25°, 9th 26°, 10th 28°, 11th 32°, 28th 32°. There were registered collectively 67° of frost as against 18° for April 1880. The continued cold east and north-east winds of the early part of the month, together with a succession of frosty nights from the 1st to the 12th, seriously retarded vegetation, but about the 14th a change for the better occurred; the wind veered to the south-west, a succession of bright sunny days, interspersed with soft showers, caused vegetation to burst into growth rapidly. The following, amongst a great number of plants, flowered in the Rock Garden during the month:—*Erythronium dens canis*, *E. grandiflorum*, *Corbularia nivalis*, *Crocus biflorus*, *C. Auckeri*, *C. tulipifolius*, *C. albiflorus*, *Iris reticulata*, *Carex Frazeri*, *Puschkinia scilloides*, *Narcissus lobularis*, *Salix lanata*, *Adonis vernalis*, *Iberis saxatilis*, *Menziesia cærulea*, *Primula Cashmeriana*, *P. denticulata*, *P. ciliata purpurea*, *Ornithogalum excapum*, *Anemone*

Robinsoniana, Androsace Laggeri. During the month the following species and varieties of *Helleborus* were in flower:—*Helleborus albicans major, H. angustifolius, H. abchasicus, H. purpurascens, H. p. minor, H. orientalis, H. viridis, H. atrorubens, H. olympicus, H. o. albus, H. guttatus.* The species and vars. of this interesting genus of plants are well deserving of more extended cultivation for winter and spring flowering, as they come into flower early and continue long in bloom.

May 1881.—During the month the thermometer never fell to the freezing-point (which fact will bear favourable comparison with last year, when it fell on three occasions below 32°, registering collectively 7° of frost), although the night temperatures of the first fortnight were very low—on the 1st, 38°; 2nd, 38°; 3rd, 36°; 4th, 38°; 5th, 37°; 8th, 38°; 9th, 39°; 10th, 33°; 11th, 35°. The month began with what Solomon calls "a continual dropping in a very rainy day," and north-east winds. From the 12th to the end of the month the temperatures were high, and accordingly vegetation grew very rapidly. Upwards of 150 species and varieties of plants came into flower during the month in the Rock Garden, which was well worthy of a visit by all those interested in Alpine and herbaceous plants.

June 1881.—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 readings were on the 6th, 38°; 7th, 35°; 8th, 37°; 9th, 34°; 10th, 38°; 16th, 38°; 24th, 36°; 28th, 38°. These low temperatures checked the growth of plants and prevented the fertilizing of the flower, but the warm days in a measure counteracted the effect, and vegetation progressed steadily—thanks to showers, dews, and almost daily sunshine. Though late, the show of hardy spring flowers, and especially those of an alpine character, was really fine; and, notwithstanding the damage done to vegetation by the last severe winter, it is seldom that such a large amount of blossom is seen as we had during the month.

Since last month, 221 species and varieties of plants came into flower in the Rock Garden, making a total of 484 for the season, as compared with 581 at the corresponding date last year. Amongst them were the following:—*Saxifraga pyramidalis, S. Nepalensis, S. Wilkommiana, Meconopsis simplicifolia, M. aculeata, Erigeron Roylei, Veronica Guthriana, Fritillaria Kamschatica, Cornus canadensis, Linnæa borealis, Ixiolirion montanum, Symphiandra Warneri, Salix Sadleri, Genista scoparia pendula, Rosa pyrenaica, Chrysobactron Hookeri, Androsace sarmentosa, Sedum Kamschaticum, Hypericum Burseri, Orchis foliosa, Cypripedium spectabile, Chamæbatia foliolosa, Lilium colchicum,* and *Morina Wallichi.*

July 1881.—The lowest readings of the thermometer during the month were on the 1st, 40°; 2d, 44°; 7th, 45°; 16th, 43°; 21st, 42°; 28th, 38°; 29th, 42°. The injurious effects of last winter upon vegetation was now very obvious, many plants that produced young shoots in spring and gave promise of continued growth having succumbed. Owing to the unfavourable nature of the last five seasons, vegetation generally has shown a marked deterioration in many parts of Scotland, especially in exposed situations. Since last month 77 species and varieties of plants have flowered in the Rock Garden, making a total of 561, compared with 701 at the corresponding period of last year.

Amongst those in flower were :—

Saxifraga platypetala.
Ajuga pyramidalis.
Epipactis palustris.
Astilbe japonica.
Morina Wallichi.
Sisyrinchum cœlestinum.
Spiræa palmata.
Lilium longiflorum.
,, auratum.
,, chaixi.
Orobanche rubra.
Meconopsis Wallichi.
Tritelia Murrayana.
Allium M'Nabianum.

II. Record of some of the Plants Killed or Injured during the Winter of 1880–81 at the Royal Botanic Garden, Edinburgh.

1. *Killed or greatly injured.*

Arbutus Unedo.
Picea bracteata.
Viburnum Tinus.
Cupressus macrocarpa.
Libocedrus chilensis.
Veronica Andersoni.
,, salicifolia.
,, Traversi.
Quercus Ilex.
,, Suber.
Laurus nobilis.
Catalpa syringæfolia.
Lavatera arborea.
Linum perenne.
Anemone pectinata.
,, scorpioides.
,, palmata.
Benthamia fragifera.
Chamæpuce Casabonæ.
Cheiranthus Cheiri.
,, longifolius.
Stobæa purpurea.
Matthiola (Stocks).
Convolvulus mauritanicus.
Artichoke, globe.
Arenaria grandiflora.
Loiseleuria procumbens.
Chamæbatia foliolosa.
Prunus laurocerasus.
Garrya elliptica.
Draba chamæjasme.
Galax aphylla.
Phlox aristata.
Phillyrea angustifolia.

Phillyrea media.
Iberis tenoreana.
Erigeron unipulchrum.
Dianthus alpinus.
Calceolaria chelidoniæfolia.
Gypsophylla arenaria.
,, cerastioides.
Hypericum reptans.
Petrocoptis Lagascæ.
Ruta macrophylla.
Calluna vulgaris tomentosa.
Erica tetralix.
Erica australis.
,, cinerea bicolor.
Erythrina herbacea.
Oxytropis fœtida.
,, cyanus.
Cydonia vulgaris.
Ruscus aculeatus.
Crucianella stylosa.
Micromeria piperella.
Epilobium obcordatum.
Asperula cynanchica.
Corydalis claviculata.

2. *Slightly injured.*

Araucaria imbricata.
Abies Morinda.
Picea amabilis.
,, Loweana.
,, lasiocarpa.
Cedrus Deodara.
Hollies.
Portugal Laurel.
Cytisus.
Eurybia Gunni.
Polygonum vacciniifolium.
Roses H.P. (Dwarfs).
Chamærops humilis.
Gunnera scabra.
Hydrangea hortensis.
Helianthemum vulgare.
Linum fruticosum.
Erica australis rosea.
Aucuba japonica.
,, variegata.
Thuja aurea.
Thea viridis.
Menziesia polifolia.
Yucca filamentosa.
,, gloriosa.

III. Table of Register of Spring Plants showing dates of flowering in 1880 and 1881, at the Royal Botanic Garden, Edinburgh.

	1880.	1881.
Galanthus nivalis,	Feb. 7	Mar. 2
Eranthus hyemalis,	,, 8	,, 4
Galanthus plicatus,	,, 8	,, 1
Leucojum vernum,	,, 9	,, 4
Tussilago fragrans,	,, 12	,, 4
Corylus Avellana,	,, 11	,, 1
Crocus Susianus,	,, 12	,, 8
Rhododendron atrovirens,	,, 5	,, 6
Dondia Epipactis,	,, 2	Feb. 28
Nordmannia cordifolia,	,, 20	,, 25

	1880.	1881.
Tussilago alba, ...	Feb. 10	Mar. 8
Scilla præcox, ...	„ 25	„ 10
Crocus vernus, ...	„ 20	„ 12
Sisyrinchium grandiflorum album, .	„ 24	„ 8
Aubrietia grandiflora, . . .	Mar. 4	„ 12
Scilla sibirica, ...	Feb. 26	„ 12
Sisyrinchium grandiflorum, . .	„ 24	„ 18
Draba aizoides, ...	„ 15	Feb. 26
Daphne Mezereum, . . .	„ 28	Mar. 2
Scilla bifolia, ...	Mar. 6	„ 9
Tussilago nivea, ...	„ 8	„ 9
Bulbocodium vernum, . . .	„ 1	„ 5
Arabis albida, ...	„ 3	„ 20
Iberis gibraltarica, ...	(Killed)	...
Scilla bifolia alba, ...	Mar. 7	Mar. 20
„ taurica, ...	„ 10	„ 21
Rhododendron Nobleanum, . .	„ 5	„ 15
Narcissus pumilus, ...	„ 9	„ 18
Orobus vernus, ...	„ 8	„ 20
Iris reticulata, ...	„ 10	„ 28
Erythronium Dens canis, . .	, 11	„ 29
Symplocarpus fœtidus, ...	„ 11	„ 14
Mandragora officinalis, ...	„ 15	April 2
Ribes sanguineum, ...	„ 17	Mar. 24
Corydalis solida, ...	„ 16	April 1
Symphytum caucasicum	„ 16	Mar. 24
Narcissus Pseudo-Narcissus, . .	„ 19	April 20
Hyoscyamus scopolia, ...	„ 24	„ 20
Fritillaria imperialis, . . .	April 12	May 6
Adonis vernalis, ...	„ 20	„ 11

IV. Extracts from Correspondents as to the Effects of the Winter of 1880-81 in different parts of Scotland.

1. From the North of Scotland.

From Mr. Thos. M'Donald, *The Gardens, Balfour Castle, Kirkwall, Orkney.*

June 3, 1881.

The garden and grounds of Balfour Castle are situated on a light clayey soil, about 600 yards from, and 50 feet above, the sea, with an exposure to the south. The most severe months are March and April, when we are visited by gales from the south and south-east.

The past winter has been the most severe of which we have any record. The plants which suffered most were *Escallonia macrantha*, *Veronica Andersoni*, *Viburnum Tinus;* Norway Spruce and Austrian Pine also suffered where much exposed. The kitchen garden stood well.

Lowest Temperatures registered during past Winter.

	No. of nights below 32° in shade.	Min. lying on grass.	Date.
November 1880,	10	19·5	20th.
December ,,	15	12·5	29th.
January 1881,	8	2·3	18th.
February ,,	10	18·5	12th.
March ,,	15	2·5	2nd.
April ,,	2	25·4	3rd.

From Mr. D. Melville, *The Gardens, Dunrobin Castle, Sutherlandshire.*

April, 1881.

The winter of 1880-81 has been the most protracted and severe in the north of which we have any record, lasting with frost and snow almost without a break from the 19th October 1880 till the end of March 1881. From the end of March to the middle of May cold east winds prevailed, which retarded vegetation of all kinds to a very late period. The weather during April was fortunately dry and very suitable for getting forward with out-door operations which were much in arrear. Altogether the winter may be fairly said to have lasted fully six months, monopolising its own allotted period, and the greater part of what in the ordinary course of things should have been spring. The gardens here are close to the sea, 13 feet above high water mark, and protected by woods and rising ground from the north, north-east, and north-west, but exposed to the full force of the easterly winds, which are frequently very injurious to evergreens during March and April.

Previous to last winter, our lowest temperature during the last twenty years occurred on the 22nd January 1867, wher the thermometer went down to 14°, or 18° of frost. On 17th January last the thermometer went down to 13°, or 19° of frost, and it was at or below the freezing-point on 107 nights during the winter. The worst block by snow for many years occurred between the 3rd and 8th March on the Highland Railway Company's line between Inverness and Perth, while the same Company's line through Caithness was blocked at the same time for a fortnight.

Among plants killed may be noted *Clianthus puniceus*, *Ceanothus azureus*, *Cercis siliquastrum*, most of the Hollyhocks, and a large percentage of standard Roses. Plants injured—*Phormium tenax*, *Veronica Andersoni*, *Fuchsia Riccartoni*, *Eulalia japonica*, and *Cryptomeria elegans*.

The following plants have stood the winter without injury—*Aralia Sieboldi*, *Escallonia macrantha*, *Salisburia adiantifolia*, *Arundo conspicua*, *Acer polymorphum sanguineum*, *A. p. palmatifidum*, *A. p. dissectum*, and some others of the new Japanese Acers.

The rainfall for 1880 was 26½ inches, being about 5 inches below the average.

From Mr. Angus Macdonald, *Balmacaan*, *Glenurquhart*, *Inverness-shire.*

May 5, 1881.

We are 15 miles distant from the sea, and 70 feet above its level. The exposure is south-easterly and well sheltered from the east and north-east. The lowest temperature registered was 27° of frost. Plants, with the exception of Roses, in this and neighbouring gardens suffered little or no injury.

From Mr. William Paterson, *The Gardens, Balmoral Castle, Aberdeenshire.*

May 13, 1881.

A great amount of damage has been done to vegetation in this locality. During the month of January and the first half of February we had very little snow, and the consequence was, that small plants and vegetables having no protection were entirely destroyed. Winter vegetables, such as Cabbages, Savoys, Greens, Leeks, Parsley, and Turnips have been entirely destroyed, the only exception being Parsnips, which are quite safe. In many cases the frost found its way to potatoes in pits, and very few of these were safe which had not a covering of from 2 to 3 feet of earth. Turnips in the fields were completely destroyed. Spring flowering plants, such as Pansies, Violas, Forget-me-nots, Arabis of sorts, *Iberis*, *Bellis perennis*, *Thymus*, Wallflowers, *Santolina incana*, *Alyssum saxatile*, *A. compacta*, &c., &c., have suffered greatly. H. P. Roses, were killed down to the ground, but being well mulched with stable manure, they are now coming away again. *Rhododendron ponticum* is much injured; also hybrids of *R. Catawbiense*, and other hardy sorts, are more or less injured. *Mahonia aquifolia* injured. Common Laurels, killed or injured. Irish Yews, injured on south side of plants. *Wellingtonia gigantea*, much injured. *Picea lasiocarpa*, injured. *Cupressus Lawsoniana* and *C. Nutkaensis*, slightly injured.

Last autumn was favourable to the thorough ripening of the young wood of Conifers, Evergreen and Deciduous Trees and Shrubs, but had it been otherwise a great many more plants would have been killed or injured.

The following were the lowest temperatures registered :—

November	January	February	March	April
2=19° frost.	5=19° frost	1=17° frost.	1=24° frost.	1=11° frost.
3=18½ ,,	6=18 ,,	2=20 ,,	2=31 ,,	2= 7 ,,
15=18 ,,	7=27 ,,	6=10 ,,	3=32 ,,	3=21 ,,
18=15 ,,	8=28 ,,	7=24 ,,	7=12 ,,	5=11½ ,,
20=29½ ,,	9=28 ,,	8=11½ ,,	15=10¼ ,,	6= 9¼ ,,
21=34 ,,	10=27½ ,,	11=11 ,,	20=10 ,,	7= 9 ,,
22=21 ,,	12=19 ,,	12=37 ,,	21=11½ ,,	9= 8½ ,,
	13=36 ,,	16=19 ,,	22=25 ,,	10=12¾ ,,
	14=39½ ,,	24=17 ,,	23=10¾ ,,	
	15=24 ,,	25=11½ ,,	27=14 ,,	
	16=21½ ,,	28=30 ,,	29=10½ ,,	
December	17=42 ,,		30=16 ,,	
	18=39 ,,		31=16 ,,	
	19=21¾ ,,			
17=27° frost.	20=17 ,,			
18=17¼ ,,	21=24 ,,			
22=30 ,,	22=25 ,,			
27=38 ,,	24=26½ ,,			
28=36 ,,	25=18 ,,			
31=18 ,,	26=30 ,,			
	27=38½ ,,			

We had 20 frosty nights in October, 16 in November, 23 in December, 26 in January, 21 in February, 24 in March, 16 in April, and 5 in May. The lowest reading in May was on the morning of the 10th, when 8° of frost were registered. The thermometer stands clear of buildings, and is placed 3½ feet from the ground. The exposure is to the north, and the distance from the sea is 50 miles, with an elevation of about 875 feet above its level.

From Mr J. Forrest, *The Gardens, Haddo House, Aberdeenshire.*

May, 1881.

Our distance from the sea is 12 miles, with a height of 189 feet above its level. The exposure is to the south-east, and there are no hills in the immediate neighbourhood. The past winter has been one of unusual length and severity. From the 18th of October till the 12th of March the thermometer, which is 2½ feet from the ground and protected, was at or below the freezing-point every night with the exception of twenty-four.

The lowest readings were as follows :—

October	December	January	February
21=11° frost.	17=16° frost.	4=14° frost.	12=16° frost.
	21=18 ,,	5=17 ,,	
	22=13 ,,	6=28 ,,	
	27=31 ,,	7=23 ,,	
November		9=16 ,,	March
		12=24 ,,	
		13=27 ,,	
		14=20 ,,	
1=12° frost.		16=21 ,,	1=16° frost.
2 – 17 ,,		17=35 ,,	3=22 ,,
19=18 ,,		18=34 ,,	
20=27 ,,		20=14 ,,	
21=17 ,,		21=24 ,,	
		23=25 ,,	
		25=31 ,,	
		26=18 ,,	

On 17th January a thermometer sent to the river side 1 mile from this, and about 80 feet lower, fell to 12° below zero.

On Christmas Eve snow fell to the depth of 18 inches. This broke down large limbs of both evergreen and deciduous trees and shrubs. From that time till the middle of March the ground was continually covered with snow, which varied from one to two feet in depth. The weight of snow seemed to have as much to do with the destruction of winter vegetables as the severity of the frost, the most of them being crushed down and rotted under the snow.

Autumn planted Cabbages, Broccoli, and German Greens were all killed. Brussels Sprouts, Savoys, Winter Cabbages, Celery, Leeks, Parsley, and Spinach were very much injured. Wallflower and Common Thyme were killed. Young wood of Apricots killed. Other fruit trees not injured. Gooseberry and Currant bushes very much broken down with snow. Roses all killed down to snow-line. Shrubs of all sorts are dreadfully cut up. Plants on Walls :—*Desfontainea spinosa*, *Escallonia macrantha*, and *Viburnum Tinus*—all killed. *Garrya elliptica*, *Ceanothus azureus*, *Euonymus* of sorts, and Ivies much injured. Bay, Colchicum, and Portugal Laurels all killed to snow-line. A number of Rhododendrons in damp situations killed to the ground; and all others more or less injured. A few young Hollies killed, and many slightly injured. Thujas, Irish and Common Yews in exposed situations slightly injured. Young plants, under 5 feet, of *Wellingtonia* and *Cedrus Deodara*, killed. Large plants of these are very much cut up, and in many cases have their side branches killed as far as 12 feet above ground. Some of the hardier *Coniferæ* are slightly browned, but have suffered no permanent injury.

2. From the Middle of Scotland.

From Mr. Wm. Reid, *The Gardens, Cortachy Castle, Forfarshire.*

May 1, 1881.

Cortachy is distant from the sea about 24 miles, with an elevation of 430 feet above its level. It is well sheltered from all directions except the south-east.

The following were the lowest temperatures registered :—December 17th, 11° ; January 16th, 4° (this being the lowest) ; February 12th, 14° ; March 2nd, 10°.

Excepting some hybrid Rhododendrons, Rosemary on walls, and Tea Roses grown as pillars, there were no deaths. Common and Portugal Laurels were slightly injured. Hybrid Rhododendron flower buds were mostly killed. *Escallonia macrantha*, *Lonicera aurea reticulata*, and *Laurustinus* on walls were damaged. Trees appear to have suffered no damage except a few brown points on those that were planted in the autumn. All green vegetables were a good deal damaged, and Globe Artichokes (which were protected), were almost entirely killed.

From Mr. John Robb, *The Gardens, Drummond Castle, Perthshire.*

May 5, 1881.

The shrubs, of which we have a great quantity, are very much *singed*, especially Portugal Laurels. Some of these in low quarters are quite denuded of their foliage, but I think by the end of May they will be green again. Myrtles on a south wall are much browned but not killed. Large plants of *Ceanothus* on the same wall are greatly damaged. *Magnolia grandiflora* and Clematis of the *Jackmanni* and other types are starting away quite fresh. Hardy Heaths have suffered much. Large old plants are quite dead, while others have their branches cut back, and all the young growths are killed. Standard Roses are much injured, and some killed. *Dwarfs* are killed almost to the ground, although covered with about 18 inches of snow all the winter. Vegetables, such as Savoys, Brussels Sprouts, Leeks, and Kale are quite destroyed. Fruit trees seem to have escaped, and if the frost keeps off we will have a good crop of fruit.

We are distant from the sea 20 miles on the east side and 30 on the west, with an elevation of 430 feet above its level, and with a fine southern exposure.

The following were the lowest temperatures registered :—

October	December	January	February	April
20 = 17° frost.	16 = 12° frost.	5 = 16° frost.	12 = 20° frost.	1 = 13° frost.
	17 = 18 ,,	6 = 16 ,,	28 = 16 ,,	2 = 13 ,,
	18 = 18 ,,	7 = 16 ,,		3 = 13 ,,
	20 = 13 ,,	8 = 25 ,,		4 = 14 ,,
	21 = 16 ,,	9 = 14 ,,		5 = 14 ,,
November	25 = 16 ,,	10 = 21 ,,		6 = 14 ,,
	26 = 18 ,,	11 = 16 ,,	March.	
	27 = 16 ,,	13 = 22 ,,		
	28 = 12 ,,	14 = 28 ,,		
2 = 19° frost.	29 = 11 ,,	15 = 25 ,,		
3 = 17 ,,	31 = 16 ,,	16 = 26 ,,	1 = 16° frost.	
4 = 10 ,,		17 = 30 ,,	2 = 24 ,,	
15 = 16 ,,		18 = 25 ,,	3 = 21 ,,	
18 = 16 ,,		19 = 25 ,,	4 = 6 ,,	
19 = 24 ,,		20 = 9 ,,	6 = 6 ,,	
21 = 20 ,,		21 = 21 ,,	7 = 6 ,,	
22 = 14 ,,		22 = 9 ,,	30 = 13 ,,	
23 = 16 ,,		25 = 13 ,,	31 = 13 ,,	
		26 = 12 ,,		

The thermometer is placed 4 feet from the ground.

From Mr. A. M'Kinnon, *The Gardens, Scone Palace, Perthshire.*

May 14, 1881.

The gardens of Scone Palace are situated about 20 miles from the sea. The soil is a heavy loam, resting on a a stiff clayey subsoil, at an altitude of about 95 feet above sea-level, and well sheltered on all sides by large forest trees.

Frost set in here on the morning of the 10th October 1880, when 4° were registered. From that date till the end of the month there were 18 frosty nights, giving a total of 90° of frost; the lowest readings being on the following dates:—19th, 6°; 20th, 14°; 26th, 11°.

During November 1880 the thermometer was below the freezing-point on 12 mornings, the lowest readings being on the 15th, 13°; 16th, 12°; 18th, 14°; 20th, 18°; 21st, 22°; 22nd, 14°. There were registered for the month 121° of frost.

December 1880.—There were 23 frosty nights, the lowest readings being on the following dates:—16th, 14°; 17th, 26°; 18th, 19°; 20th, 13°; 27th, 17°; 31st, 18°. Total for the month, 199° of frost.

January 1881.—The highest readings during this month were on the 2nd, when 37° were registered, and on the 31st, 38°. The thermometer was below the freezing-point on 29 mornings, the lowest readings being on the 5th, 13°; 6th, 12°; 7th, 13°; 8th, 20°; 9th, 22°; 10th, 18°; 11th, 14°; 12th, 19°; 13th, 26°; 14th, 32°; 15th, 20°; 16th, 24°; 17th, 27°; 18th, 29°; 19th, 16°; 20th, 20°; 21st, 24°; 22nd, 27°; 23rd, 25°: 24th, 36°; 25th, 22°; 26th, 27°; 27th, 28°. Total for the month, 537°.

February 1881.—The thermometer was at or below the freezing-point on 21 occasions, the lowest readings being on the 12th, 22°; on the 13th, 13°; and on the 24th, 15°. Total for the month, 162°. The highest readings during this month was on the 4th, 38°, and on the 25th, 40°.

March 1881.—The thermometer was below the freezing-point on 22 mornings. The following were the lowest temperatures:—1st, 16°; 2nd, 23°; 3rd, 18°; 22nd, 15°; 30th, 12°. There were registered for the month 170°. The highest readings were—on the 10th, 50°; on the 17th, 56°; and on the 19th, 51°.

April 1881.—The thermometer during the month was below the freezing-point on 9 occasions, the lowest readings being on the 1st, 13°; on the 2nd, 8°; on the 5th, 7°. Total registered for the month, 46°.

From the 4th of October 1880 till the 11th of April 1881 there were 134 frosty nights, giving a total of 1325° of frost.

The long continued frost has been very disastrous to vegetation. Laurels are nearly all killed to the ground. *Araucaria imbricata*, *Taxodium sempervirens*, *Wellingtonia gigantea* much injured. *Garrya elliptica* killed. *Cedrus Deodara* is much injured, and in some instances killed. *Cotoneaster microphylla*, *Clematis Jackmanni*, *Lonicera brachypoda aurea reticulata*, killed to the ground. Common Ivy has lost the most of its foliage. Privet, English Yews and *Rhododendron ponticum* in some situations are much injured. Pampas Grass killed. Standard Roses killed. Dwarf Roses killed to the ground.

The stems of some of the Portugal Laurels, from 4 to 6 inches in diameter, were split from top to bottom, and I observed branches of Oak and Ash trees in the park, about 6 to 8 inches in diameter, also split with the intense frost.

Vegetables suffered very much. Autumn planted Cabbages were all killed. Broccoli, Brussels Sprouts, Green Kale, and Savoys were also killed. Celery much injured.

Peaches, Nectarines, Apricots, Plums, and other fruit trees on the open wall, have escaped without injury. This is no doubt owing to the young wood being in a thoroughly ripened state. They are now full of blossom, and promise an abundant crop.

The Tay here was completely frozen over, the ice on some parts of the river being 12 inches in thickness. On the ponds and lochs in this neighbourhood the ice was from 16 to 18 inches in thickness.

From Mr. William S. Bissett, *The Gardens, Moncrieffe House, Perthshire.*

May 10, 1881.

The grounds of Moncrieffe are distant from the sea about 25 miles, with an elevation ranging from 30 to fully 700 feet above its level. The house and gardens stand at an elevation of about 50 feet. They are exposed to the south and south-west (from which direction they suffer considerably), and protected on the north and north-east by hills. . The lowest temperatures registered were on the mornings of the 14th, 16th, and 17th of January, when 28°, 29°, and 30° of frost were registered respectively. On the morning of the 27th there were 26° of frost. From the 13th to the 28th January 328° of frost were registered, making an average of 22° for each of the 15 nights. The past winter has been the most lengthened, and, with the exception of a few nights, the most severe during the last forty years. Some plants, such as Laurustinus, Sweet Bay, *Euonymus variegata*, *Lupinus arboreus*, and also Pentstemons, Stocks, and Wallflower, which were only partially injured by the winter of 1879–80, have been killed down to the ground. Some plants, such as *Cupressus Lambertiana* and Hybrid Rhododendrons, have only been partially destroyed. In some parts of the policies *Abies Douglasi* has been considerably browned. Roses have not suffered so much as they did during the winter of 1879–80. Broccoli, Brussels Sprouts, and all the Brassica tribe were killed. The snow which fell on the 4th, 5th, and 6th of March measured from 18 to 24 inches in depth. It did considerable damage by breaking down shrubs, especially Red Cedars.

From Mr. John Fortune, *The Gardens, Blair-Adam, Kinross-shire.*

May 4, 1881.

Distance from Firth of Forth, 12 miles. Height above sea-level, 500 to 600 feet.

The winter began on 19th October with 7° of frost, and on the 20th of same month we had 10°. In November we had frequently 14° of frost, and after an interval of comparatively mild weather the winter set in in earnest about the middle of December. The lowest temperature during that month was on the 17th, when we had 16° of frost. In January the thermometer was above the freezing-point on five mornings only. The lowest temperature during the winter was on the 17th of this month, when we had 23° of frost. In February and March, although the frost continued, it was never very severe. During the winter we had some eight or nine distinct falls of snow, the first fall taking place in October and the last in the beginning of March. *Araucaria imbricata* is slightly injured, Wellingtonias very much browned where exposed, and an Evergreen Oak very badly. Of shrubs injured there are Rhododendrons, Common and Portugal Laurels, Escallonias, and Ivies. No trees or shrubs are killed. Some Roses are killed, while others are cut down to the ground, but are now springing. Vegetables, with the exception of Leeks, some Autumn-planted Cabbages, and Parsley, are all killed. Strawberries are materially weakened, even where the plants were young.

I may mention that some of the Araucarias have not been injured since the year 1860–61 until now. Hollies were damaged by the winter of 1878–79, and have passed through this winter unhurt; whereas Araucarias escaped unhurt in 1878–79, and have been damaged by that of 1880–81.

The thermometer is placed 3 feet above the ground.

From Mr. WM. M'ALLISTER, *The Gardens, Arddarroch, Garelochhead, Helensburgh, Dumbartonshire.*

May 12, 1881.

There has been very little damage done here with frost. On the most exposed points of the shore, where the east wind strikes, Whins and Broom have been very much cut up, but the damage was done mostly in March and April. The months of September and October were exceptionally dry in this neighbourhood, and in consequence trees and shrubs ripened their growths well. The rainfall for these two months in 1880 was only about 4 inches, while the average for the same two months for thirty years has been 17 inches. The yearly rainfall averages 72 inches.

This place is situated on the shore of Loch Long. The garden is about 300 yards from the shore, and is well sheltered from the Loch. It is 80 feet above its level. The lowest temperature was 9°, or 23° of frost, on January 16th, at the garden, and at the conservatory, which is close to the sea, on the same date, only 17° of frost were registered. The exposure is to the south-west.

Desfontainea spinosa on a wall, without any covering, has stood and flowered regularly for the last ten years. *Garrya elliptica* flowers freely, and a white Camellia (standard) in the shelter of a shrubbery has several flowers open at the present time. *Rhododendron Nobleanum* used to be in flower at Christmas, but last winter most of the blooms were destroyed with frost when just opening. Old standard Fuchsias are breaking very well this season. The excessive moisture as a rule does more harm here than frost.

From Mr. John Smith, *The Gardens, Ballikinrain Castle, Stirlingshire.*

May 16, 1881.

The past winter has been the most trying on vegetation that ever I experienced. Broccoli, Brussels Sprouts, Savoys, German Greens, Spinach, and Autumn Cabbages have all been completely destroyed. China and H. P. Roses have been killed down to within a few inches of the ground, but most of them are starting again. Common Bays, *Garrya elliptica*, *Aucuba japonica*, *Laurustinus*, and *Abies Douglasi*, have all been much injured. Lavender, Thyme, Sweet Bays, *Berberis Darwini*, and a good many Privets, have been killed. The common Whin and Broom have been much cut up. Our lowest temperature was on January 22nd, when we had 4°, or 28° of frost. The total for the same month was 299° of frost. The deepest fall of show was on 5th March, when we had 16 inches.

Distance from the sea, 20 miles; height above it, 265 feet. Exposure northern.

From the Rev. David Landsborough, *Kilmarnock.*

June 15, 1881.

Report on East Coast of Arran, Buteshire.

The past winter has been so severe and long continued that it was impossible to give earlier, a satisfactory account of its effects upon vegetation.

The places regarding which I report are on the east coast of Arran, on the sea level, and near to the sea. Cromla at Corrie, and the low Castle Gardens at Brodick being separated from it at high water only by the public highway, and Captain Brown's, Lamlash, by the highway and a narrow field. One or two plants are introduced which grow in neighbouring gardens, the names of the gardens being given. In no case have the plants received any protection. Last winter the frost was more intense than it has been for many years. At the lighthouse on the Island of Pladda, at the south of Arran, and only half a mile from Arran, an accurate register of temperature is kept, the thermometer being situated 100 feet above the ground (about 110 above sea-level). Mr Grierson, the lightkeeper, has informed me that during last winter the temperature was lower than it had been since he came to the situation eight years ago. On the 16th, 21st, and 26th of January the thermometer fell to 28° (or 4° of frost). The gardener at Brodick Castle has also kept a register of the temperature at the low Castle Gardens, using an accurate self-registering thermometer, and he informs me that the lowest temperature was in January, when it fell to 13°. The temperature at Captain Brown's, Lamlash, and at Cromla, Corrie, being so similar in situation to the low Castle Gardens, cannot differ much from it, though I am inclined to think it will at both be two or three degrees higher, as the air flowing from the great Rosa Glen, which issues at Brodick, running from the north-west, and coming from the centre of the island, may to some extent cool the temperature, though the garden is thoroughly sheltered from its direct effect, and is otherwise admirably situated at the base of Goatfell, and sheltered by its wood. I may add that the Tree-ferns at Cromla grow in corners well sheltered. When no locality is given Cromla garden is meant.

Gum Trees.

Blue Gum (*Eucalyptus globulus*)—

Corrie Hotel.—Leaves dead, tree uninjured,—now beginning to grow.

Cromla, Corrie.—Grows in a colder and heavier soil than at the Hotel. All the wood of last summer killed, now beginning to grow.

At Brodick.—Two, both killed. One at Captain Brown's, Lamlash, leaves killed, tree uninjured.

Almond-leaved Gum (*E. amygdalina*)—

At Cromla, Corrie—Two—one killed ; the other has lost most of its leaves, but tree uninjured. Last year it began to grow early in February. This year it is only beginning now.

Brodick Castle Wood.—Two trees—one has lost the wood of last year ; the other its leaves, but otherwise uninjured.

Two varieties of this tree grew from the same seed. Both at Corrie and Brodick, the one variety has proved more hardy than the other.

The Giant Gum (*Eucalyptus gigantea*).—This is one of the finest of the "Gums," the leaves are very large, lightish in colour, and of great substance. The tree is of rapid growth, and hardier than any other Gum with which I am acquainted. The seed was gathered on the Blue Mountains, New South Wales, and sown in a stove in 1879. Last year it was planted at Cromla, Corrie, and at Captain Brown's, Lamlash. The tree at Lamlash has not lost a leaf, nor is one discoloured. It began early to grow, and has already made shoots 13 inches in length, while a Blue Gum beside it is only now beginning to grow. The tree at Corrie is also uninjured by frost ; but has been eaten by some animal.

The following species of Gum Tree raised from seed, kindly sent by Baron Ferdinand von Mueller, New South Wales, were raised last summer by the Duke of Hamilton's gardener, and planted in the open soil two months ago. They are now healthy and vigorous:—*E. calophylla*, *E. coriacea*, *E. diversicolor*, *E. globulus*, *E. hæmastoma*, *E. Stuartiana*, *E. marginata*, *E. melliodora*, *E. pilularis*, *E. polyanthema*, and *E. rostrata*.

Ferns.

Dicksonia antarctica.—In no previous winter has this fern suffered as it did last. All the fronds of 1878 and 1879 have been destroyed, while those of last year are greatly injured. Four vigorous fronds of this year's growth are now nearly full size. The stem is 1 foot 5 inches in height; and 2 feet in girth, at one foot from the ground.

Dicksonia squarrosa.—The condition of this fern is similar to that of the preceding. Its stem is 7 inches in height and 9 in girth.

Todea superba.—This fine fern is coming up beautifully, but the fronds of last year were destroyed.

Todea hymenophylloides, uninjured.

Adiantum pedatum, uninjured.

Asplenium Belangeri, *A. lucidum*, and *A. falcatum*, all uninjured.

Other Plants.

Cordyline indivisa, *C. Australis*, *C. Veitchii*, *Acacia melanoxylon*, Cromla, Corrie, and Castle Garden, Brodick, *Eurya latifolia*, *Desfontainea spinosa* (7 feet in height), *Euonymus latifolia aurea*, *Myrtus communis*, a standard 10 feet in height, *Azalea amœna*, *Deutzia gracilis*, *Rhododendron ciliatum*, *Escallonia macrantha*, *Coccoloba vespertilionis*, *Photinia serrulata*, *Elæagnus japonica variegata*, *Thujopsis dolobrata* (5 feet 4 inches in height), *Araucaria imbricata*, at Cromla, *Quercus Suber*, and Marechal Niel Rose, upper Castle Gardens, Little Japan double cherry (*Prunus sinensis flore pleno*),—all uninjured.

Camellia japonica, leaves slightly browned. *Araucaria Cunninghami*, Upper Castle Gardens, Brodick, much browned.

Edwardsia grandiflora, killed.

Banksian Rose, Strathwhillan, Brodick, will be in bloom in a fortnight—only one bud on a large plant, which never bloomed before.

The Rose *Aphis* is scarcely to be seen this year, either in Arran or in my garden at Kilmarnock, where in other years it was a plague.

Tropæolum speciosum.—Some at Strathwhillan, Brodick, in a sheltered corner against a wall, not cut down, and will bloom in a week.

Rhododendron arboreum.—This did not bloom till it had grown for nearly thirty years. This spring at Strathwhillan, Brodick, it was covered with buds, but some of the buds were killed by the frost.

3.—From the South of Scotland.

From Mr. Malcolm Dunn, *The Palace Gardens, Dalkeith, Mid-Lothian.*

August 1881.

Frost set in with 3° on the 12th of October 1880, which gave vegetation a perceptible check, but injured nothing of any importance. On the 19th, however, the frost returned with greater severity, and killed all tender plants—such as Dahlias, French Beans, Potatoes, and the like—the amount of frost being 7°, followed by 13° on the 20th, 6° on the 21st, 11° on the 22nd, 3° on the 23rd, and 4° on the 24th. On the 27th there were 2° of frost, 28th 1°, 29th 1°, and 30th 6°; making a total of 57 degrees of frost registered on 11 days during the month; an amount considerably over the average for October.

November opened with sharp frost on the 1st, 2nd, and 3rd; followed by 4 days fresh, 2 days slight frost, and again 4 days fresh. On the 14th, keen frost set in, and continued till the 24th; the amount registered on the respective days being, 9°, 12°, 10°, 3°, 14°, 6°, 18°, 16°, 17°, 12°, 3°. The ice attained a thickness of 4 inches on still water, and snow fell to the amount of 8 inches. The total amount of frost registered for the month was 154° on 16 days.

From the 25th of November till the 13th of December the weather was comparatively mild; but on the 14th of the latter month a storm of frost and snow began, which lasted almost without a break till the middle of April. Severe frost prevailed from the 14th till the end of December; the total amount for the month being 158°, registered on 20 days. The severest frost was 15° on the 17th.

On New Year's Day, 1881, there was only 1° of frost, and on the following two days the thermometer never fell below 40°. Keen frost returned on the 4th, and from that date till the end of the month it prevailed with great severity. On 24 consecutive days the mean temperature was below the freezing point; and on 4 days the average temperature was 18°, or 14° below freezing point. The severest frost was on the 17th, when the thermometer stood at 3° 2 a.m. till 8 a.m., indicating 29° of frost. During the month, 482° of frost were registered on 29 days. Snow fell frequently, but high winds swept it off trees, shrubs and crops, so that it afforded very little protection to them against the severity of the frost.

In February, frost prevailed every day, except on the 4th. The severest was 16° of frost on the 28th; the total amount for the month being 162°. A considerable depth of snow fell, but was again swept off crops and trees by frequent gales. On the 7th a severe gale of frosty wind, from the S.-W., did great injury to evergreens, especially to Conifers exposed to its direct force. In many cases, it stripped them of their foliage on the windward side and left them with a brown, naked, and unhealthy look, from which it will take some seasons of favourable weather to completely restore them.

March came in with 17° of frost on the 1st, 22° on the 2nd, and 20° on the 3rd, which was followed by a high gale of frosty wind from the E. on the 4th, 5th, and 6th, which drifted the loose snow fiercely before it, and laid vegetable crops completely bare to the severities of the storm; from which in consequence they suffered great damage. During the month frost was registered on 22 days, and amounted in all to 179°.

April began with 12° of frost on the 1st, increasing to 14° on the 6th, and continued frosty till the 12th. From the 18th till the 24th frost prevailed; there being 96° of frost registered on 18 days this month. Vegetables suffered severely from the keen frost in the early part of the month, and young cabbage and other plants were completely destroyed by the keen biting frosty wind.

May opened with mild weather; but on the 3rd there were 5° of frost, on the 9th 1°, on the 10th 3°, on the 16th 1°, and on the 17th 2°, after which there was no more frost for the season. In this month, 12° of frost were registered on 5 days. From the 12th of October till the 17th of May,—217 days,—there were 148 frosty days, on which 1300° of frost were registered.

From the first week in May the day temperature increased rapidly, and although crops were at that time fully three weeks behind the average, by the end of the month they had almost reached the usual stage of growth at that season. The last days of May and the first week of June were excessively warm, and, there being abundance of moisture in the soil, vegetation made vigorous and rapid growth till about the end of the month, when continuous rains and cold began to show their paralysing effects on vegetation, and for the remainder of the season there was comparatively little growth. Fruit trees, in general, had a favourable period for flowering and setting their crops, which were above an average; but owing to the cold and wet summer and autumn most kinds of fruit were deficient in flavour and quality.

Except where trees and shrubs were exposed to the fierce blast of the frosty winds, which were such a prominent feature of the past winter, they have suffered less than usual in such a severe season. Vegetable crops, however, were so much exposed to the biting blast of the frosty winds, and daily freezing and thawing for such a lengthened period, that they suffered more than they have done in this district for many years, and in many places the losses were very great.

Among plants killed or injured, the following may be noted:—Some plants of *Arbutus unedo* which had been killed to the ground in the previous winter, are now killed outright; not a single plant being left alive. *Aucuba japonica* has stood the past winter much better than the previous one, and shows little signs of injury. Common Laurels are severely injured; so much so that many of them are killed to the ground, and the remainder were so much damaged that they had to be cut over. Most of them are breaking away freely from the stools, but it will take some years till the gaps are again filled. Laurustinus suffered great injury during the two previous winters, and the few plants left stood the winter with little additional injury,—a few of the young growths being killed. Sweet Bay (*Laurus nobilis*) was again cut to the ground, but is now coming away strong from the stools. *Magnolia grandiflora*, on wall, suffered no injury, while *Escallonia macrantha* on same wall is severely injured, being killed almost to the ground. *Grislinia littoralis*, *Elæagnus reflexa*, and *Berberis Beali*, are again killed to the ground. Heaths of various kinds have suffered considerably; *Erica arborea* which withstood the previous two severe winters, having been almost destroyed. Rhododendrons with any trace of *Rhododendron arboreum* blood in them have suffered severely, some being killed outright, and mostly all of them so badly damaged as to require to be cut back. Great numbers of the flower buds of hybrid Rhododendrons were killed, and the remainder so badly injured that they never came to maturity, so that there was great scarcity of flowers upon them this season. The buds of the common *Rhododendron ponticum* were also slightly injured in wet low lying spots, but there was such an abundance of them that the few that were killed were not missed, and the display of flower was very fine. A few bushes of *Rhododendron ferrugineum* were eaten to the stumps by hares and rabbits during the snow storms in January and February. For these dwarf sorts of Rhododendrons, rabbits appear to have a great partiality. Other Rhododendrons growing alongside of them were not touched.

Conifers in general stood the winter well; and except the brown and blasted appearance of those exposed to the frosty gales, they exhibit no signs of injury, even among some that are generally considered to be rather tender. A few had some of their foliage nipped by the frost, which dropped off, and fresh foliage has obliterated all trace of injury. I need scarcely add that the Japanese Conifers have held their reputation as being among the hardiest of our exotic trees, as well as the most ornamental and interesting of the Coniferous family.

The Walnut, Mulberry, Guelder Rose, Ailantus, Evergreen oak, Phillyrea, and Privet, had most of their young wood injured, and in some instances the trees were severely injured. The young wood was also injured, more or less, of *Catalpa syringæfolia*, *Deutzia gracilis*, *Spiræa Lindleyana*, *prunifolia*, *Reveesiana*, *Thunbergi*; *Sambucus racemosa*, *Paulownia imperialis*, *Pterocarya caucasia*, *Hartogia capensis*, *Lonicera brachypoda*, *Hedera canariensis* and *Rægneriana*, *Cydonia japonica*, and *Glycine sinensis*. All the Clematis, except *Jackmanni*, were killed to the ground, as were also *Ampelopsis hederacea*, *Jasminum Wallichianum*, *J. revolutum*, and *Oreodaphne californica*. Rosemary and Lavender were severely injured, many plants being killed outright. Roses generally withstood the winter well. Tea roses, except *Gloire de Dijon*, had mostly succumbed the previous winter, and had not been renewed; but Hybrid Perpetuals, China, Bourbon, and other common Roses, were little injured.

Bambusa Fortunei variegata, has again proved tolerably hardy, having lost only a few of its leaves; and *Eulalia japonica variegata* appears to be at least equally hardy. The Pampas Grass has again suffered severely, most of the plants being killed. *Tritoma Uvaria* was killed to the ground, but started again.

Fruit trees suffered very little injury owing to the wood being so well ripened the previous autumn. Even Peach trees escaped with less injury to the young wood than is often seen in ordinary seasons. The only fruit plant which suffered was the Strawberry, being killed or badly injured from exposure to the daily thawing and freezing and bleak winds which proved so fatal to vegetable crops. The consequence was a very poor crop of fruit.

Among vegetables, scarcely any except Brussels Sprouts and Leeks came through scatheless. Cabbage and Savoys quickly succumbed. Curled greens stood well till the blasting frosty winds took them off, which also destroyed Celery and Broccoli. Young plants of the Cabbage tribe were also killed off in the month of March, when the snow had disappeared and they were left exposed to the effects of frost and wind. The consequence was a dearth of vegetables in spring, and a great scarcity of young plants, till those raised in spring were ready.

On the whole, with the few exceptions noted, the damage done by the past winter is not nearly so great as in the previous one. Generally speaking, trees and shrubs flowered abundantly, and made good progress till the continuous cold and wet of the summer months gave growth a check. Crops were late in being got into the ground, but the soil was in splendid condition, after the long time it had been subjected to the mellowing influence of the frost, and crops came away with great vigour and made rapid progress while the genial weather lasted. After June slow progress was made, and although the crops taken all over were up to the average, they did not reach the promise of the early summer.

From Mr. C. M'Taggart, *The Gardens, Arniston, Mid-Lothian.*
July 2, 1881.

I may state it is only the hardier kinds of trees and shrubs that are planted here. The Common Bay Laurel has suffered very much, and will mostly have to be cut over, but all seem to be coming freely from the stem. The fine old Portugal Laurels are badly disfigured, and I am afraid will never fill up again until cut over. The Evergreen Oaks have also suffered; some of the young plants entirely gone. *Cupressus* of sorts, Wellingtonia, Rhododendrons, &c., do not seem to be anything the worse.

Vegetables nearly all killed, Brussels Sprouts excepted. There was no accurate record kept here of the temperatures of the last winter. On three different occasions the thermometer was slightly below zero, $1\frac{1}{2}°$ at the most; more frequently we had from 27° to 30° of frost.

From Mr Geo. Brown, *The Gardens, Yester, Haddingtonshire.*
June 16, 1881.

The effects of the past winter on vegetation here have been very serious. The winter has been the severest that the oldest inhabitant can remember. This place is situated in Lat. 55·54° N. Long. 2·44° W., ten miles from the sea coast, and 400 feet above its level.

The hardest nights we had here were on the 14th and 15th December, when the thermometer (in box) fell to 2° (or thirty degrees of frost) on both nights.

The hardiest shrubs, such as Laurels, Box, Hollies, and Yews, were severely browned.

The more tender ones, such as *Garrya elliptica*, *Aucuba japonica*, *Viburnum Tinus*, and about one-half of our Dwarf Roses, were completely killed.

Vegetables, such as Greens, Broccoli, and Savoys, were killed; Celery stood well, even without any protection; of Leeks and

Brussels Sprouts we lost about one-half. Those that withstood the frost best were those laid over on the ground.

From Mr. Daniel Smith, *The Gardens, Bargany, Ayrshire.*

May 16, 1881.

Distance from the sea 4 miles, with an elevation of about 100 feet above its level. Exposure east and west. The lowest temperature was on 16th January, when the thermometer was 2° above zero, and on the 19th 4°, giving respectively 30° and 28° of frost. There was more snow here than has been for many years, 3½ inches being the general fall, which is 1 inch more than what has been for the last nineteen years.

Plants Injured.—*Garrya elliptica*, 15 feet high on south wall, killed down to within 1 foot of the ground. *Cupressus Lambertiana* very much injured, but will recover. Common Bays much browned, but recovering fast. With these exceptions little damage has been done to Shrubs and Conifers. Roses have suffered much, being killed down to the mulching. All sorts of vegetables are killed. Fruit trees are uninjured.

From Mr. David Murray, *The Gardens, Culzean Castle, Maybole, Ayrshire.*

May 9, 1881.

The lowest temperature registered here during the past winter was on January 22nd, when we had 21° of frost. The following plants all grow within 200 yards of the sea, and 200 feet above its level :—

Badly Injured but not Killed.—*Fuchsia Riccartoni*, Myrtle of sorts, Sweet-scented Verbena, Coronilla, *Escallonia Mackayi*, *Berberis Darwini*, *Veronica*, Blue Gum, *Desfontainea spinosa*, and New Zealand Flax.

Slightly Injured.—Hydrangeas, *Tritoma uvaria*, Sweet Bay, Rhododendrons (Hybrids and *ponticum*) where exposed to the north and east winds, *Ceanothus azureus*, and some Camellias.

Uninjured.—*Araucaria*, *Arbutus*, *Aucuba*, *Escallonia macrantha*, *Magnolia grandiflora*, *Garrya elliptica*, *Aralia Sieboldi*, &c.

Our vegetables, such as late Broccoli, were nearly all killed, none being left except half a crop of "Lauder's Goschen." Globe Artichokes, although protected, were cut up. Our fruit crop looks very promising, every fruit tree and bush being covered with blossom.

From Mr. John Shannon, *The Gardens, Jardine Hall, Lockerbie, Dumfriesshire.*

May 16, 1881.

The past winter has been most severe in this locality. All our fine old Laurels and Bays which were injured in 1879–80 have been killed by the past winter's frost. A great many Rhododendrons which were injured in 1879–80 are now killed. *Aucuba japonica,* some killed and some injured. Ivies, many killed and many injured. *Cupressus M'Nabiana* killed. *Wellingtonia gigantea* slightly injured. *Cedrus Deodara,* some killed and some badly injured. Roses all killed back to the mulching level, but are now springing again. All winter vegetables, with the exception of Leeks, were killed. We are distant from the sea 15 miles, and 200 feet above its level. The exposure is S.S.W. Our lowest temperatures were on the 16th, 17th, 21st, 22nd, and 25th of January, when we had 39°, 40°, 28°, 33°, and 34° of frost respectively. For several days the temperature continued throughout the whole day at over 20° of frost.

From Mr. Thomas Duncan, *The Gardens, Auchen Castle, Moffat, Dumfriesshire.*

June 17, 1881.

I have but little to report of the past winter. There is no great variety of shrubs here, the majority of the clumps are *Rhododendron ponticum* and Hybrids.

The policies lie on a steep hillside exposed to the north-east, about 27 miles from the Solway Firth, and 600 feet above the sea level. The summer of 1880 was one of the best for many years, but a decided change set in on the 15th September, when a storm of wind and rain from the north-east put an end to outdoor flowers for the season. I may remark that on the 15th September 1878 we had a heavy storm of wind and rain from the south, followed by a hard winter. The first frost of 1880 was on the 4th October, when the register stood at 26°. The thermometer was below freezing point on ten mornings, the lowest on the 20th and 22nd, when the register stood at 22° and 20° respectively, total for the month 72°. November very cold and wintry; the thermometer was below freezing point on fourteen mornings, lowest on the 2nd, 21st, and 22nd, the register standing at 15°, 12°, and 16° respectively; total for the month 139°.

In December there were eighteen frosty mornings, lowest on the 17th, 28th, and 31st, when the register stood at 16°, 20°, and 18° respectively; total for the month 121°.

January 1881 came in with a thaw, but the frost set in again on the 5th with 7° of frost. The thermometer was below freezing point on twenty-three mornings, the lowest being on the 10th, 11°; 12th, 12°; 15th, 8°; 16th, 2°; 17th, 33°; 22nd, 10°; 24th, 8°; 26th, 10°; 27th, 7°. Total for the month 409°.

February. The thermometer was below freezing point on nineteen mornings; lowest on the 7th, 12th, and 28th, when the register stood at 18°, 16°, and 20° respectively, with a total for the month of 115°.

March. The thermometer was below freezing point on nineteen mornings, with the lowest on the 1st, 2nd, 3rd, 22nd, 30th, and 31st, when the register stood at 15°, 9°, 15°, 17°, 17°, and 16°, respectively; total for the month 168°.

April. The thermometer was below freezing point on fifteen days, lowest on the 1st, 3rd, 4th, and 6th, when the register stood at 22°, 22°, 19°, and 20° respectively; total for the month 98°.

In May there was frost on five mornings; lowest on the 10th, when the register stood at 27°; total for the month 14°. Total for the eight months 1136°.

Bay Laurels have suffered very much from the frost, many of them being killed to the ground. Portugal Laurels had their last year's shoots killed. Araucarias had their last year's growths browned, a number of them killed from 4 to 6 inches, but a great number of the browned points are starting into life. *Rhododendron ponticum* very little injured, and only on that side exposed to the north wind. Several of the named ones are injured, and four or five killed out of over a hundred varieties. The clumps are a mass of bloom at this date (June 17th), the injured ones marring but little the general effect. Yews have their points browned. Hollies all injured, a number killed to the ground. All winter vegetables killed except a few greens—about one-third of these survived.

Places in this neighbourhood 200 feet lower down suffered more than up here, having from 2° to 3° more frost.

From Mr. J. Borthwick, *The Gardens*, *Stobo Castle*, *Peeblesshire.*

May 21, 1881.

We are distant from the sea 50 miles, with an elevation of 590 feet above its level. The lowest temperatures registered here were on the 17th and 18th of January, when the thermometer fell to 15° below zero, making 47° of frost. Celery and all our winter vegetables were killed before the 1st of January. Shrubs at the Garden are very much injured, but at the Castle, which stands a good many feet higher, they are not so bad. Hollies at the Garden all killed, at the Castle very little injured. Portugal Laurels nearly all killed.

Ivy at the Garden, some killed and the remainder very much injured; at the Castle quite fresh. Irish Yews much browned. *Garrya elliptica* and Aucubas all killed. Tree Box of sorts much damaged. Out of two or three hundred Roses very few are lost, five or six only being killed. They were heavily top-dressed with manure. Strawberries have suffered severely. Plums and Cherries are well covered with blossom. Gooseberries and Currants promise a fair crop.

From Mr. ANDREW TURNBULL, *Bothwell Castle, Lanarkshire.*

May 1881.

We are 32 miles distant from the sea, and 146 feet above its level. The exposure is south-westerly. The average height above sea-level of the whole parish of Bothwell is about 300 feet.

The past winter was the most severe of which I have any recollection. It commenced early in October, and on the 20th of November the thermometer fell to 1° above zero, which was the lowest point it reached during that month. The lowest temperatures in January were on the 14th, 16th, 17th, 20th, 22nd, and 24th, when the thermometer fell to 1°, 7°, 6°, 2°, 4°, and $3\frac{1}{2}$° respectively below zero. Taking the average of the whole month, we had $18\frac{1}{2}$° of frost for each day, and we had at no time more than 5 inches of snow on the ground. Vegetables were entirely killed. Roses have suffered more than they did in 1860-61, even the old French varieties being generally killed to the root. Rhododendrons have suffered much, the common *ponticum* being more hurt than any of the others. The flower-buds of this are all destroyed, and those of *Nobleana* are mostly destroyed, while those of Cunningham's White have escaped unhurt. Old Ivy plants are generally killed. Portugal Laurels, where exposed to the north-east, have lost all their leaves. Wellingtonias are greatly damaged. *Abies Douglasi* mostly killed. *Araucaria imbricata*, where not killed, greatly damaged.

From Mr. FRANCIS DAVIDSON, *The Gardens, Hamilton Palace, Lanarkshire.*

June 24, 1881.

We are at a distance here of about 36 miles from the sea. The Gardens are situated in close proximity to the old town of Hamilton, and the Ordnance Survey Map gives the altitude at a point so near the new garden that it may be taken as its true position, that is to say, 186 feet above sea-level.

After the dry summer of 1880, frost set in so early and so keenly as to do extensive damage to vegetation.

In the latter part of October we registered from 4° to 10° of frost; this did no inconsiderable injury to the potato crop then unlifted, and from that time it continued with more or less severity during the next four months.

On the 18th of November the thermometer fell to 10°, and on the 20th to 3°. At this date we had the heaviest fall of snow that visited this district during the whole winter, as it fell to the depth of 8 inches.

It was not before the 16th of January, however, that we experienced the lowest temperature; on that occasion the thermometer fell 5° below zero. The respective readings of the thermometer for several mornings at that time were as follows:—

January	14th,	1° below zero	January	20th,	1° below zero.
,,	15th,	3° above ,,	,,	21st,	7° above ,,
,,	16th,	5° below ,,	,,	22nd,	3° below ,,
,,	17th,	4° ,, ,,	,,	23rd,	16° above ,,
,,	18th,	3° above ,,	,,	24th,	2½° below ,,
,,	19th,	7° ,, ,,			

The above were the only times the thermometer fell here below zero, but we would have a mean of about 15° of frost till far on in March, when its intensity began to relax. In April we had occasionally 12°, but during May the temperature was always above freezing point, while in the first week of the present month, June, we had 4° of frost.

Winter vegetables and autumn sown plants were almost entirely killed. Of hardy shrubs the Portugal and Bay Laurels have suffered the most injury, in many cases having been killed. *Araucaria imbricata* nearly killed; Irish Yews much injured; so also are the English Yews. There are a good many deaths among Roses, and it is to be regretted that the remaining portion of the grand old Caledonian Forest, the sturdy oaks that have stood the blasts of at least one hundred winters are a standing testimony to the severity of the winter of 1880–81, in some instances scarcely a vestige of greenness is to be seen, while others give melancholy evidence of being much injured. The same also has to be reported of some fine old specimens that stand in the policies of the ducal residence.

From Mr. James Whitton, *The Gardens, Thirlestane Castle, Lauder, Berwickshire.*

May 9, 1881.

We are 18 miles distant from, and 558 feet above, the level of the sea, and situated in the middle of a valley about 300 yards from the River Leader, and 20 feet above its bed. We are thoroughly well sheltered by high plantations on all sides except the south, and enclosed by hills on north-east, west, and south-west, which rise to a height of about 1000 feet. There are two streams in addition to the Leader, one on each side, at a distance of about 300 yards, so that the place is very much subject to hoar-frosts. The soil is a clayey loam on a tilly subsoil, and the ground slopes slightly to the north-east.

Lowest Readings of Thermometer in Air, and Protected, during the Winter of 1880–81.

November	December	January	March
20 = 8° 21 = 1 22 = 4 23 = 7	17 = 8° 18 = 10	14 = − 1° 15 = 0° 16 = − 3 17 = −11 18 = − 1 19 = 9 20 = 10 21 = 5 22 = 5 23 = 10 24 = − 4 25 = 1 26 = − 5 27 = − 4	1 = 8° 2 = 7 3 = 7

From the above readings of January it will be seen that there is a mean of something less than a degree above zero, while that of the 17th is 3° lower than we ever had before. With all this, however, we cannot show so much injury to plants on account of their being so terribly cut up the winter before, which gives us less to work upon. Wellingtonias are all but killed off. *Rhododendron ponticum* is so much destroyed that I am afraid most of them will require to be cut down. Yews have again suffered much, both as single plants and as hedges, of which we had some nice little bits, but I am afraid they are now past recovery. A large number of Tree Box are entirely killed, many of them having been planted forty years ago, when the gardens were laid out. All the Laurels on the place were killed to the ground in 1878–79, and the young wood they have since made is again killed back. Clematis are all killed. Roses on walls, and the young wood of Peaches and other fruit-trees, appear to be safe. Roses, &c., in open borders are killed down to the snow-line. Vegetables never were so completely destroyed, the whole of them being killed excepting Leeks and Parsley.

In striking contrast to this place is that of Spottiswoode, a few miles from here, and situated on the southern slope of the Lammermoors, at a height of 788 feet above the sea. There scarcely any damage is done to the finely-grown Laurels and other evergreens which beautify the place. *Araucaria* is quite safe, and *Rhododendron Nobleanum* is flowering freely, without having got the slightest protection. The only plants that seem to have suffered any injury in the shrubberies are those growing under the shade of trees; also some large plants of *Garrya elliptica* and *Escallonia macrantha.* Vegetables, however, have fared no better than our own, all being killed with the exception of Leeks.

The place is well sheltered on the north by the rising ground, and with high plantations which nearly surround it. As no register is kept of the readings of the thermometer, I am unable to give the lowest temperatures experienced during the past winter.

From CHARLES STUART, M.D., *Chirnside, Berwickshire.*

May 16, 1881.

Chirnside is situated on a ridge or spur of the Lammermoors, 413 feet above the sea level, 9 miles east from Berwick-upon-Tweed, with an exposure to the south. There is an uninterrupted prospect over the country into Northumberland for 31 miles to the top of High Cheviot.

The soil is a rich loam, with a fine dry subsoil of Red Sandstone in a broken up form.

One mile south, the rivers Blackadder and Whitadder unite at Allanton Bridge, 144 feet 2 inches above the sea, and it is in the course of these two rivers that the great damage to trees and shrubs has taken place; comparatively little harm has been done in more elevated situations. The subsoil in the course of the Blackadder is of a cold clayey character, and it is in similar soils where most mischief has been done. On the 18th October 1880, after a rapid fall of the barometer, the weather broke. Severe frosts followed, there being 15° difference between evening and morning temperature. Snow presently appeared, Cheviot being thrice covered to its base with deep snow before the 22nd November. On the 19th, 20th, 21st, and 22nd very low temperatures were recorded, the thermometer standing at 15° at Chirnside Bridge (196 feet above sea level) at six P.M. on 21st, and there was very little difference in the readings all that day. At Blackadder and Kelloe (on the river Blackadder) the thermometer registered 29° of frost or 3° above zero. On the 24th fresh weather set in, and we had it very fine for a fortnight.

On the 15th December there was a return of winter, which continued more or less till April, with unprecedented low temperatures (and severe snowstorms on the 18th January and 5th March 1881). During January, at Blackadder, the thermometer was on seven occasions below zero; on the 14th, 6°; 15th, 1°; 16th, 12°; 17th, 22°; 23rd, 24°; 25th, 3°; 26th, 16°. Wood pigeons were observed to fall off the trees frozen to death, and many cases of frost-bite occurred on the 17th January. On the 26th, wood pigeons allowed themselves to be caught by hand, feeding at the sheep-boxes in the fields, being unable to fly; waterhens were also caught. With the leaves hardly off the trees, the wood still full of sap and unripened, when the winter set in with such severity the great destruction to trees and shrubs is not so very remarkable.

On the hill here the Hollies are untouched; 100 feet lower there is not one in existence. At Whitehall and Ninewells ancient Hollies and Yews are all dead, and at Blackadder there is not one alive on the estate. The yellow flowering Ribes and also the *Aucuba japonica* are killed on the hill, 413 feet above the sea.

While all the Broccoli and Cabbage tribe are killed in low situations, on our well-drained soil they are an excellent crop.

List of trees and shrubs killed at Blackadder, about 200 feet above sea level; soil a cold clay; 11 miles from the sea, within 100 yards of river—

Abies Menziesi, *Araucaria imbricata*, *Cedrus atlantica*, *Deodara*, and *Libani*, *Cryptomeria japonica*, *Juniperus virginiana*, *Picea lasiocarpa* and *pinsapo*, *Pinus excelsa*, *Wellingtonia gigantea*, *Taxus baccata and fastigiata*, *Ampelopsis*, *Aucuba japonica*, *Buxus*, *Berberis Darwini*, *Clematis* in variety, *Cratægus Pyracantha*, *Cytisus*, *Laburnum* in variety, *Garrya elliptica*, *Hedera*, *Ilex* in variety, *Jasminum*, *Laurus nobilis*, *Ligustrum* in variety, *Mahonia japonica*, *Ribes*, *Skimmia japonica*, Rhododendrons, Roses, Portugal Laurel, Bay Laurel, Apples, Peaches, Plums, Cherries and Nectarines.

The following more or less injured:—

Abies Douglasi, *Biota aurea*, *Cryptomeria elegans*, *Cupressus Lawsoniana* and *erecta viridis*, *Picea nobilis* and *Nordmanniana* (blasted), *Retinospora* in variety, *Thujopsis dolabrata*, *Thuja Lobbi*, *Aristolochia Sipho*, Hawthorn, *Lonicera*, Oak, English, Turkey, and Evergreen (much damaged, and in many places killed), *Spirea*, *Vinca*, *Weigela rosea*, *Azalea pontica* (the four latter much damaged or killed.

198 fruit trees were dug up from the garden dead or useless, and 78 at Allanbank, on the other side of the river; while at Kelloe, a mile higher up the Blackadder, all the Evergreens and many of the fruit trees have been killed. Many years must elapse before trees

and shrubs will be again what they were, and in low situations a severe lesson has been given to plant nothing but of the hardiest description, with the prospect of other Arctic winters.

From Mr. PETER LONEY, *The Gardens, Marchmont House, Dunse, Berwickshire.*

July 20, 1881.

Elevation, 500 feet ; latitude, 55° 43′ 30″, longitude, 2° 25′ 20″. Situated on a ridge at the base of the Lammermoors. We do not have such low temperatures as are recorded at a few other places in the county, but we have a longer continuance of storms, and in the aggregate a low series of readings of the thermometer. We have seldom any autumn growth, which is greatly in favour of all hard wooded trees and shrubs ; they withstand the early autumn frosts better than at such places as Blackadder and along the valley of the Tweed, but our losses are much heavier this year than they were in 1879–80.

Dead—
Almond.
Aloysia.
Arbutus.
Aucuba.
Bay, Sweet.
Berberis.
Broccoli.
Brussels Sprouts.
Buddlea.
Cabbages.
Cauliflower.
Ceanothus.
Chimonanthus.
Escallonia.
Eucalyptus.
Garrya elliptica.
Laurel, Portugal.
Laurustinus.
Lavender.

Dead—
Leycesteria.
Lonicera.
Stocks.
Onions.
Paulownia.
Roses (Standard).
Rosemary.
Yuccas.

Injured—
Apricots.
Apples.
Araucaria.
Artichoke.
Borecole.
Celery.
Cherries.
Cotoneaster.
Cratægus.
Cytisus.

Injured—
Deutzia.
Dianthus.
Euonymus.
Hedera (Ivy).
Ilex (sorts).
Jasminum.
Laurel.
Magnolia.
Pyrus japonica.
Quince.
Ribes.
Roses (own roots).
Wallflowers.
Chestnuts slightly.
Oaks ,,
Spruce Firs ,,
Elms ,,
Acacias ,,

Minimum temperatures at Marchmont House. Instruments in accordance with the Scottish Meteorological Society, and all tested.

Date.	Min.	Min. B.B.	Date.	Min.	Min. B.B.
1880.	°	°	1881.	°	°
Oct. 19	28	23	Jan. 26	9	0
,, 20	26	18	,, 27	9	0
,, 22	25	13	Feb. 12	20	15
Nov. 2	25	15	,, 24	20	9
,, 15	20	15	,, 25	25	12
,, 16	23	11	,, 28	19	10
,, 21	16	3	March 1	20	8
,, 22	17	7	,, 2	10	2
,, 23	19	11	,, 3	18	5
Dec. 17	16	8	,, 21	25	19
,, 18	16	10	,, 23	20	13
,, 28	22	9	,, 30	22	17
,, 31	25	15	,, 31	22	14
1881.			April 3	28	21
Jan. 8	15	8	,, 4	25	13
,, 9	13	8	,, 6	24	14
,, 15	14	6	,, 21	30	24
,, 16	12	3	May 3	31	25
,, 17	2	−8	,, 10	32	21
,, 18	11	−2	,, 17	31	28
,, 19	21	12	,, 23	40	29
,, 24	17	9			

The following are a few of the lowest readings of black bulb thermometer on the grass here :—

June 6, . .	30°	June 10, . .	23°	June 15, . .	32°
,, 7, . .	29	,, 11, . .	31	,, 24, . .	29
,, 8, . .	30	,, 12, . .	30	,, 29, . .	32
,, 9, . .	28	,, 14, . .	31	,, 30, . .	31

During the month, 28° of frost.

July 16, . . 36° | July 20, . . 39°

And at present, 9 P.M., temperature on B.B. 39°, with hail at 11.30 this morning.

Omitted from Report for 1879–80.

From Mr. A. M'Intosh, *The Gardens, Paxton House, Berwickshire.*

May 1880.

The effects of last winter on vegetation is becoming more and more visible every day. Portugal and Common Laurels, Yews, *Laurustinus*, *Aucuba japonica*, *Cedrus*, *Andromeda procera*, *Salisburia adiantifolia*, *Cryptomeria elegans*, *Cytisus*, *Jasminum*, *Clematis*, *Cotoneaster*, *Garrya elliptica*, &c., in our shrubbery are a total wreck.

Trees on walls killed. Rhododendrons very much damaged and in some cases killed. Of fruit trees, Peaches are killed on south walls; Apricots some killed and others very much damaged. Pears and Apples are slightly injured, and fruit bud destroyed. All standard Roses are killed, and a good many dwarfs where not protected. The effects on the Brassica tribe have been most disastrous, the Broccoli and Celery suffering most.

Our lowest temperatures were on the following dates, viz.—December 4th, 10° below zero; December 5th, 1° below zero.

I may state that Mr. Buchan, Secretary of the Scottish Meteorological Society, has tested our glasses and found them correct.

PROCEEDINGS

OF THE

BOTANICAL SOCIETY.

SESSION XLV.

Thursday, 11*th November* 1880.—Mr William Gorrie, President, occupied the Chair.

The following alterations on Law IV., as well as a new Law, both recommended by the Council, and previously intimated at the April and May meetings of the Society, were considered and agreed to:—

Law IV. as amended:—"Non-Resident Fellows must arrange with the Assistant-Secretary for the transmission of their copies of the Transactions, and they are requested to acknowledge receipt. Billets of the meetings may, if desired, be also obtained."

The following additional Law, Chapter X.:—"In the event of any member acting in such a way as shall seem to the Fellows of the Society to be detrimental to its interests, the Council may recommend that the name of such member be deleted from the roll. The recommendation shall be brought before the Society at its first ordinary meeting. It shall be finally decided at the immediately succeeding meeting by ballot. If confirmed by a majority of two-thirds of the votes of at least fifteen Fellows, the name of such person shall be deleted from the roll of membership, and all his privileges connected with the Society shall be forfeited."

The following Candidate was elected a Resident Fellow:—

William Badger, M.B., C.M. Edin., Penicuik.

The following Communications were read:—

I. *Valedictory Address* by Mr W. Gorrie, President—*On Acquiring, by Selection, Hardier Varieties or Forms of Half-hardy Exotics.*

The usual statement as to the numerical position of the Society was also made, in which it appeared that there were now 150 Resident Fellows.

Dr Cleghorn confirmed, from his Himalayan experience, the observation of the President, that fine Sikkim and Nepaul plants are more injured by the alternating frosty and mild weather prevailing here from February to May than from the rigours of our winter climate. They had there cold enough winters, but immediately afterwards strong continuous sunshine. On these mountains they had none of the changeable spring weather so characteristic of Britain.

A vote of thanks to Mr Gorrie for his admirable address was moved by Professor Balfour, and carried by acclamation.

II. *Description of a Tree Struck by Lightning near Musselburgh.* By Mr Robert Morham, City Chambers. Communicated by Sir Robert Christison, Bart. (Plate IV.)

On 8th July 1880, during a thunderstorm of some severity, an oak on the south side of the east entrance to the grounds of Drummore, near Musselburgh, the property of Colonel Aitchison, was struck by lightning. The tree stands just outside the gateway, within which, as well as in the grounds of Preston Grange on the opposite side of the road, there are numerous trees of general standing similar to that of the injured tree.

The accompanying sketch will give some idea of the effect of the lightning on the tree.

To judge by the quantity and calibre of the branches which lay on the ground for some time after the occurrence, it is surmised that about from one-third to one-half of the tree was destroyed. Some of the branches lying on the ground were sound to appearance, but a considerable proportion seemed thoroughly shivered though still retaining their general form.

The parts of the tree as now left standing consist of (1) the trunk; (2) the whole of one of the two principal branches above the fork, with its subsidiary branches and foliage, and a small portion of the other principal branch adhering to it; and (3) a further remnant of the destroyed principal branch with a small subsidiary branch springing from it.

The trunk is split from top to bottom into two not very unequal parts, the larger being that from which springs the apparently uninjured main branch. There is one principal cleft with a number of smaller ones adjacent, the latter being more like what carpenters call "shakes." The principal cleft is nearly continuous, but has at intervals small breaks or digressions, usually opposite those parts in the exterior of the trunk where fringes of small twigs occur. A great portion of the bark is off the trunk, and at the height of about 4 feet from the ground, where the circumference is nearly 7 feet, only one-fifth of the bark is left.

The surviving main stem appears in the meantime as healthy as if nothing had happened, the leaves about the end of September beginning to wither to about the same degree as other similar trees in the vicinity. On the stricken branch, the remaining part of which extends 10 or 12 feet above the fork, none of the bark remains, and the leaves on the small subsidiary branch appeared from the first to be quite dead.

According to the information received from Colonel Aitchison's gardener, the lightning struck the tree about 10.30 A.M., making a sound like the report of a large cannon, the peal of thunder and the shattering of the tree happening at the same moment. The storm came from the north-east, and lasted an hour or so, being specially severe for about twenty minutes.

III. *On Plant-Preserving.* By R. C. A. Prior, M.D.

There is very little progress to be made in the knowledge of plants without the means of preserving them for reference and comparison. The following is the German method, and I think the best, and is the one by which I have myself dried tens of thousands of them.

Much of the apparatus here recommended may seem to be superfluous, to such at least as have only now and then dried a pretty flower in a book; but if the botanical student wishes to become more than a mere dilettante, he will find the saving of time and labour in making an extensive collection repay him amply for a first rather heavy outlay.

Take into the field a tin box made for the purpose and called a *vasculum;* or if you are not provided with one, get a tin candle box, which you may buy or borrow in almost any country village. Take also a portfolio with about twenty or thirty sheets of any strong paper in it. As soon as your vasculum is full, sit down and empty it out, and lay such specimens as are best worth keeping into the portfolio. This you may have to do four or five times in the day. Let the man who accompanies you carry the vasculum on one side and the portfolio on the other, by straps over the shoulders; but yourself carry nothing but a knife with a very strong blade, about 9 inches long, 2 inches broad, and a quarter of an inch thick, fixed into a wooden handle, and traversing the whole length of it, suspended in a sheath from the waist. Such a knife is of use, not only for digging up plants and lopping boughs, but may serve you as a step in scaling walls and rocks, and should therefore be made of the best steel. Never carry an alpenstock. An oak walking-stick with a crook to it is often useful for pulling down branches of trees; but to speak from my own experience of mountain climbing, an alpenstock on a botanical excursion is only fit for young ladies and town-bred young gentlemen who go up the Rigi.

Upon your return home, or early the next morning, transfer the plants from the portfolio to dry paper. Any that has much size in it is unfit for the purpose, and blotting-paper takes out their colour. You cannot have a better than the shopkeepers' whitey-brown. Lay one of your plants, or, if the species is a small one, two or three or twenty plants within a sheet of this, fold it down upon them, and lay it upon a pad of five or six sheets of a bibulous paper to absorb the moisture, and another pad upon it; then another sheet of plants upon that, and another pad alternately. The best paper for these pads is that which is made expressly for botanists, and called "Bentall." It is sold by Mr Edward Newman, 32 Botolph Lane, Eastcheap, London, E.C. Get ten reams of it, the smaller size (except for botanizing in a tropical country), and one ream of the whitey-brown, and have this cut to the size of the Bentall. Procure also of the same size twenty-four pieces of very strong thick mill-board, and two or three pairs of wooden boards, each board made of two thinner ones laid transversely the one upon the other, and glued together and screwed round the edges. Or you may have pieces of mill-board glued upon boards of poplar, which I have found to answer the purpose just as well, and you can make them yourself as you want them. Lastly, get a pair of straps and buckles for each pair of boards, the straps of very strong webbing, about a yard and a half or two yards long.

Being now provided with your apparatus, pile up the sheets that contain the plants and the requisite pads of Bentall, till you have as many as a pair of straps will contain. In laying in the plants, keep the roots and thick parts outwards, and to flatten them insert here and there a mill-board. Then open a pair of straps upon the table, place a deal board with its cross-grain downwards upon them, your pile of plants on the board, and the fellow board on the top of it with the cross-grain upwards, and buckle it up as tight as you can, and put it under a heavy weight. In Germany a napkin-press is much used, but it is necessary to be very careful, or the stems and fruits and tender flowers may be crushed, I found a steel press of great service. It is made of two bars 12 inches long, 2 inches broad, and 3-eighths thick, with square holes at the ends through which pass two upright screws about 2 feet long, with nuts to press down the upper bar, and a key to turn them. After you have strapped up your bundle, place it in this press, and screw down the top bar upon it as tight as you safely can without injury to the plants, then draw up the straps and buckle them, and take off the press to use it for another bundle.

A weight press may be extemporized anywhere. You may heave up your bedstead and put your plants under the frame; or a blanket chest, or a kitchen dresser. Or you may get an empty box, or hamper, or sack, and fill it with stones, or sand; or build up books, or bricks, or stones upon them. To make a still heavier press, fix the end of a long joist, or pole, or ladder into a hole in a wall, or under a grate, or anything that will hold it, and set your bundle of plants under it, near the fixed end, and suspend a heavy weight from the other, to act as on a steelyard. The heavier the pressure, the quicker the plants dry; and so long as you use plenty of Bentall, you need not be afraid of crushing them. It is difficult to convince ladies of the weight that is necessary, and of the time and labour they waste through their incredulity. They most of them think 20 lbs. an enormous weight.

On the morrow remove the damp pads, and shift the sheets of whitey-brown with the plants they contain, to dry ones, and do this daily till your specimens no longer stick to the paper. In strapping them up, be sure to keep the cross-grain or the mill-board side of your boards outwards, or they will split. The poplar ones are apt to become rounded with use, but this is of no great consequence. It is the best wood on which to glue the mill-board, as being less likely to split than deal, and less subject to insects than lime and other light woods, and it is easily obtained in most continental countries.

The greatest difficulty that a collector has to contend with is the drying his paper; especially if the flowering season is a damp one. In dry weather the best way is to lay it out in the sun on wooden boards, and in countries where galleries are carried round the house, this is easily done. You may sometimes avail yourself of a leaden roof, or even a tiled one. The darker the colour of the paper, the more quickly it dries in the sun, and on this account a slate-coloured French paper is excellent. When there are no means of spreading it in the sun, or the air is too damp, hang it over the clothes-horse before a fire, or over strings stretched from wall to wall of your room near the ceiling. The warmer it is applied to the plants, the quicker they dry, the better they retain their colour, and the more free they remain from mould and insects.

Orchideous and most other monocotyledonous and succulent plants, require to be first dipped into boiling water as far as up to their flowers, to destroy their vitality. After this the paper must be changed frequently, or they become mouldy. A flat-iron is sometimes useful with plants that are very retentive of life, but is apt to make them brittle, and to destroy the form of the seed-vessels. Some botanists dry their Carices in a box full of sand with a canvas bottom, so as not to compress them too much. Some put their succulents into tin boxes full of sand, and bake them. Where a person devotes himself to one order of plants exclusively, he may devise various means of preserving them best suited to their peculiar character.

Whatever method is followed, avoid above all things to pull about your specimens till they are fit to put away into the herbarium. It is the more necessary to give this caution, as most of our English books recommend moving the plant itself to a fresh sheet of paper every day, a practice which is sure to distort its shape and break off the stamina and petals; not to speak of the great additional labour that it entails on the collector, and the necessity of doing it with his own hands. Many of my most valuable specimens were dried by men of colour, and other uneducated people, thirty years ago or longer, with no other trouble to myself than that of laying them as they came from the field into the sheets of paper on which they are still lying.

Should you not have time to examine them, or not have the requisite books with you, where you collect them, you may do so at your leisure at any future time by steeping them in boiling water, which will quickly soften them and restore their forms, a process familiar to us all at the tea-table. But whether you examine them or not, be sure to write on a label where and when you found them, and under what circumstances of altitude, aspect, surface, and company, and attach it to the stalk of the plant as you lay it in.

We will now suppose your season's collection to be completed, named, and labelled, and to consist of, say, 500 species, and two specimens of each; one exhibiting the flowers, and the other the fruit. You would know the best way to put them up for preservation in the herbarium. In Germany the specimens are generally laid loose inside a sheet of cartridge paper, and in this state they are more easily examined, but in the hands of careless people are apt to be disarranged. In England they are almost always attached to the paper, either glued to it or strapped down with strips of glued paper. This last way is perhaps the best in a private collection, as it allows the specimen to be detached for examination or replaced with a better one. At the British Museum and at Kew they are glued down, and may thus be readily consulted, and are not liable to be mismatched or stolen; but it is only one surface of a plant that can be seen. To make the strips, tack down a sheet of paper upon a board with pins or tintacks at the edges, and paint it all over thickly with glue. Let it dry, and keep it between paper, in or under a large book. It is otherwise apt to curl up. When you are going to fix your specimens, have a sponge filled with hot water upon a soup plate, and lay the strips with the paper side downward upon it, and as the glue melts, take them up with a pair of forceps and strap down the stalks of your plants with them. Stick on the labels immediately under the specimens, and write the name in full on the right hand lower corner of the sheet they are fixed on. This done, enclose the several genera in whole sheets of a paper of a different colour, write the name of the genus outside, and tie them up tight in portfolios.

If you mix specimens from other herbaria with your own, it is safer, as a precaution against insects, to wash them over with a camel's hair brush dipped in a strong solution of corrosive sublimate in spirits of wine. As an additional precaution, lock up your collection in cabinets made to close tight, and keep them in a dry room; and judging from my own herbarium, I may say that, once well dried in the way recommended above, and kept dry, the plants are as perfect, and retain their colours nearly as vivid at the end of five-and-twenty or thirty years, as on the day they were laid within it. To save the beginner from disappointment, it is as well to tell him that light blues and pinks always fade into a dirty white, let him take what care he will to preserve them; and that heaths and fir trees lose their leaves.

If, in spite of all your care, insects should find their way to your specimens, wash them over with benzoline, and tie them up tight in large sheets of paper before returning them to the cabinet. The *Times* newspaper is very useful for this purpose, but brown paper is supposed to be better.

In conclusion, whatever difference of opinion there may be as to the best method of preserving your plants, there are some points upon which all experienced collectors will agree; namely, in recommending you, whatever the country you visit, not to hurry over too much ground, but to explore your region thoroughly; nor to waste your time and labour upon bad specimens, but to reject them at once, and wait till you find better; and in drying them, to use your paper warm, and plenty of it, and to press hard.

It may not be out of place to add yet a few words on the season for visiting the Continent. Most botanists begin too late. In the south of Europe, as Greece, Sicily, and Portugal, there is a good deal to be found in March, and something from the very beginning of the year, but the best month is April: for countries a little further north, such as Dalmatia, Naples, and the Pyrenees, May and June: for the middle of Europe, as the southern provinces of Austria, and the adjoining parts of Hungary, the south of France, and north of Italy, the same months a week or ten days later. In all these there is something to be found all through the spring; a few things even earlier. Upon the Alps the flowering season varies with the weather to the extent of several weeks. There are some beautiful plants to be collected in sunny spots of the subalpine region as early as February, while the valleys are still deep in snow; and all through the spring till the end of June the botanist will do well to avail himself of every spell of fine weather to explore it. For the higher Alps July is usually the best month, as it is also for the north of Europe.

IV. *On a curious form of Kohl-Rabi, from Mr Pollock, Stirling.* By Mr John Sadler.

MISCELLANEOUS COMMUNICATIONS.

1. Mr Charles Howie, Largo, exhibited a monstrosity in the flowering spike of *Plantago lanceolata*, in which the spike was divided into ten small spikes.

2. Mr Sadler called attention to a good specimen of *Clethra arborea*, lately in flower in one of the conservatories of the Royal Botanic Garden. This fine evergreen is about 17 feet in height, but would have been taller had it not been cut back on several occasions to prevent it going through the glass. The tree was first introduced to Kew in 1784 by Mr Mason, from Madeira. It was figured in the *Botanical Magazine*, t. 1057. Has the culture of this tree in the open air been ever attempted in England? The President said he had tried to do so with negative results.

3. Mr Sadler intimated that operations for the erection of the new class-room at the Royal Botanic Garden had been commenced by the contractors, Messrs William Beattie & Sons. In clearing the ground for the site a number of trees and shrubs had to be cut down, and others, where practicable, transplanted. Two fine English Yews were removed and placed within the southernmost gate of the new Arboretum, permission to do this having been granted by Her Majesty's Office of Works, as the Arboretum and Botanic Garden are not yet amalgamated.

Thursday, 9th December, 1880.—Mr WILLIAM GORRIE, President, in the Chair.

The following Office-Bearers for 1880–81 were elected :—

PRESIDENT.

Professor I. BAYLEY BALFOUR Sc.D., M.B., C.M.

VICE-PRESIDENTS.

THOMAS ALEXANDER GOLDIE BALFOUR, M.D., F.R.S.E., F.R.C.P.E.
ALEXANDER BUCHAN, A.M., F.R.S.E.
HUGH CLEGHORN, M.D., F.R.S.E.
WILLIAM GORRIE of Rait Lodge, F.R. Cal. Hort. Soc.

COUNCILLORS.

C. H. MILLAR of Blair Castle, F.R.S.E.
Sir WYVILLE THOMSON, LL.D., F.R.S.E.
ISAAC ANDERSON-HENRY, F.L.S., F.R.S.E.
Sir ROBERT CHRISTISON, Bart., M.D. D.C.L.
Professor THOMAS R. FRASER, M.D. F.R.S.E.
Professor DOUGLAS MACLAGAN, M.D. F.R.S.E.
JOHN SADLER, F.R.P.S., F.R. Cal. Hort. Soc.
ROBERT GRAY, F.R.S.E.
WILLIAM CRAIG, M.D., C.M., F.R.C.S.E., F.R.S.E.
MALCOLM DUNN, Pres. Scot. Hort. Assoc., F.R. Cal. Hort. Soc.

Honorary Secretary—Emeritus Professor BALFOUR, M.D., F.R.SS. L. & E.
Honorary Curator—The PROFESSOR of BOTANY.
Foreign Secretary—Professor DICKSON, M.D., F.R.S.E.
Treasurer—PATRICK NEILL FRASER, F.R. Cal. Hort. Soc.
Assistant-Secretary—ANDREW TAYLOR, F.C.S., 37 South Clerk Street.

LOCAL SECRETARIES.

Aberdeen—GEORGE DICKIE, M.A., M.D., F.L.S.
Berwick—PHILIP W. MACLAGAN, M.D.
Birmingham—GEORGE A. PANTON, F.L.S., St Bennet's Hill.
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.
Dublin—W. R. M'NAB, M.D., F.L.S., Professor of Botany, Roy. Col. Science.
Dumfries—JAMES GILCHRIST, M.D.
Exeter—THOMAS SHAPTER, M.D.
Fife—J. T. BOSWELL, LL.D., F.L.S., of Balmuto, Kirkcaldy.
Georgetown, Demerara—W. H. CAMPBELL, LL.D.
Glasgow—Professor BAYLEY BALFOUR.
Greenock—DONALD MACRAILD, M.D.
Kilbarchan—Rev. G. ALISON.
London—WILLIAM CARRUTHERS, F.R.S., F.L.S., British Museum.
London, Brixton—JOHN ARCHIBALD, M.B., C.M., F.R.C.S.E.
Manchester—BENJAMIN CARRINGTON, M.D., Eccles.
Melbourne, Australia—Baron FERDINAND VON MUELLER, M.D.
Nairn—WILLIAM ALEX. STABLES.
Nashville, Tennessee—GEORGE S. BLACKIE, M.D.
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. 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. and E.
Wolverhampton—JOHN FRASER, M.A., M.D.
Zanzibar—JOHN KIRK, M.D., F.L.S.

The following Candidates were duly elected Resident Fellows:—

MR LAIRD, Monifieth Nurseries, Dundee.
JAMES BREBNER, 2 Scottswood Terrace, Dundee.

The following Communications were read:—

I. *Obituary Notices of Members who have Died during Last Season.* By Mr ANDREW TAYLOR, Assistant-Secretary.

II. *Botanical Correspondence.* Communicated by Mr JOHN SADLER.

Dr Traill wrote from North Ronaldshay, Orkney, on November 12, that a good many young plants of *Phormium tenax* grown from seeds that had ripened there last autumn, were now growing healthily in his garden, as were also four plants of *Myrsine Urvillei*, two of which had been in the open all last winter; plants of *Leptospermum scoparium*, "Manuku," had also stood out quite safely during the last two or three winters. Since Dr Traill introduced, about half-a-dozen years since, five or six kinds of shrubby *Veronicas*, their flowers are fertilised, probably through insect agency, and self-sown plants yearly spring up, many of which are evidently hybrids, so curiously varied in foliage and flowers as to render the naming of the original stock difficult. A cross between *V. decussata* and *V. buxifolia* is so exactly like a florist's variety of *V. Devoniana* that only a practised eye could distinguish them.

E. G. Loder, Esq., Floore, Weedon, Northamptonshire, writes, on November 12, desiring that *Yucca Treculiana* be tried in the open, in perfectly drained rockwork. Messrs Veitch had a splendid plant in their rockwork for years, until spoiled when flowering in 1878. Plants of *Yucca angustifolia* were sent, grown in one of his open borders, from seeds collected by Mr Loder, in Colorado; they had stood the brunt of two severe winters unharmed without protection. *Yucca angustifolia* var. *mitis*, and some other varieties from further south in New Mexico are more tender. "*Yucca baccata* I found in the south of Colorado, near Trinidad, on the borders of New Mexico. *Echinocereus Fendleri* has magnificent purple flowers. I sent a plant, in flower, to Kew last spring, and Sir Joseph Hooker was much pleased with it, and had it figured in the *Botanical Magazine*. *Echinocereus phœniceus* and *E. gonacanthus* have scarlet flowers. All the plants I have seen in Europe named *E. phœniceus* have been I believe *E. gonacanthus*. *Mammillaria vivipara* has pretty rose-coloured flowers. *Echinocactus Simpsoni* is the earliest to bloom in spring; the flower-buds come up from the centre of the plant (being a true *Echinocactus*), but as the plant grows the flowers get pushed down, as it were; and towards the end of summer (looking at the position of the dried-up flowers) one would think that the plant had flowered at the side like a *Mammillaria*. It is a very interesting plant; it reaches 13,000 feet in Colorado; my plants came from 10,000 feet." Mr Loder sent *Cacti* from a cold frame in his garden where they had been during the last two severe winters; they all flowered splendidly both in the spring of 1879 and 1880. A plant or two of each species out in the open air, at the foot of a wall, where some overhanging ivy wards off the snow and much of the rain, withstood the cold of last winter, when the thermometer indicated 32° of frost. Beside them, *Agave virginica* also withstood the cold and flowered this summer in the open air. *Puya coarctata* and *Dasylirion Bigelowii* also do well (but have since died), as well as *Agave utahensis;* but *A. Deserti* and *A. Shawii* succumbed. A few *Cacti* planted in the vertical face of a haw-haw wall facing S.W., and not protected from rain, though the drainage is perfect, withstood the severity of last winter. More are now planted, as well as *Agaves* and *Mesembryanthemums.* A very pretty plant, *Gillia aggregata*, from the Rocky Mountains, flowered with Mr Loder this year, but did not ripen seed. He had seen only small plants of this in Colorado, 2 feet high, with a small spike of flowers, but his garden specimen was 4 feet high, branching like a large individual of *Lythrum Salicaria*, with hundreds of flowers. The colour is fine, but the scent of the flower is not agreeable. *Agave utahensis* since stood 41° of frost uninjured.

W. E. Gumbleton, Esq., Belgrave, Queenstown, Co. Cork, writes, at date November 21, 1880:—"In reply to your inquiry about hardiness of *Clethra arborea*, I write a line to let you know that on the island of Valentia, off the coast of Kerry, this beautiful shrub is perfectly hardy, a fine specimen of it some 20 feet in height having been, next to his monster *Fuschia Riccartoni*, 165 feet in circumference, the great pride and delight of my much esteemed old friend, the late Knight of Kerry. Even the severe and prolonged winter of 1878–79 left it quite uninjured. It has been planted out, I believe, somewhat over twenty years, in the middle of a small wood and close to the sea, and blooms profusely all over the tree every summer, usually also producing seeds. *Leptospermum bullatum* also lives out there, flowering abundantly and ripening seeds also. I believe we have had, for us, very severe frost for the last few nights—Wednesday night, 11°; Thursday night, 9°; and Friday night, 12°, if not 13°; and I am happy to say my three new shrubs—*Bigelowia arborescens*, *Carpenteria Californica*, and *Fallugia paradoxa*—seem quite uninjured thereby, though quite unprotected in any way. The first-named I hardly expected would prove hardy."

III. *Report on Temperatures and on the Progress of Open-air Vegetation at the Royal Botanic Garden from August to November.* By Mr JOHN SADLER, Curator.

Mr Alexander Buchan gave instances from the readings of the various stations of the Scottish Meteorological Society to show that last October had been the coldest month of that name for 170 years past. He attributed the extraordinary plant appearances just alluded to by Mr Sadler to the present spring-like weather following after what was really a short winter, which had again been preceded by one of the mildest autumns on record.

Mr Johnstone, of Inverleith Nurseries, called attention to a snowstorm at Caterham in Surrey on October 21, which had done immense damage to oaks and other trees.

MISCELLANEOUS COMMUNICATIONS.

1. Mr John Campbell, Ledaig, near Oban, sent flowers in bloom from his garden.

2. Mr Johnstone had lately seen, near Tighnabruach, Kyles of Bute, a fine Eucalyptus, planted fourteen years ago, virtually in the open.

3. Mr Methven exhibited from his hothouses what Professor Traill, of Aberdeen, who was present, pronounced *Momordicas Charantia*, he having seen it growing as a hedge creeper round the villages in Brazil.

4. Mr N. Fraser presented to the University herbarium two fine specimens of *Dicksonia, nov. sp.*, from Aneitum, New Hebrides.

Thursday, 13*th January* 1881.—Professor BAYLEY BALFOUR, President, in the Chair.

Thomas B. Sprague, C.A., F.R.S.E., was appointed Auditor, and David Christison, M.D., Artist, for 1880–81.

The following Candidates were elected Resident Fellows:—

PATRICK GEDDES, Assistant to the Professor of Botany.
JOHN M. MACFARLANE, B.Sc., Lecturer on Botany.
ANGUS ALEXANDER M'LEOD, Superintendent of Public Parks and Gardens of Edinburgh, 14 Royal Exchange Square.
JOHN WHITE, 34 Manor Place.
JOHN C. POTTAGE, 7 Coates Place.
JAMES M. ANDERSON, S.S.C., 1 Blackford Road.
JAMES GALLOWAY, St Fillans, Trinity.
JAMES ALEXANDER, jun., 1 Waterloo Place.

The President, on taking the chair for the first time, thanked the Society for the honour it had conferred upon him, and referred to the loss the Society had sustained in the death, since its last meeting, of his predecessor in office, the late Mr William Gorrie. On the motion of Professor Dickson it was agreed to send a letter of sympathy, signed by the President, to Mr Gorrie's sister-in-law.

The following Communications were read :—

I. *On the Exact Measurement of Trees (IV.) Growth of Wood in* 1880 ; *Extent of the Season of Growth.* By Sir ROBERT CHRISTISON, Bart.

Mr Alex. Buchan referred to the proposed extension of Sir Robert Christison's inquiries over the whole of Scotland, on a scheme under the co-operation of the Scottish Meteorological and Highland and Agricultural Societies, and under Sir Robert's superintendence. Interesting results might likely be obtained from the diverse simultaneous observations made on either side of the dividing mountain range running through the centre of Scotland, which appeared to cause fine dry weather on the west coast when the Edinburgh side of the island was under the domain of rain and easterly haars.

Sir R. Christison hoped that such an extended series of observations would lead indirectly to a better acquaintance on the part of foresters with the scientific conditions of growth—a subject at present too much under rule of thumb practice.

II. *Report on Temperatures, and on the Progress of Open-Air Vegetation at the Royal Botanic Garden.* By Mr JOHN SADLER, Curator.

MISCELLANEOUS COMMUNICATIONS.

1. Mr John Campbell, Ledaig, near Oban, sent the following flowers in bloom from his garden :—*Veronica speciosa, Myrtus communis, Erica herbacea, Aster argophyllus, Cytisus odoratus* (?), *Jasminum nudiflorum, Helleborus niger, Tritoma Uvaria.*

2. Mr Sadler exhibited *Polyspora axillaris* (Gordonia), at present growing in the Orchid-house of the Royal Botanic Garden.

3. Mr Sadler also laid on the table specimens of *Hymenogaster Klotschii*, a fungus new to Britain found in an Eucalyptus tub at the Royal Botanic Garden ; as well as a specimen of *Hydrangium carnium*, a fungus also confined to a similar habitat so far as

presently known, and which had been described as new to Britain a few years since by Professor Dickson, in an Eucalyptus tub in the Glasgow Botanic Gardens.

Dr M. C. Cooke, who congratulated himself on at last being present at a meeting of the Society, confirmed the remarks as to the specimens being new to Britain; the *Hydrangium carnium* had been first found in Germany; many others of the hypogeal fungi showed a partiality for the neighbourhood of special trees.

4. Mr P. Neill Fraser, the Treasurer, brought before the Society a price-list of collections of natural history from the West Indies made under the superintendence of Baron Eggers, which included dried and living plants, fruits, and seeds, as well as *Microlepidoptera* and *Coleoptera*, land and fresh-water shells. Mr Fraser expressed willingness to correspond on the subject.

Thursday, 10*th February* 1881.—Professor BALFOUR, President, in the Chair.

The Treasurer submitted his Report on the financial affairs of the Society for the past Session, with the Auditor's Abstract and Report thereon.

An Abstract of the Accounts had been previously circulated with the Billet calling the Meeting.

The state of Funds was as follows:—

Amount at close of Session 1878–79,				£228	11	2
Increase during Session 1878–80,				17	18	0
Funds belonging to the Society,				£246	9	2
Illustration Fund :—						
Balance on hand at close of Session 1878–79,	£32	15	5			
Increase during Session 1879–80,	0	18	8			
Amount of Illustration Fund,				33	14	1
				£280	3	3

The following Candidates were elected Resident Fellows:—

GEORGE MURRAY, Chemist, Messrs Duncan, Flockhart & Co's.
WILLIAM E. DIXON, 8 Brandon Terrace.
FRANK EWEN BEDDARD, B.A., 81A Princes Street.

The Chairman exhibited the new part of "Herefordshire Pomona," also a new "Text-Book on Botany," in three volumes, by Professor Cominhoâ of Rio Janeiro, which was beautifully illustrated alike with woodcuts and coloured lithographs. He also laid on the table some Brazilian scientific pamphlets, by Dr Rodriguez.

The following Communications were read:—

I. *On Lepidophloios, a genus of Coal-Measure Plants.* Illustrated by Diagrams and Specimens. By J. M. MACFARLANE, B. Sc.

II. *Extracts from Botanical Correspondence.* By Mr JOHN SADLER.

Mr Sadler gave some extracts from botanical correspondence. In a letter from Edmund Giles Loder, Esq. of Floore, Weedon, Northamptonshire, some meteorological details of the district were given, which are of interest in respect of the account of the rare exotics raised there, which were recently laid before the Society. On June 5, 1880, the thermometer had fallen to 28°, or 5° of frost. Last year the total rainfall was 32½ inches, of which nearly nine fell in July—3 inches in forty-eight hours. The exposed minimum thermometer had registered as follows:—On October 21, 1880, 18°; 24th, 16°; on November 2, 16°; and on the 22d, 15°. During this last January the readings had been, on the 13th, 6°; on the 14th, 4°; 15th, 7°. In a letter of January 11th, from North Ronaldshay, Orkney, Dr Traill noted the effects of this winter, especially on some New Zealand introductions in his garden, where they had been shaken by some heavy gales of wind, experiencing also repeated snow-storms and frost, which, though not intense, was of some continuance. The Grislinia, the Penettya and the Manuka appeared unscathed, but Myrsine of two species, which had stood last winter well, were evidently suffering. Of the Veronicas both *V. lindleyana* and *V. andersoni* looked bad; even *V. buxifolia*, which has stood well for six years, begins to fail, though *V. decussata* stands out best. A number of seeds from Stewart's Island, New Zealand, had just been planted, including those of trees and shrubs growing near the sea and even exposed to its spray. Although small they form clumps of foilage, acting as nurses to trees of larger growth.

III. *On Temperatures from 1st January at Royal Botanic Garden, and Effects thereof on Vegetation.* By Mr JOHN SADLER, Curator.

Mr Johnston mentioned that on January 14th, in various districts from Perth to Coupar-Angus and all through Strathmore, the thermometer had registered from 3° to 5° and even 7° below zero. So severe had the frost been that large branches of Portugal laurels, 6 inches in diameter, had been split open by the subsequent expansion of the sap.

MISCELLANEOUS COMMUNICATIONS.

1. Mr Sadler exhibited from the cold frames in the Royal Botanic Garden specimens in flower of *Saxifraga Burseriana* var. *major*. It is a dwarf species, with comparatively large white flowers. At the February meeting, 1880, this plant was exhibited in flower from the rock garden, also *S. Stracheyi*, *Cyclamen Coum*, *C. vernum*, from the south of Europe, and *Corydalis Ledebouriana*.

2. Mr John Paterson, of Lamlash, Arran, sent from his garden specimens of the following plants in flower during the last week in January, viz., the snowdrop, *Jasminum nudiflorum*, *Rhododendron Nobleanum*, and the sweet violet.

3. Mr J. Campbell, Ledaig, near Oban, sent the following flowers in bloom, gathered on the 9th February :—Snowdrops in full flower, *Rhododendron Nobleanum*, *Viburnum Tinus*, *Erica carnea*, *Veronica speciosa*, *Jasminum nudiflorum*.

4. Mr Sadler also called attention to a large series of drawings of Indian plants executed by Mr Cathcart, who accompanied Sir Joseph Hooker in his Himalayan travels. These had been presented to the library at the Royal Botanic Garden by Mrs Urquhart (sister-in-law of the late Mr Gorrie), to whom the drawings had belonged. Mr Sadler also exhibited four photographs of cones of Oregon *Abies*, sent by Professor Sargent, of the Arnold Arboretum, including one of *Abies amabilis* from David Douglas's original locality on the Columbia River.

Thursday, 10*th March* 1881.—Dr THOMAS ALEXANDER GOLDIE BALFOUR, Vice-President, in the Chair.

The following Candidates were elected Foreign and Corresponding Members :—

Dr JOAQUIM MONTEIRO CAMINHOA, Professor of Botany and Zoology, Rio Janeiro.
JOÃO BARBOZA RODRIGUES, Secretary and Professor-Adjunct in the Imperial College of Pedro II., Rio Janeiro, Brazil.

The following Candidate was elected a Non-Resident Fellow :—

ROBERT HALLIDAY GUNNING, A.M., M.D. Edin., Palmeira, Brazil.

The following Communications were read :—

I. *On the Morphology of the Pitchers of* Cephalotus follicularis. By Professor ALEX. DICKSON.

II. *Note on the Physical Effects produced by the Floating Power of some of the family Fucaceæ as observed at the Strand between Colonsay and Oransay, August* 25, 1880. By Mr SYMINGTON GRIEVE.

Towards the end of last August we were on a visit to the island of Colonsay, and on the 25th of that month we determined to make an excursion to the island of Oransay, which is divided from Colonsay by a beautiful sandy strand that varies in breadth from half a mile to a mile and a quarter. At ordinary full tides there is a depth of water upon the strand of from six to nine feet, and there is a period of from three to six hours each tide during which the strand is dry.

The sand is mixed with immense quantities of comminuted shells, which gives it a white appearance; and the inner part of almost every bay that indents the coast has similar tracts, while the promontories are rugged, and their shores strewn with stones, some of which are water-worn, while others bear evidence of having been recently detached from the neighbouring rocks, and on these stones there is a luxuriant growth of sea-weed.

To arrange for an excursion to Oransay it was therefore necessary to know at what hour the tide would recede from the strand, so that the visitor might get across as soon thereafter as possible, and take the full advantage of the time that would elapse before the tide made it necessary to recross again.

On the occasion of our excursion we arrived a short time before the falling tide had left it, and instead of waiting, we determined to wade through, so as to get more time on Oransay. We took to the water, which was from twelve to eighteen inches in depth, and had not gone far when we found that there were very strong currents running westwards and eastwards towards the open Atlantic, and here and there upon the sandy bottom we saw sinuous markings that might have been the grooved tortuous tracks of immense eels as they made their way seawards; and we went on in the hope that as we got further from the shore we would come across one of these fish.

But though the courses were numerous still we saw nothing that to our mind could make them, until suddenly, about mid-channel, we observed that one of these markings seemed either to begin or end at the foot of a large stone; but though we lifted the masses of sea-weed that were attached to it, in the hope that below we should find a veritable sea serpent, still we were disappointed. A little further on we came to another which again terminated at a stone, and as we looked on, considering what could be the solution of the problem, the stone moved; we thought we must be mistaken, so we watched it carefully, and after a pause it began to travel westwards, and having got over a ridge of sand into deeper water, it proceeded much faster; and as it journeyed, buoyed by the sea-weed, and dragged by the current, it left a trail behind. At last the mystery is solved, the buoyant power of the air-vessels of the sea-weed is half lifting the stone from the ground, and as the current carries the weed along it waves from side to side, conveying the same motion to the stone, which leaves a winding impression on the sand. A further examination of the courses showed us that all were not alike, some being quite straight, and we noticed several where the stone, after travelling a straight course, had been left dry upon the sand, and when the tide flowed again had been driven off at an angle back upon its first track, leaving a trail much like the letter V. Some courses intersected each other, and occasionally sinuous and straight courses were to be thus found in combination.

Now, may this not cause reflection as to what may be the real solution of some supposed reptilian marks upon sandy or muddy beaches, whether ancient or modern, especially if they occur where there is a great fluctuation in the rise and fall of the tides, and at the same time a strong current?

It will be evident that with a receding flood tide it is quite possible, nay, even probable, that such markings would be made on stretches of mud or sand along a shore, and if the next tide did not obliterate the trails formed by the sea-weed carried stones on the upper part of the beach, most probably these markings, exposed for a time to the sun, would harden, and this operation would go on from tide to tide, until a considerable part of the shore would be covered with the markings, and, when another series of flood tides came, the now firm moulds would be filled up with layers of fresh sand or mud, and might thus remain for ages, until some enthusiastic geologist broke up the matrices and found a new wonder.

Subsequent investigations have shown us that the tracks are not soon obliterated upon the sand, and during calm weather will remain for several days quite distinct, though their sharp outlines become less clearly defined after each tide. It is also well to remark that the difference of the height to which spring and neap tides rise here is very considerable.

But to return to the strand of Oransay; let us say, that having now got the clue to the cause of the markings, we found that there was an immense number of stones thus travelling westwards and eastwards, and that they varied much in weight, those we saw moving being from a few ounces to half a hundredweight, but we observed at various parts isolated boulders that we judged would each weigh several hundredweights, and these we think must have been carried there by sea-weed.

The quantity of rock thus carried out to sea by each tide is very great, and we believe, must weigh many tons; and if this movement is in constant operation even for a few weeks or months of each year, it must be a most important factor to be kept in mind in considering the physical changes that are in operation in this part of Scotland. And if this is likely to be the case, when we consider such a narrow channel as that between Colonsay and Oransay, what must it be if a similar force is working all along the west of Scotland? and if you extend the field for consideration, how much greater the effects?

The sea-weeds attached to the stones were principally of the tribe Fucidæ, and those we noticed most were *Fucus nodosus*, *serratus*, and *vesiculosus;* each of these varieties of sea-ware has, with regard to high water mark, its own zone along sea coasts, but conjointly they cover wherever they occur the whole beach from high to low water mark, and may be arranged as follows:—

1. *Fucus nodosus*—high water to half tide.

2. *Fucus serratus*—about half tide.

3. *Fucus vesiculosus*—extending from near high tide to low water mark.

But as *Fucus serratus* is devoid, or nearly devoid, of air vessels, it may be left out of account for our present purpose.

It will be seen that with *Fucus nodosus* and *vesiculosus* we have a growth of sea-weed extending from high to low water mark, and that for part of that distance these two weeds intermingle; and it is quite possible to find both varieties growing upon the same stones.

You will also bear in mind that both of these sea weeds are supplied with air vessels which float the weed with the rising tide; and so great is the buoyant power, that loose stones to which the Fuci are attached are raised from their beds and floated, the current transporting them in whatever direction it may set.

The result of the continued action of this carrying force will be to denude our coasts of much of the detached and broken rock around them; and if these fragments are carried out to sea, floated by these vegetable buoys, they will ultimately be deposited at the bottom of the ocean, for periodically the sea-weed will decay off, and then the stones freed from their floats will sink.

These individual stones as units may seem insignificant factors in the physical changes continually going on, but in the aggregate they represent a mighty force filling up the ocean bed. But this is not all; for we have evidence that another and perhaps more important operation is going on as regards the position of sea and land.

Our observations led us to notice that at a place where a stone was left by the receding tide it sank, and that all except flat stones went downwards until they were checked by the resistance offered by the sand to the great surface of the attached masses of sea-weed. Most of the stones which thus rest in transit across the strand rise with the succeeding tide, but at certain seasons, we believe, many sink in the sand to rise no more, owing to the attached sea-ware either rotting off or losing its buoyant powers, and stones thus deposited are slowly but surely forming a barrier, which will in time become an isthmus between Colonsay and Oransay; then we shall find the latter island as a peninsula to the former, and as the sand accumulates on each side of the isthmus, it will gradually increase in breadth, until instead of being a peninsula, Oransay shall really form a southern point to Colonsay.*

Having been led to this conclusion, we made inquiries among the

* At times a portion of the sand upon the strand changes its position, and the deposited stones can then be seen.

natives as to their actual observation, and while some inclined to think the depth of water on the strand at high tide was not quite so great as it used to be thirty or forty years ago, still all were not entirely agreed, the fact being that no one had made accurate observations. However, we succeeded in obtaining evidence which quite corroborates our view as to the change referred to, being in operation in the immediate neighbourhood.

Near the western entrance to the sound that divides Colonsay from Oransay, and on which is situated the strand, there is what is now the south-west point of Colonsay, and this promontory is known by the name of Ardskinish, but this name properly refers to the extreme point, its etymology being "Ard" high, and "innis" island, and this exactly describes what this place was until about seventy years ago, the outer point being an island at high water, and the low-lying tract between it and the mainland of Colonsay a strand.

An old man, resident at Kilchattan on Colonsay, told us that until recently several men were living who could remember the point as an island ; and he mentioned two, who are still alive, who he believed would recollect it, and he could remember himself when the neck of sand, dry at high water, was not above 20 feet in breadth, and now at the narrowest point at high tide it will be the third of a mile ; and from the accumulation of sand blown from the beach, the land at some points, according to the Ordnance Survey Map, is nearly 40 feet above the sea-level.

We have thus a case where the operation of filling up a strand by natural laws has taken place during the memory of men now living.

We are not aware that other observers have noticed these facts before ; but it would be interesting if they have done so, to put them on record, as the subject seems worthy of fuller investigation.

III. *On Temperatures from February 1st at the Royal Botanic Garden, and Effects thereof on Vegetation.* By Mr John Sadler, Curator.

MISCELLANEOUS COMMUNICATIONS.

1. Mr John Campbell, Ledaig, Argyllshire, sent plants in flower from his garden gathered two days previously.

2. Professor Dickson showed a museum specimen of the embryo of *Caryocar nuciferum.*

3. Dr Cleghorn called attention to Mr Clement Markham's new book "On the Introduction of Chinchona Cultivation into British India," characterising it as an exhaustive treatise on the subject.

Thursday, 14th April 1881.—Alexander Buchan, Esq., Vice-President, in the Chair.

The following Candidate was elected a Non-Resident Fellow:—

Daniel Scott, Wood Manager at Darnaway Castle.

The following Communications were read:—

I. *The Structure and Division of the Vegetable Cell* (Part I.). By J. M. Macfarlane, B.Sc.

II. *Remarks on the Recent Weather.* By Alexander Buchan, M.A., F.R.S.E.

Mr Buchan intimated that he had found it necessary to postpone a paper he had undertaken to furnish on dates of flowering of the spring plants in the Royal Botanic Garden in relation to the weather of the years 1876–81. Last January, he remarked, was unquestionably over the whole of Scotland, excepting a bit of Caithness and Sutherland and the northern part of the Hebrides, the coldest month, on the mean of the month, of which we had any record. This great cold was confined to the period from the 5th to the 29th. The year opened with a temperature 4 to 6° or 7° above the average. During the week from the 7th to the 13th of January, however, very low temperatures ruled, the mean of that week being 10° below the average of those days. The following week, 14th to 20th, showed 14°·3 below the average of those days. The following week, again, showed 12°·3 below the average of that week. So that there were three weeks, January 7 to 27, in which the temperature was 12°·2 below the average of that part of the year. His desire was to see the effect upon the spring vegetation of the Botanic Garden of this unwonted state of things. There was a period of warmth about the average in the first week of February. The next week, 11th to 16th, was about 5° below the average. The period from February 19 to March 6 was considerably below the average, the first three days of March showing 11° and upwards. Then there was a warm period from March 8 to 19, when the temperature varied from 1° to 10° above the average. Then from March 20 to April 11 the temperature was very much below the average, reaching on one occasion (March 22) fully 13° below the average.

III. *On Temperatures from 1st February at the Royal Botanic Garden, and Effects thereof on Vegetation.* By Mr JOHN SADLER, Curator.

Thursday, 12th May 1881.—Professor BALFOUR, in the Chair.

The following Candidate was duly elected a Resident Fellow:—

Mr W. IVISON MACADAM, F.I.C., F.C.S., Lecturer on Chemistry, Surgeons' Hall.

The deaths of Dr INNES of Forres, and Dr RANDLE WILBRAHAM FALCONER of Bath, Non-Resident Fellows, were noted.

The following Communications were read:—

I. *The Structure and Division of the Vegetable Cell* (Part II.), *with Microscopic Demonstration.* By J. M. MACFARLANE, B.Sc.

II. *On the Growth of* Crocus sativus, *the Source of Hay Saffron in Kashmir.* By Dr DOWNES, medical missionary. Communicated by Mr ISAAC ANDERSON-HENRY.

According to the late Dr Elmslie the native names are *Kóng-pósh*, n.m. saffron-flower, and *Kóngs*, n.m. saffron (*Crocus sativus*). Cake saffron is largely an adulteration of the stigmata of wallflower and other plants. The *Crocus sativus* is the only plant grown in Kashmir, the stigmata of which compose hay saffron. The famous saffron fields are situated in the vicinity of Pampur, on a plain fully 50 feet above the valley. The bulbs grow on soil said to have been specially imported for the purpose. In dry seasons the produce averages nearly a ton, though the crop was in 1871 only half that quantity. Some 1500 lbs. of saffron are exported yearly from Kashmir to Ladakh. From 9d. to 1s. sterling is given for 180 grains. The bulbs are planted out in June, and the stigmata are collected in October. It is principally used as a condiment, its power on the system whether in health or disease being trivial. The mark on the forehead of a Hindu Pundit is partially derived from it. The Mussulmans of the valley are generally unable to buy it. According to O'Shaughnessy the odour is fragrant, and the taste bitter but agreeable. It tinges the saliva yellow. Pereira makes one grain of good saffron to contain the stigmata and styles of nine flowers, so that the formation of an ounce would require 4320 flowers. Bulbs from Kashmir, received by Dr Royle in 1826, when in charge of the Saharunpore Botanical Gardens, which flowered, and were afterwards figured, turned out to be varieties of *Crocus sativus*. This author has little doubt of the Asiatic derivation of this species.

The four stations for saffron cultivation, called "Warewas," are flat treeless tablelands, on the borders of the hills, 50 to 150 feet higher than the Kashmir Valley, which is 5200 feet above the sea-level. They are little, if at all irrigated. The soil is a stiff clay. Dr Downes has been informed that saffron has been successfully cultivated in the gardens of the city of Kashmir; indeed, he believes that the oppression and greed of government officials is the sole cause preventing its general growth. He does not think a special soil needed for the cultivation of *Crocus sativus*. In a hopeful experiment of this kind at Alwar, near Delhi, Mr Landseer started bulb-growing on earth brought in barrels from Kashmir. But in the second year the five beds of bulbs had increased to nine, and as there was no further import of Kashmir earth, native soil had to be partly used, and with success. In Kashmir the *Crocus sativus* is cultivated on raised parterres, well drained and carefully weeded, though Dr Downes believes not irrigated. As the half of the price of the produce, which is the due of the cultivator, very seldom comes his way—owing to the plundering of intermediate government officials—the plant is left very much to its own care. During the last two famine years no saffron has been gathered, though this year a small crop is expected. According to one native tradition the *Crocus sativus* miraculously appeared in Pampur after the prayer of a holy man some 300 years ago; while others assert its introduction from the direction of Kabul by a ruler named Bar-sháh.

III. *On a* Eucalyptus globulus *growing in the Kyles of Bute.** By Mr Andrew Taylor.

Mr Taylor read a letter from Colonel Campbell, South Hall, Colintraive, Argyllshire, describing a fine *Eucalyptus globulus* growing in his garden:—"The plant was grown from seed sent from Australia by one of my tenants residing about two miles from South Hall nine years ago. It was then in a flower-pot, about 3 feet high and three years old. Little attention was paid to the plant. It was left out in winter without any protection, and the frost has never affected it. The present height (December 15, 1880) is 45 feet 9 inches, the girth 6 inches from the ground is 33 inches, girth 5 feet from the ground $28\frac{1}{2}$ inches. It forms itself into two branches of equal size, 6 feet from the ground. It is rather bare of small branches for 15 feet, some of which have died off, but the upper part is very vigorous and healthy. Some flowers appeared upon it in 1879, but none during last summer. I have never succeeded here in growing the plant except from the seed.

"Mr Johnstone (Inverleith Nurseries) sent some of the twigs to Mr Smith of Kew Gardens, with what appeared to be seed adhering to them. I send you his reply. Mr Smith writes, March 22, 1880:—All the *Eucalyptus globulus* (unprotected) in the neighbourhood of London had been killed; that he does not know any such specimen in England as that at Colintraive, and that the bodies called by Mr Johnstone embryo flower buds are the flower-stalks of last year's flowers." Colonel Campbell had raised some plants of the Eucalyptus from seed got from Edinburgh last summer. They were planted out in the autumn, but the frost of October appears to have killed them all, though the old tree has not suffered.

The garden at South Hall has a good exposure to the south, is well sheltered, and stands about 25 feet above the sea level. Two large Camellias and a Kalmia have grown in the open without any protection, and have flowered regularly for upwards of twenty years. They stand close to the Eucalyptus.†

IV. *Notes on Open-Air Vegetation and Temperatures at the Royal Botanic Garden.* By Mr Sadler, Curator.

* See Proc. Bot. Soc. p. liii.

† The tree succumbed this winter after bearing fruit.

MISCELLANEOUS COMMUNICATIONS.

1. Dr Gunning, of Brazil, asked to lay before the Society a proposal that the magnificent "Iconographia das Orchidos," by Dr Joao Rodrigues, one of their foreign members, be published in Edinburgh. A project to print this magnificent work at the expense of the Brazilian Government fell through, because it was supposed it had been forestalled by the previous book on the subject published in Germany by Henrique Reichenbach, and the subsidy of £5000 anticipated from the Brazilian Parliament was withdrawn. But the German monograph was executed at a distance, from deteriorated specimens, and is only adorned with a few uncoloured engravings. Rodriguez has minutely described and coloured each species from specimens collected by him ere they lost the glory of their native forests. The figures are painted by himself, and considered very fine. Sir Joseph Hooker has pronounced the "Iconographia" eminently worthy of publication. So charmed was Reichenbach himself with the MS. volume that in 1877 he offered to publish it; but this was declined. Meanwhile Rodrigues has succeeded his friendly competitor in monograph writing as a contributor to the "Flora" edited by Dr G. Eichler.

2. Dr Cleghorn exhibited a stem of the common broom 12 feet long and 8 inches in girth at 1 foot from the ground, which had made this growth at Stravithie, near St Andrews, since 1870, and was cut down just before the meeting. The usual height of the broom in this country is from 3 to 6 feet, or even 12 feet, according to soil and situation, though in the woods of Galicia it attains the height of 20 or 30 feet or upwards. According to Loudon the broom in Spain and the south of France attains a timber-like size, and the wood, being finely veined, is much sought for veneering; the best vine stakes are also made from its branches.

3. Mr John Campbell, Ledaig, Argyllshire, sent seventeen plants from his garden, mostly in bloom. They included *Kerria japonica*, *Dielytra spectabilis*, *Narcissus poeticus*, *Orchis mascula*, as well as the lilac, apple, pear, and strawberry. A fresh specimen of *Aster argyrophyllus* showed it to have withstood the winter.

4. Mr John Sim, associate, Perth, sent a paper on the "Transmutation of Species" in which he controverted the more advanced views recently promulgated on this subject, dwelling specially on the difficulties of thus accounting for the origin from the wild state of our cereals and culinary vegetables.

5. A collection of alpine and other plants in flower, grown in

pots, was exhibited from the Royal Botanic Garden, including *Sarracenia flava, S. purpurea; Darlingtonia californica, Arnebia echioides, Arabis blepharophylla superba, Aubrietia Hendersoni, A. Bougainvillea*, dark seedling vars.; *Thlaspi rotundifolia, Gentiana acaulis alba, G. verna; Saxifraga calyciflora, Corydalis bracteata, Lychnis alpina, Pinguicula grandiflora, Androsace gigantea, Primula sikkimensis, P. Stuartii, P. Palinuri, P. mollis, P. scotica, P. auriculata, P. Sieboldi*, vars., *P. ciliata*, hybrid vars.; and a fine specimen of the Cistus Rape (*Cytisus Hypocistus*), sent from Cannes by Mrs Flockhart, Gairney House, Trinity.

Mr C. Jenner's gardener, Mr Chapman, had also been very successful in growing *Gentiana acaulis alba*.

Thursday, 9th June 1881.—Professor BALFOUR, and afterwards Professor DICKSON, in the Chair.

The death of Dr Ludwig Rabenhorst, of Messen, Saxony, Editor of *Hedwigia*, and a Foreign and Corresponding Member, was noted.

The following Communications were read:—

I. *Meeting of the Scottish Alpine Botanical Club at the Spittal of Glenshee, on 29th July* 1880. By Dr CHARLES STUART, Chirnside. Communicated by Mr WILLIAM B. BOYD.

The members who attended this meeting were Professor Alexander Dickson, Vice-President; Mr Boyd, Secretary; Dr Craig, Treasurer; Rev. Mr Alison, Chaplain; Dr Aitken, Minstrel; Captain Norman, R.N.; Mr Potts, Dr Charles Stuart, and Mr John Sadler.

We met at Perth Station on the arrival of the morning train from the south, and travelled together by Coupar-Angus to Blairgowrie, where we lunched, and pursued our journey in a drag with three horses to the Spittal, which, after a pleasant journey, we reached in good time. The scenery all the way from Blairgowrie was very interesting, the hills on both sides of the road being finely wooded, with the Ericht and then the Shee adding beauty to the landscape. The fine position of Craighall, elevated about 300 feet above the Ericht, on a rocky eminence, with the hill behind finely wooded, was much admired. About Bridge of Cally, where the road strikes off for Kirkmichael, the scenery is very attractive. The weather was on the whole propitious, although we came in occasionally for a Highland shower. Reaching the moorland parts of our route, we stopped our conveyance, and made some botanical explorations—gathering *Tofieldia palustris*, *Meum athamanticum*, *Carduus heterophyllus*, *Habenaria viridis*, *&c.*, and sundry other plants of a sub-alpine character. The evening was cold but dry, and we were all in high spirits, as Canlochan was our botanising ground for the morning. Our quarters at the Spittal were very comfortable, all the bedrooms in the hotel being engaged for our occupation, and we had every reason to be satisfied with the creature comforts provided, which, both in quantity and quality, left little to be desired. We made an early start on Friday morning, the 30th July, in two waggonettes, driving to the top of the Cairnwell by The Devil's Elbow, 2000 feet above Scalwel, the highest road in Scotland. Striking across Glen Lochy to the right, we ascended the first ridge, which we crossed, and held due north for some time, and then east. We gathered many plants in crossing the moors, but none of them very rare. *Cornus suecica* was observed, but not in flower, and several species of *Splachnum*, growing on decaying dung, with a number of the commoner alpine willows. I should have mentioned, that in coming up the Cairnwell tufts of *Calluna vulgaris* of a bright rose or salmon colour were seen. They grew as a rule in the face of banks of a gravelly nature, and the soil evidently had something to do with the colour of the flowers. They failed to grow upon being brought to the south. Although deers' antlers were found, no animals were seen till we reached the forest of Canlochan. The walk proved rather longer than we anticipated, but when the botanising ground was reached fatigue was forgotten. At the eastern corner, where we descend into the Corry of Canlochan, there is an oozy spring or well eye. Here *Splachnum vasculosum* was growing and fruiting in profusion, a sight enough to gladden the heart of any botanist. We secured specimens, and commenced what proved to be anything but a comfortable descent by the Goat's Neck. The week before we visited Canlochan there had been the most violent thunder storm which had ever been known in these parts. The waterspouts had torn down the Goat's Neck in a torrent, denuding the rocks of their gravelly covering, and making them difficult to walk over. The descent, however, was safely accomplished after a little difficulty. Here in former times fine specimens of *Veronica alpina* and *V. saxatilis* were wont to grow on the gravelly debris; few were seen on the present occasion. On the rocks *Saxifraga nivalis*, associated with the commoner varieties, was in abundance. *Sonchus alpinus*, without flowers, was gathered on the right hand rocks, well out of the reach of ordinary collectors. *Erigeron alpinum*, *Saussurea alpina*, *Dryas octopetala*, *Pyrola rotundifolia*, and *Gentiana nivalis* were gathered, the latter sparingly. *Aspidium lonchitis* (the cut leaved variety) and the other mountain ferns were seen in considerable abundance. The holly fern is in great beauty and luxuriance among the loose rocky debris under the corry, associated with occasional specimens of *Polypodium alpestre*, and other ferns. We were not a little astonished to observe the Swiss *Erinus alpinus*, *Primula auricula*, and *Myosotis alpestris* on the boggy soil covering some of the rocks, all evidently introduced. Any botanist capable of perpetrating a hoax of this kind is unworthy of notice. The rarer plants were rather scarce, but the commoner alpines grew in great profusion. When at the *Sonchus* station, we espied a human figure high up among the rocks watching our motions. At first we considered he was the forester sent to turn us out of the corry. However, after some time, this person scrambled down to us, when we were at the *Gentian* station, and said he was a member of the Dundee Naturalists' Club. He was made glad by receiving specimens of "*The Gentian*," which he had never seen before, although he had often heard of the Canlochan plants, this being his first visit. After parting with us he was going to Braemar over the hills by Loch Callater, and had a rough walk before him, but the weather was fine, and the hills free from mist. Our party separated somehow among the rocks, one section scrambling up the centre of the corry to the tablelands above, where, skirting Glas Mool, and proceeding due west, they reached the Braemar road at a point near a keeper's house, where with Professor Balfour in former years we ascended the stream, nine miles from Braemar. The rest of the party kept more to the south, and struck the Cairnwell near the watering place.

We had engaged the conveyances to meet us at the top of the pass to take us back to our inn, and we reached the Spittal, all greatly delighted with the day's excursion.

Glen Taitneach and Glas Tulichan, 3400 *feet.*

Although rather stiff with our exertions on the previous day, we started on 31st July on foot for Glen Taitneach and Glas Tulachan. In the glen we were joined by Robertson, keeper to Colonel Farquharson of Invercauld, who acted as our guide upon the occasion. Fording the stream about a mile above the shepherds' houses, we held to the left, over the shoulder of the hill, and, gradually ascending after a walk of seven miles over very rough heathery ground, we reached a fine looking large corry, with rocky ledges. On a closer inspection they were found to be dry, and far from productive. In the course of our walk *Rubus Chamaemorus*, or cloudberry, was picked, covered with its red unripe fruit, the whole moor in some places carpeted with it. The fruit assumes an amber hue when ripe, and is pleasantly acid to the taste when the mouth becomes dry in hill climbing. *Cornus suecica* was associated with it, but not much in flower, also many of the commoner alpine plants. *Sibbaldia procumbens* was very plentiful in the turf, but the rarer plants were not to be found. After a partial examination of the corry we halted half way up, on a steep slope, and lunched, all agreeing that it was a relief after such a pull up to get anchored to a stone. Some of our members worked round the corry examining the rocks, while others scrambled on to the ridge and reached the Sappers' pole at the summit. The view from this point was very fine, the well-known Braemar mountains Ben Macdhui, Cairntoul, Breriach, Ben An, Ben-a-Bourd, being clear to their tops, and right across the valley dark Loch-na-Ghar was very conspicuous. While one party was busy in the corry, and in good shelter, we came down in furious showers of sleet, containing large pieces of ice, picking fine specimens of *Azalea procumbens* and other alpines. From the ridge, as we proceeded, Loch-nun-Nean, a picturesque lake about a mile long, containing two green islands, upon which the gulls breed, was visible across the valley below. The elevation on the left of this lake is between 2000 and 3000 feet, and it contains trout of rare quality. Persons living at the Spittal Hotel have the privilege of fishing it, and there is a hut and cooking utensils, where by roughing it one can spend the night. In summer a pleasant excursion can be made by going there in the afternoon, fishing in the evening and morning, and coming down next day. There is a good seven miles walk to it, the last part of the ascent very steep indeed. The fish average three-quarters of a pound, and many much heavier, being fed upon a shell-fish abundant in the lake. Some of our members fished there with indifferent success. Near the loch was gathered a curious variety of *Sax. stellaris*, somewhat in appearance like *Montia fontana*, and also *Armeria maritima* var. *alpina*. In the Corry Tulachan were picked *Veronica alpina*, *Cornus suecica*, *Betula nana* (a new station for this plant), *Trientalis Europaea*, *Asplenium viride*, *Asplenium*

Trichomanes, *Aspidium Lonchitis*, *Lycopodium annotinum*, pink flowered variety of *Thymus Serpyllum*, and *Ædopodium Griffithii*. *Thlaspi alpestre* was also gathered in this glen. This was considered a good plant, the best indeed obtained during our stay at the Spittal. The rabbits had been nibbling it, and very few flowering specimens were obtained. One member at least has been able to grow it since his return, and no doubt seeds will soon be obtainable. Gradually descending, the stream was reached, and, walking down its banks, gilded by sheets of *Saxifraga aizoides* in full flower, our progress was agreeable. The glen, in Gaelic *Taitneach*, "pleasant glen," deserves its name, a more beautifully sequestered place it would be difficult to find, and the walk to the Spittal was very pleasant indeed; and although botanically not very interesting, Glas Tulachan and the Pleasant Glen are well worth a visit, and repay any labour in walking that has to be undertaken. In the birch wood, near the shepherds' houses, a fine spike of *Digitalis purpurea* was gathered of a bright salmon colour, with pink spots. The root could not be got, but some of the seed vessels have ripened although quite green when brought home, and from the seeds a potful of vigorous seedlings have been raised. If they come true when they flower, a distinct and beautiful variety of this striking plant will have been obtained.

Loch Callater and Corry Kandor, 2d August 1880.

This morning we were early astir, and having partaken of a substantial breakfast, we started in two waggonettes for Loch Callater, thirteen miles off. In pleasant company the time passed quickly, and after ascending the Cairnwell the drive down Glen Cluny was much enjoyed. In the glen we met many parties returning to the "south countrie" from Braemar, and in returning in the evening a golden eagle was observed on the prowl for its evening meal. We took about two and a half hours to reach the keeper's house at the end of the lake, where we put up our horses till our return from the hills at 6.30 P.M. The mountains being clear to their summit, many parties had come up from Braemar to ascend Loch-na-Ghar, with no end of guides and ponies, and we saw the cavalcade in single file start on its winding way, and from the other side of the lake kept it in view for a considerable time. With little delay we started, keeping the right hand side of Loch Callater, and in place of making for the Breakneck Waterfall at the head of the glen, we started across the moors, keeping for the rocks at Loch Kandor. The crowberry and cloudberry carpeted the heather in many places. No one had seen *Empetrum nigrum* so covered with fruit as it is here. This was observed on a previous occasion when Professor Dickson pulled up a patch, literally black with the berries, and weighing many pounds. The fruit contains many seeds, is pleasantly acid, and seems much relished by the grouse, if one might judge by their droppings, which exhibited the black bloom of the skin of the fruit, for colouring, and seemed to produce a diarrhœa in these birds, from the irritation of the seeds on their mucous membranes. By the sides of Loch Callater, indeed in the lake, beautiful specimens of *Lobelia Dortmanni* in fine flower, *Subularia aquatica*, and *Isoetes echinospora* (a new plant for this loch) were picked. In the bog at its head several good Carices were observed. As previously stated, we pushed on for the corry, and after a stiff walk attained the high ground, with Loch Kandor at our feet. So steep and abrupt do the rocks come down, that there is barely room left to walk round its banks or edges. Our party here divided; three gentlemen started to fish the lake, Professor Dickson, Mr Sadler, and Dr Craig set out to scale the ledges to the left of the tarn, while the other members started to examine the corry proper. The first named division secured specimens of *Carex frigidus* and *Salix Sadleri*, both new to Britain, and discovered by Mr Sadler of the Botanic Garden, a few years ago. These plants were identified by Dr Boswell Syme. Both grow on ledges almost inaccessible to an ordinary climber; and some years ago the writer was with Mr Sadler when he discovered them. The grand and newest discovery of the Alpine Botanist's Club, is, however, the station for *Sonchus alpinus*, which grows in a considerable patch in a perpendicular cleft in the precipice. On this occasion it was again seen, but no member was sufficiently foolhardy to break his neck in an attempt to scale the exact rock. This is a new station for this plant, and from its inaccessibility there is a good chance that it will remain safe for some time to come. With many other good things *Carex rupestris* and *C. atrata* were gathered in remarkably fine condition. The rocks near the loch were covered with alpine willows. *Salix lanata*, by no means common, a beautiful woolly species, was gathered by Mr Boyd, Captain Norman, and Dr Aitken, in the upper corry. It thrives in the rock garden, accommodating itself to its change of residence completely. Last spring its yellow catkins were greatly admired, so large and fragrant, on a five years old plant obtained at Canlochan. *Salix Myrsinites*, L., and *S. Lapponum*, L., with its varieties *arenaria* and

Stuartiana, the last found by the stream flowing into Loch Callater. *Phleum alpinum*, *Veronica alpina*, *Polypodium alpestre*, *Pyrola media*, and *Splachnum sphæricum*, were also gathered. The scrambling in the corry was very difficult, the inclination being of the steepest and "the screedano" of loose stones, washed from above by the mountain torrents, very difficult to cross. They were in many places covered with ferns of the commoner mountain varieties, while *Cochlearia grœnlandica* and *Saxifraga oppositifolia* were growing in the fissures. Altogether, in the corry the vegetation is not great, but near and over Loch Kandor, there are capital moist ledges for the experienced climber. In ascending the glen one of the members found a red grouse nest containing three abortive eggs, none of them much larger than those of the blackbird; it is not unusual occasionally to find one abortive egg among the others in a nest, but in this case all the eggs in the nest were abortive and less than half the usual size. This was considered such an unusual occurrence that the eggs were thought worthy of being placed in the Edinburgh Museum of Science and Art. The place is so vast, so weird looking, and so solitary, that no one, whether he be naturalist or not, should fail to see it. On the higher ledges, if you met with an accident, you might remain food for the ravens. The very sheep are often lost here. Tempted by the sweet herbage they descend to ledges from which they cannot return or be rescued. We heard several men putting up a rocky barrier to prevent the sheep doing what I have attempted to describe—although we heard them hammering far above us, I am not aware they were seen at all—some stones they sent down, however, might have made us feel them. Several animals lost on the ledges were observed upon this occasion, where they must remain till they are starved to death. Although several of our members were always in view, no one could feel otherwise than very solitary. Now this was on a fine day, what must it be when the storm is raging, the rain and mist obscuring the view? Our fishers killed a good dish of small black trout—where they get anything but stray flies it is not easy to see. Still they are numerous and take both fly and worm. When the wind is high it is absolutely dangerous to venture among the rocks and ledges. On the present occasion we had nothing to complain of on this score, but on my first visit some years ago a speedy retreat was made. Many hours were pleasantly spent on this visit among the alpines, and we returned to Loch Callater Lodge at 6.30 with full vascula, making a sharp start for the Spittal, which was not reached till 9.30, all more or less fatigued with our exertions.

After the club had dispersed at Blairgowrie, four of the members remained behind for the purpose of examining the botany of Cluny Loch. The forenoon was dull and showery, but it cleared up about the middle of the day, and we had a lovely afternoon for our visit to the loch. After calling upon Lord Airlie's manager, and getting the use of his boat, which he kindly lent to us, we were soon in the middle of beautiful beds of *Nymphæa alba*, mixed here and there with *Nuphar lutea*, but the principal object of our visit was to procure specimens of *Naias flexilis*. We succeeded in raking from the bottom in some quantity, several beautiful specimens for the Herbarium. We got it in different places, but found it in greatest abundance near the boathouse. Mixed with the *Naias* we got quantities of *Elatine hexandra*, *Subularia aquatica*, *Myriophyllum verticillatum*, and fine specimens of *Utricularia minor*. Before leaving we were shown round the garden, where were a number of very interesting old-fashioned herbaceous plants. We also saw the interesting collection of curiosities collected from all parts of the world by our host, from old-fashioned matchlocks and pistols, of which he had a wonderful assortment, to curious growths of trees found in the district. The old gentleman seemed a thorough enthusiast, and never seemed to tire of telling stories connected with the particular objects in his collection. We spent a very pleasant afternoon, and returned to Blairgowrie in time for dinner.

Dr William Craig exhibited specimens obtained in this excursion.

II. *Report on the Effect of the Winter* 1880–81 *on Vegetation in different parts of Scotland; and Temperatures on the Progress of Open-Air Vegetation at the Royal Botanic Garden from the beginning of March.* By Mr JOHN SADLER, Curator.

Mr Jenner called attention to the great destruction of Holly leaves during the winter.

Mr W. B. Boyd stated that in the Kelso district Hollies bearing fruit were killed, while those yielding leaves only were perfectly intact.

Mr Sadler mentioned that he had never seen so many wasps in the garden as during the past fortnight, and suggested that something should be done to keep them down. The Chairman said he had also noticed the unusual number of wasps, and thought this was to be accounted for by the uniform severity of the winter, which kept them wholly within-doors, whereas in an ordinary season many of them were tempted out by mild weather to be destroyed by a sudden change.

III. *On a Plant of* Primula vulgaris, *with a green corolla.* By Professor DICKSON.

Professor Dickson exhibited a plant of *Primula vulgaris*, with a green corolla, he had obtained from Mr Maclean, one of his students. The plant was grown in the garden of Miss Redpath, at Gilmerton, but its previous history was unknown.

IV. *On Recent Additions to the University Herbarium from Shire Highlands, Central Africa.* By Mr TAYLOR.

Mr Taylor exhibited dried specimens of plants recently sent to the Herbarium by Mr John Buchanan, Shire Highlands, Central Africa, and at the same time some living plants grown from seeds and bulbs, also sent by him to the Garden. The dried specimens, of which there were 150, had been provisionally named by Professor Oliver, who wrote in commendatory terms of the pains taken by Mr Buchanan, specially in collecting fruit as well as flowers. Figures of several of the new genera and species will soon appear under the direction of the Kew authorities. One of the living plants on the table raised from seed sent with the specimens, the *Æschynomene Schimperi*, H., a beautiful papilionaceous genus, several varieties of which Mr Buchanan sent home, had been hitherto noted as peculiar to Nileland or Southern Africa. Again, the *Oxalis sensitiva*, called by the natives "His Father has Died," had been found in the mountain district of the tropics. So, too, have a composite, *Dioscorea Schimperiana*, a Yam, and *Lapeyrousia abyssinica*, both eaten in the Shire, only in famine times, but known generally over Africa. A species of *Thesium*, used as a native cure for sore eyes, must have been brought here by emigrant tribes, as the genus finds no place in Oliver's "Flora of Tropical Africa." The like reasoning covers the appearance on the table of *Datura alba* and *Cucumis melo*, though *Rhynchosia caribæa*, Dec., also exhibited, is known at the Cape as well as tropical America; but an *Oxyanthus* in the parcel, used by the natives to sharpen the scent of hunting-dogs, seems confined to the specific habitat, as is also *Cadalvena spectabilis*, a lovely Iris with yellow flowers, whose leaves, usually four, spread square on the ground. The *Sanseviera* *longiflora* is sent as a fibre producer. Several new species of *Indigofera* were found in the parcel ; as well as a new species of *Garcinia*, from which the natives take a red dye ; and *Khaya senegalensis* (?) Jus., out of whose long straight trunk the natives fashion canoes ; the *Gonioma*, peculiar to tropical Africa, yielding a white juice, allied to india rubber ; likewise *Erythrophlœum guineense*, Don, used here, as throughout Africa, for the purposes of the ordeal ; and two new Ferns.

Professor Dickson commended the judgment and care shown by Mr Buchanan in sending this new parcel of specimens. Altogether he had been a most satisfactory botanical correspondent.

V. *Microscopic Demonstration of Embryonic Specimens of* Salvinia natans. By Mr R. Kidston.

A series of preparations of the prothallium of *Salvinia natans* were exhibited under the microscope. The stomata of this plant have been described by Schleiden as consisting of small slits without guard cells. On the upper surface of the scutellum, however, the stomata are of considerable size—about five times as large as those of the floating leaves, and distinctly provided with guard cells. There seems little doubt but that guard cells are also present on the leaf "slit like" stomata ; but they are very small, and require very careful focussing to see them.

MISCELLANEOUS NOTICES.

1. Dr William Craig intimated that he had obtained seeds of true *Jaborandi* from Brazil, through the courtesy of Dr Paterson, of Boa Vista, Grange, and he had given these to the Garden.

2. Professor Dickson called attention to a plant of a new species of *Allium* from Cabul, on the table, the seeds of which had been sent by Mrs Colonel Maclean.

3. The Rev. H. Evans, of Scremerston Vicarage, near Berwick-on-Tweed, sent specimens for the Garden of *Cypripedium Calceolus* and *Aspidium rigidum*, from Craven.

4. Mr Taylor intimated that members might now have an opportunity of seeing in flower at Rait Lodge the *Aciphylla Colensoi* or Wild Spaniard, one of the New Zealand introductions of their late President.

On the table were placed a collection of Alpine and other plants in flower, among which were the following:—*Primula capitata*, having a spiral fasciated flower-stalk; Daisies, abnormal flowering vars; *Aloe socotrina* and a crassulaceous plant, brought from the Island of Socotra by the President; *Lewisia redivira*, *Vella spinosa*, *Ramondia pyrenaica*, *Myosotis alpestris*, *Dianthus alpinus*, *Saxifraga MacNabiana*, and other seedlings of *Saxifraga pyramidalis*; *Allium*, species from Cabul; *Sarmienta repens*, *Lilium kamtschaticum*, *Veronica saxatilis*, purple variety; *Silene quadridentata*, *Ixiolirion alatavicum*, *Erinus alpinus*, *Thalictrum tuberosum*, *Saxifraga Caryana*, *Silene Elizabethæ*, &c.

Thursday, 14*th July* 1881.—Professor BAYLEY BALFOUR, President, in the Chair.

The deaths of Professor SCHLEIDEN, Honorary Fellow, and Professor GEORGE S. BLAIKIE, M.D., of Nashville, Tennessee, Non-Resident Fellow, were noted.

The following Communications were read:—

I. *Note on* Chlamydomyxa labyrinthuloides, *Archer*. By Mr PATRICK GEDDES, F.R.S.E.

This remarkable organism was discovered by Archer in the cells of *Sphagnum*, and described by him in the "Quarterly Journal of Microscopical Science" for 1875. The lamination of the cell coatings, and the formation of peculiar wart-like thickenings inclosing red pigment, were considered as tending to support the old view of growth by accretion of successive laminæ. The occasional collection of the chlorophyll into definite patches—incipient chlorophyll grains—was also described. A distinct resting protococcus stage occurs early in development.

On these grounds it was pointed out that this organism could not be satisfactorily referred to any existing animal or vegetable group, since it presented close affinities with the Rhizopods on the one hand, and with the Palmellaceous Algæ on the other. A more perfectly intermediate type, indeed, cannot be imagined.

An interesting and animated discussion followed, in which the President, and Professors Dickson and Ramsay MacNab of Dublin, took part.

II. *Notes on the Action of some Aniline Dyes on Vegetable Tissues.* By JOHN M. MACFARLANE, B.Sc.

III. *Notes on Plants grown at Hay Lodge, Trinity.* By Mr ISAAC ANDERSON-HENRY, F.R.S.E., F.L.S.

Specimens 1 and 2 are plants of *Androsace incisa,* raised by me from seeds sent by my niece from the hills above Rawul Pindee. That the name I give is correct is confirmed by Sir Joseph Hooker, to whom I submitted a plant, and who informs me that he is getting it figured for the Botanical Magazine. There is a slight difference between the two plants, that one farthest advanced showing a tendency in the flowers to fade off into scarlet before they die. It blooms well in the open border, from which I infer that it will be well suited for the rockery.

3. A plant raised from seeds sent by the same relative collected in Ladak or Kashmir—apparently a species of *Dracocephalum.* It stood all winter in the open border, and appears to be quite hardy. Being this day uplifted from the border, it will not show to advantage.

4. RHEUM (*R. ribes*?).—This odd-looking species I raised from Sikkim seeds. May it not be identical with *R. ribes* got in Affghanistan by Dr Aitchison? The leaves, somewhat like a *ribes,* favour this belief.

5. Hybrid PRIMULA (*P. rosea* × *P. Kashmirensis*).—I have another of this (× with *P. Kashmirensis*) also in flower at this late season for Primulas. It has this other advantage in having its leaves slightly fragrant, while both parents in their foliage have a disagreeable odour, especially the *P. Kashmirensis,* which is quite offensive.

6. RHODODENDRON Hybrid (*R. Jenkinsii* × *R. Edgeworthii,* at least I take it for this), which I made in 1864, this being the first to bloom. But tallies go astray. By having it marked as a hybrid, I feel pretty certain I am right in the parentage, and the odour of the flower strengthens my belief. But what I call attention to is the *morphological* formation of the flower. While the flowers of both *R. Jenkinsii* and *R. Edgworthii* are, like those of the most, if not all, of the genus, *monopetalous,* the only bloom open shows very distinctly *five* petals apparently all pedicelled, though they all may be joined at the bottom. It bloomed in June, and the style and seed vessels are yet upon the plant springing as it were out of another *morphological* structure forming a kind of involucre.

Except for these abnormal formations, there is nothing else of great interest about the plant, though, perhaps, I am the first who has crossed these two large species, and hybridists know this is somewhat difficult to effect.

7. I beg now to submit a plant, of which I shall be glad if the Society will give me the name, or the name of the *genus* it belongs to. I cannot say from whence or from whom I received it. It is very likely I may have raised it from seed from abroad, without any name given to it. I was attracted to it lately, first, by the *fragrance* of its foliage, and latterly by its umbels of coming flowers, something like a *Bouvardia*, which it is not, as you will see from the thread-like filaments of one of its flowers now open. You will please observe it is not so much the flower as the foliage which is so *fragrant*, having the perfume of lavender or lemon.

Note.—On afterwards communicating with Sir Joseph D. Hooker, he at once found it to be *Monardella odoratissima.*

8. *Rheum Moorcroftianum.*—I raised this plant from seeds kindly sent me from Kew, being collected in Affghanistan by Dr Aitchison, at elevations between 12,000 and 14,000 feet. This has shown itself to be a very rapid grower, far outstripping *R. nobile* in this particular. Royle, in his "Illustrations of Indian Botany," p. 315, speaks of this Rheum as being superior for its purgative properties, and says—"Mr Moorcroft sent me some rhubarb, which, for compactness of texture, colour, and properties, was as fine as any I have ever seen, from near Ladak, in 34° N. lat. and 77½° E. long., a very cold region." It must, therefore, be quite hardy in our climate.

9. *Veronica Chathamica* is from the island of Chatham, near New Zealand. It is not yet recorded in any of our botanical works. It is a small prostrate shrub with wiry branches. The racemes are few or many. The flowers are numerous, closely set, peduncles ½ inch long. Corolla large, dark purple. This beautiful shrub has been cultivated by Mr Travers in his garden at Wellington, where the profusion of its dark flowers and prostrate habit has proved a most showy addition to those plants adapted for the ornamentation of rockwork or earth banks. Such is the account I have of it. I raised it from seeds sent me from New Zealand.

10. *Veronica anomala,* which I have also raised from seed sent to me from New Zealand. This species is not recorded, so far as I know, in any botanical work in this country. It is a dense-growing alpine shrub got in New Zealand at an elevation of 3000 feet.

11. *Veronica Haastii.*—Of this I have only young plants. It is recorded and described by Sir Joseph Hooker as a tortuous decumbent shrub, with flowers sessile and in pairs, but the corolla not seen. Of it he says—"This and *V. epacridea* are most remarkable plants of a different habit from any hitherto described ("Handbook of New Zealand Flora," p. 213).

12. *Veronica Kirkii* (Armstrong).—Except that this is another Alpine species from an elevation of from 3000 to 4000 feet, I have no other information about it.

13. *Veronica lycopodioides.*—This is also a young plant, and so small that I hesitated about submitting it to the meeting. But it is altogether so peculiar, so unlike a phanerogam, and so like a moss, that I could not resist the desire to let you see it. Yet, Sir Joseph Hooker described it as an "erect (?), much-branched, stout shrub, having leaves most densely and closely four-fariously imbricate, having flowers sessile, in small, dense, oblong heads at the ends of the branches." But, altogether, Sir Joseph's description is, in all its particulars, so disconform to the plant I have raised from seeds received with this name, that I must hesitate to say it is correct (see "Hooker's Flora of New Zealand," p. 211). Yet, these New Zealand things undergo such singular transformations that this I now exhibit, still in babyhood, may yet realise the description Sir Joseph gives of it.

14. *Wahlenbergia saxicola* (or Bluebell of New Zealand), is fully described in the "Handbook of New Zealand Flora." It is an Alpine and sub-Alpine species, going up to an elevation of 6000 feet. It must, therefore, be quite hardy with us, though I have not yet tried it out all winter.

IV. *List of Plants collected on the Islands of Colonsay and Oransay.* (Part II.) By Mr Symington Grieve.

V. *Continuation of Report on the effects of the Winter of* 1880–81 *on Vegetation in different parts of Scotland, and Temperatures in, and Progress of Open-Air Vegetation at, the Royal Botanic Garden from the beginning of June.* By Mr John Sadler, Curator.

Mr Alexander Buchan, M.A., called attention to the striking parallels of temperature betwixt the Hamilton district and of that around Edinburgh. He accounted for it by a similarity in features of physical geography.

MISCELLANEOUS COMMUNICATIONS.

1. Professor Balfour exhibited specimens of Maw's encaustic tiles, containing beautiful imprints of *Davallia*, *Selaginella*, and the marks of *Lepidodendron*.

2. Professor Balfour also showed a specimen of the so-called "Panama wood," or *Quillaia saponaria* from South America, belonging to the Rosaceæ, and yielding a saponaceous secretion in practical use. It had been sent to the Museum by Messrs Duncan, Flockhart, & Co.

3. Mr Robert Hutchison of Carlowrie sent elm leaves from Islay destroyed by insects.

4. Mr Sadler exhibited two large photographs by Mr Magnus Jackson, showing the Tay at the south entrance to Perth during the flood caused by the melting of the snow of March 1881, displaying the elm trees of the Inch reflecting double in the water.

5. Mr Sadler exhibited barren stems of the fungus *Lentinus lepidens* (Cooke, "Handbook," p. 242, No. 684), obtained from a damp cellar in Morningside, sent him by Dr Craig.

6. Mr Taylor showed specimens of foreign plants collected by Charles W. Cowan, Esq., from among the Esparto grass used at Valleyfield Mills, Penicuik, including the Lavender, and Sedum, several species of Compositæ, and amongst the grasses *Bromus madritensis*, *B. erectus*, *B. asper*, *Dactylis hispanica*, &c.

7. Professor Dickson called attention to plants on the table from the Royal Botanic Garden. They included specimens of *Cyananthus inflatus*, *Dianthus alpinus*, *D. eximius*, *Linum viscosum*, *Ranunculus acris* (straw-coloured variety), found by Professor Dickson; *Parnassia Himalayensis*, as well as a species of *Saxifraga* from Kedarkanta, India; *Meconopsis aculeata*, *Allium neophyllum*, *Umbilicus sempervivum*, *Saxifraga aizoides aurantiaca*, *Androsace lanuginosa*, &c.

ADDITIONS

TO THE

LIBRARY, HERBARIUM, AND MUSEUM.

AT THE

ROYAL BOTANIC GARDEN, EDINBURGH.

FROM 1ST OCTOBER 1880 TO 1ST OCTOBER 1881.

I.—LIBRARY.

BOOKS.

BALFOUR, J. H., M.D. Class Book of Botany, 1854. Manual of Botany, 5th ed., 1875. Elements of Botany, 3d ed., 1876. Palæontological Botany, 1873.—*From the Author.*

BALFOUR and SADLER. The Flora of Edinburgh, 2d ed., 1871.—*From Professor Balfour.*

BELL, JACOB, and REDWOOD, THEOPHILUS. Historical Sketch of Pharmacy in Great Britain. London, printed for Pharmaceutical Society of Great Britain, 1880.—*From the Pharmaceutical Society of Great Britain.*

BUCHANAN, JOHN, and D. J. HECTOR, F.L.S. The Indigenous Grasses of New Zealand. Illustrated by John Buchanan, F.L.S., Draughtsman to the Geological Survey Department. Parts 1, 2, 5, and 6 completing the work. 21 Plates. Published by Command. New Zealand Government, Wellington, N.Z.—*From the Colonial Museum of New Zealand.*

BOHNENSIG, G. C. W. Repertorium Annuum Literaturæ Botanicæ Periodicæ. Tomus Sextus. Haarlem, 1881.—*From the Compiler.*

BURTON, RICHARD. Botanical Guide to the Flowering Plants, Ferns, and Mosses of Manchester. Manchester, 1859.—*Presented by Mr Thomas Walker, Middlehouse, Carluke.*

CAMINHOA, J. M. Botanica Geral E. Medica. 3 vols. Rio de Janeiro-Typographia Nacional.—*From the Author*, 1878, 1879.

CATHCART. A large series of drawings of Indian Plants by native artists, executed under the direction of Mr Cathcart, who accompanied Sir Joseph Hooker in his Himalayan travels, belonging to the late William Gorrie, Esq., of Rait Lodge.—*Presented by Mrs Urquhart.*

HOOKER, J. D. The Flora of British India. Part 8. (*Rubiaceæ* to *Vacciniaceæ*). London, 1881.—*From the India Office.*

LAGER, SAINT, Dr. Reforme de la Nomenclature Botanique.—*From the Author.*

LINNÆUS. Flora Lapponica. Edited by Sir J. E. Smith. London, 1792.—*Presented by Mr Thomas Walker, Middlehouse, Carluke.*

LOUDON, Mrs. The Ladies' Flower Garden: Ornamental Perennial Plants. 2d ed. N.D. London.—*Purchased.*

M'FADYEN'S Flora of Jamaica. London, 1837. 1 vol. All published. —*Presented by Mr Thomas Walker, Middlehouse, Carluke.*

MAUNDER, SAMUEL. The Scientific and Literary Treasury. Revised by James Yate Johnston. London, 1872.—*From an Old Lady.*

NYMAN, FRIDER CAROLO. Conspectus Floræ Europæ. Part 3. Corolliforæ. Monochlamydeæ. Orbbro (Sueciæ) Typis Officinæ Bohlinianæ, 1881.—*From the Author.*

ORMEROD, E. A. Manual of Injurious Insects, with methods of Prevention and Remedy for their Attacks to Food Crops, Forest Trees, and Fruit; and with short introduction to Entomology. By Eleanor A. Ormerod, F.M.S., &c. London, 1881.—*From the Author.*

PRIOR, R. C. A., M.D. On the Popular Names of British Plants, being an Explanation of the Origin and Meaning of the Names of our Indigenous and most commonly cultivated Species. By R. C. A. Prior, M.D. 3d ed. London, 1879.—*From the Author.*

RAY, JOHN. Synopsis Stirpium Britannicarum. London, 1724.

WAHLENBERG, GEORGIUS. Flora Lapponica. Berlin, 1817.

WALKER, JOHN, D.D. Essays on Natural History and Rural Economy. Edinburgh, 1808.—*Presented by Mr Thomas Walker, Middlehouse, Carluke.*

PAMPHLETS, REPRINTS FROM SCIENTIFIC PUBLICATIONS, &c.

BALFOUR, J. H., M.D. Remarks on the Ipecacuan Plant (*Cephaelis Ipecacuanha*, Rich.), as cultivated in the Royal Botanic Garden, Edinburgh. (From the "Transactions of the Royal Society of Edinburgh," Vol. XXVI.)—*From the Author.*

——— A Set of Twelve duplicate Scientific Papers, including Biographical Sketches of the late Dr James Duncan and Professor Edward Forbes.—*From the Author.*

BALFOUR, BAYLEY, Prof. Address to the Medical Students at the opening of the Winter Session, University of Glasgow, 1879. Some Resemblances betwixt Plants and Animals, in respect of their Nutrition, with some Remarks on the Position of the Natural History Sciences in Medical Education.—*From the Author.*

BRITISH ASSOCIATION. York Meeting, Papers relative to.—*From Professor Balfour.*

Brooks, Charles Wolcott. Early Discoveries of the Hawaiian Islands in the North Pacific Ocean: Evidences of Visits by Spanish Navigators during the Sixteenth Century. By Henry A. Price, Ex-Minister Resident of the United States of America at Honolulu, Hawaiian Islands, ethnologically considered, with Introductory Remarks, when read before the California Academy of Sciences, June 7, 1880, by Charles Wolcott Brooks, San Francisco, 1880.—*From the Author.*

——— Proceedings of the California Academy of Sciences at a Reception given to the Captain and Officers of the U.S. steamer "Thomas Corwin" and Captains of the Pacific Whaling Fleet, on their return from the Arctic Regions: including a Paper read before the Academy, December 6, 1880. By Charles Wolcott Brooks.—*From the Author.*

Comes, Dott O. Osservazioni su Alcune Specie di Funghi del Napoletano e Descrizione di due Nuove Specie. Napoli, 1880.—*From the Author.*

Deans, Wm. List of Ferns and other Cryptogameæ of Madagascar, showing their relation to Mauritius and Bourbon.—*From the Author.*

De Candolle, M. C. Considerations sur l'étude de la Phyllotaxie. Par. M. C. De Candolle. Geneva, 1881.—*From the Author.*

Delpino, Frederico, Prof. Contribuzione alla Storia Dello Svillappo Del Regno Vegetale—I. Smilacæ. Genova, 1880.—*From the Author.*

——— Causa Meccanica della Fillotassi Quincunciale. Nota Preliminaire di Frederico Delpino.—*From the Author.*

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——— Notes of a hitherto Undefined Species of Encephalartos.—*From the Author.*

Ormerod, Eleanor A., F.M.S. Notes of Observations of Injurious Insects. Report 1880.—*From the Author.*

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——— British Lichens. How to Study them. By William Phillips, F.L.S. (Reprinted from the "Midland Naturalist," Vol. III., 1880.)—*From the Author.*

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——— Remarques sur la Chlorophylle. Par M. Pringsheim. (Extrait des Comptes rendus des Séances de l'Academie des Sciences. XC. Séance du 26 Janvier 1880. Paris, 1880.)—*From the Author.*

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Sadler, John. Report on Temperatures during the Winter of 1879–80 at the Royal Botanic Garden, Edinburgh ; the Effects of the same on Open-air Vegetation at the Garden and in other parts of Scotland, with the dates of Flowering of Spring Plants. By John Sadler, F.R.Ph.S., Curator of the Garden. (Paper read before the Botanical Society of Edinburgh, and printed in the Society's Transactions, Vol. XIV.)—*From the Author.*

——— On the Flowering of *Yucca gloriosa*, L., in the Royal Botanic Garden, Edinburgh. By John Sadler, Curator. One Plate. (Ex—"Trans. Bot. Soc.," Vol. XIV.)—*From the Author.*

Sargent, Prof. Four Photographs of Cones of Oregon *Abies*, including *Abies amabilis—From the Author.*

Thomson, George M., F.L.S. The Flowering Plants of New Zealand, and their relations to the Insect Fauna. By George M. Thomson, F.L.S. (Ex—"Trans. Bot. Soc., Edin.," Vol. XIV.)—*From the Author.*

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Belfast.—Natural and Philosophical Society.

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Bulletin XIX. Nos. 1 and 2.—*From the Society.*

Cambridge, Mass., U.S.A.—Annual Report of the Director of the Arnold Arboretum to the President and Fellows of Harvard College, for 1879–80. Cambridge, 1881.—*From Prof. Sargent.*

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Memoirs. Tome XXII. 1879.

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Calendar, 1881.—*From the Society.*

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Norwich.—Norfolk and Norwich Naturalists' Society.

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Paris.—Société Botanique de France.

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Session extraordinaire à Bayonne, 1880.—*From the Society.*

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Acta. Tom. VII. Fasc. 1, 1880.—*From the Directors.*

Philadelphia.—Academy of Natural Sciences.

Proceedings. Parts 1–3, 1880.—*From the Academy.*

Plymouth.—Plymouth Institution and Devon and Cornwall Natural History Society.

Transactions. Vol. VII. Part 3, 1880–81.—*From the Society.*

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Vol. II., 1, 2, 3, et 4 Trimestrès, 1877; Vol. III., 1, 2, 3, et 4 Trimestrès, 1878.—*From the Director.*

Sydney, Australia.—Royal Society of New South Wales.

Journal and Proceedings. Vols. XIII. and XIV.

Mines and Mineral Statistics: Annual Report, Department of Mines, N.S.W., 1878 and 1879 (maps to accompany latter report).—*From the Society.*

Washington.—Smithsonian Institution.

Report of Board of Regents, 1879.—*From the Institute.*

U.S. Geological Survey of the Territories.

Bulletin. Vol. V. Nos. 2 and 3.

Bulletin. Vol V. No. 4. Third Instalment of American Ornithological Bibliography. By Dr Elliot Comes, U.S.A.

Bulletin. Vol. VI. No. 1.

Miscellaneous Publications, No. 12 (1880).—History of the North American Pinnipeds: a Monograph of the Walruses, Sea-Lions, Sea-Bears, also Seals of North America. By Joel Asaph Allen.

Monograph. Vol. 12. Fresh water Rhizopods of North America. Leidy, 1879.—*From F. V. Hayden, U.S. Geologist.*

Watford.—Hertford Natural History Society and Field Club.

Transactions. Vol. I. Parts 1–4.—*From the Society.*

Wellington.—New Zealand Institute.

Transactions and Proceedings. Vol. XIII. 1880.—*From the Institute.*

Colonial Museum and Geological Survey Department.

Manual of the New Zealand Coleoptera. By Captain Thomas Brown. Wellington, 1880.—*Duplicates.*

Meteorological Report, 1800.

Reports of Geological Explorations, 1879–80.

Catalogues of the New Zealand Diptera, Orthoptera, Hymenoptera, with description of Species. By Professor Hutton.

Studies in Biology for New Zealand Students :

No. 1. The Shepherd's-Purse (*Capsella bursa pastoris*). By Professor Hutton.

No. 2. The Bean Plant (*Vicia faba*). By Professor Parker.—*Through the Director, Dr Hector.*

PERIODICALS.

Gaceta cientifica de Venezuela.—*From Sig. A. Ernst.*

The Garden. Nos. 515–302.—*Purchased.*

The Gardeners' Chronicle. Nos. 352–405.—*Purchased.*

Volumes from July 1857 to 1872.—*Purchased.*

Grevillea. Edited by Dr M. C. Cook. Nos. 50–53.—*Purchased.*

The Journal of Botany. Nos. 192–226.—*Purchased.*

The Journal of Forestry.—*From the Proprietors.*

Nature. Nos. 571–622.—*From the Editor.*

The Scottish Naturalist. Edited by Dr F. B. White. Nos. 40–44.—*From Perthshire Society of Natural Science.*

Curtis's Botanical Magazine. Vol XXXV. et seq.—*Purchased.*

Medical Directories of Great Britain and Ireland from 1861. 10 vols.—*From Professor Balfour.*

II.—DONATIONS TO THE HERBARIUM.

Balfour, John Hutton, Esq., Phillipine Islands. A specimen of *Hibiscus mutabilis* (?).

Buchanan, John, Blantyre, Central Africa. About 150 specimens of Phanerogams and other Plants from vicinity of Mount Zomba, Shire Highlands, Central Africa, sent home per Dr Rankine.

Campbell, Col. Specimens of leaves of large *Eucalyptus globulus*, grown in the open air at South Hall, near Colintraive, Argyllshire.

Christison, Sir Robert, Bart. Specimen of Oak branch from Craigiehall, near Edinburgh, showing method of insect ravages there as on July, 1880.

——— Specimen of *Allosurus crispus*, from Corry na Ciste, Ben-Nevis, 3250 feet above sea-level, at foot of great precipice, Aug. 29, 1881; also of *Convallaria majolis*, in fruit, in open garden at Ardgour House, Loch Linnhe, Sept. 12 and 13, 1881.

Crèspigny, Dr E. Set of 91 specimens of Alpine Plants from Bernese Alps.—*Purchased.*

Deamer, John H. A set of Plants, mainly Compositæ, Grasses, and Ferns, from the Middle Island, New Zealand.

Dickson, Prof. Specimen of *Pyrola rotundifolia*, also of *Epipactis palustris*, both from Newham Bog, Northumberland, Aug. 6, 1880.

DICKSON, Prof. Specimen of *Gentiana amarella* and of *Psamma baltica*, as well as of *Erythræa linarifolia* from Holy Island, Northumberland, Aug. 1881.

FERGUSON, Mrs. Mosses, &c., belonging to the late Miss Hope, Wardie Lodge.

FRASER, PATRICK NEILL, Esq. Two fronds of *Dicksonia*, nov. spec. from Aneitum, New Hebrides.

GEDDES, PATRICK, Esq. A set of about 50 Plants from neighbourhood of the City of Mexico and lakes surrounding it within 20 miles radius. Collected in October and beginning of November 1879.

KEW HERBARIUM. Remainder of Herbarium of R. Brown. *Iter Australiense*, 1802–5.—*Presented by direction of the late J. S. Bennett, Esq.*, 1876. (About 18 packages of duplicates).

LACHEUR, E. LE, Guernsey. Specimen of *Ophioglossum lusitanicum.*

PAYOT, VENANCE. Collection Phytostatique ou Fascicule de plants rares du Mont Blanc et du Mont Rosé. About 77 Alpine plants.—*Purchased.*

PHILLIPS, WILLIAM. Elvellacei Britannici. Fasc. IV.—*Purchased.*

PURCHAS, ARTHUR C. A set of 17 specimens of Plants of North Island of New Zealand, mainly from Auckland.

RAVENEL, H. W. Fungi Americani. M. C. Cooke, Editor. Part 46.

SOCIETA CRITTOGAMOLOGICA ITALIANO. Erbario Crittogamico Italiano. Ser. II. Fascicolo XIX. to XXII. inclusive (901–1100 inclusive).—*Purchased.*

III.—DONATIONS TO THE MUSEUM.

From JOHN BUCHANAN.—Collection of Leguminous Seeds and Thirty species of Castor Beans, and "Likangi" fibre, roughly beaten out with a stone.

From DR CLEGHORN.—Stem of Common Broom, eleven years old, cut at Stravithie in May 1881.

From JOHN TAYLOR.—Section of Bark of Wellingtonia, and species of Lichen brought from California by Robert Taylor.

Botanical Society of Edinburgh.

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Corrected to December 1881.

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EXPLANATION OF PLATES III.(*a*) AND III.(*b*).

Postscript.—In bringing out the illustrations for my note on the Septa across the ducts of *Bougainvillea* and *Testudinaria*, published in last part of the Society's *Transactions*, I must apologise for the delay in publication, which was due to various difficulties in their execution, difficulties to which I need not particularly refer. As my communication was little more than a memorandum of the structures I had observed, I take this opportunity of adding a few remarks as supplement.

I have to regret my still very imperfect knowledge of the literature connected with the two plants in question. As to *Nyctaginaceæ* I have consulted Regnault's memoir [1] on the structure of the stems of "*Cyclospermeæ*," and the more recent one of Petersen,[2] who has made special and careful study of the stem-anatomy of *Nyctaginaceæ*. My study of this latter work, has, I may say, from my ignorance of the Danish language, practically been confined to his figures, and to the French *resumé* accompanying the paper. I have not had opportunity of seeing the works of Unger [3] and Nægeli [4] to which Petersen makes reference. So far as I can make out, however, the occasional septa across the ducts of *Bougainvillea* have not previously been observed.

Petersen gives a figure of a portion of a moderately young stem (perhaps of the second year) of *Bougainvillea*, showing the central region with primary bundles, the outer zone

[1] Regnault, "Recherches sur les affinités de Structure des tiges des plantes du groupe des Cyclospermées," *Ann. d. Sc. Nat.*, IV. Ser. (Botanique), tome xiv. (1860).

[2] Petersen, "Bidrag til Nyctaginé-stængelens Histiologi og udviklingshistorie," *Botanisk Tidsskrift*, xi. 149. Copenhagen, 1879.

[3] Unger, *Ueber den Bau und das Wachsthum des Dicotyledonenstammes* St. Petersburg, 1840.

[4] Nægeli, *Beiträge zur Wissenschaftl. Botanik*, 1858.

with secondary bundles, the extra-fascicular cambium, and the cellular rind still covered with epidermis, immediately beneath which the cork is beginning to be developed from a phellogen layer. In that figure he correctly represents the libriform fibres of the rind as forming a nearly continuous layer. In older stems, however, such as that I have figured, these fibres become considerably separated from each other by the general growth and expansion of the rind-parenchyma. Libriform fibres similar to those of *Bougainvillea* have been described by Regnault and Petersen in *Pisonia*. It is to be noted that in the young stem there is very little parenchyma to the inner side of the libriform fibres, while in the older stem there is a considerable amount of what may be called *secondary rind-parenchyma*, internal to the libriform fibres, developed out of the extra-fascicular cambium, and consisting of cells disposed in radiating lines as seen in transverse section (Plate III. (*b*), fig. 2, *srp*.). The wood-cells are very irregularly disposed, and, from the way in which they often pass gradually, so to speak, into the adjacent parenchyma, seem to be little more than a prosenchymatous modification of the ground-tissue. With regard to the occasional reticulated septa across the ducts, I may mention that my pupil, Mr Robert Kidston, has discovered in both stem and root of *Tecoma radicans* similar occasional septa, which are almost indistinguishable in appearance from those of *Bougainvillea*.

As to *Testudinaria elephantipes*, I cannot find any reference to the remarkably beautiful septa across the large ducts, although I scarcely think they can have escaped observation. The occurrence of several tracts of soft bast which I have noted in the bundles in this plant, has already been indicated as a characteristic peculiarity in *Dioscorea* and *Tamus* by Guillaud.[1]

ALEXANDER DICKSON.

December 1881.

[1] Guillaud, "Anatomie de la Tige des Monocotylédones," *Ann. de Sc. Nat.*, VI. Ser. (*Botanique*), tome v. p. 167.

Plate III.(*a*).

Bougainvillea glabra.

Fig. 1. Micro-photo-lithograph of transverse section of stem, of several years' growth, and about one-fifth of an inch in diameter; magnified 33 diameters. The specimen was stained with aniline dye, by which means the different tissues are more readily distinguished from each other. The outermost dark zone is the somewhat fissured corky layer. The pale zone just within it consists of the younger cork-cells just emerging out of the phellogen, and not yet tangentially flattened. The dark zone just within this is the external collenchymatous portion of the outer rind-parenchyma, and the pale zone just within that is the non-collenchymatous portion of the same. The dark line just within this indicates the extra-fascicular bast-fibres; and within this again there is a pale zone of considerable thickness, consisting externally of the secondary rind-parenchyma, and internally of the extra-fascicular cambium (compare with Plate III.(*a*), fig. 2). Then we come upon the zone of secondary thickening, with small-celled matrix, in which are imbedded the secondary bundles. These bundles are disposed in irregularly radiating lines, separated from each other by lines of matrix which simulate medullary rays, but with which, as remarked by Petersen, they must not be confounded. In the centre of the stem we have the primary bundles irregularly scattered in a large celled matrix. Across the duct marked *x* is stretched the reticulated septum represented in Plate III.(*b*), fig. 3.

Plate III.(*b*).

Bougainvillea glabra.

Fig. 2. Transverse section of outer portion of stem of same age as the foregoing; magnified 200 diameters.

ck. = Cork.

ph. = Younger cork-cells developing out of phellogen.

prp. = Primary rind-parenchyma outside the extra-fascicular libriform fibres. The outer cells of this zone are collenchymatous, although not so markedly so as in the younger stem.

efl. = Extra-fascicular libriform fibres.

srp. = Secondary rind-parenchyma, internal to the last, and developed out of the subcortical meristem (extra-fascicular cambium). The larger cells in this zone contained bundles of acicular crystals.

efc. = Extra-fascicular cambium, or subcortical meristem.
pm. = Parenchymatous matrix of zone of secondary thickening.
sb. = Soft bast of secondary bundle.
ifc. = Trace of intra-fascicular cambium ?
dd. = Dotted ducts of xylem portion of secondary bundle.
w. = Wood-cells.

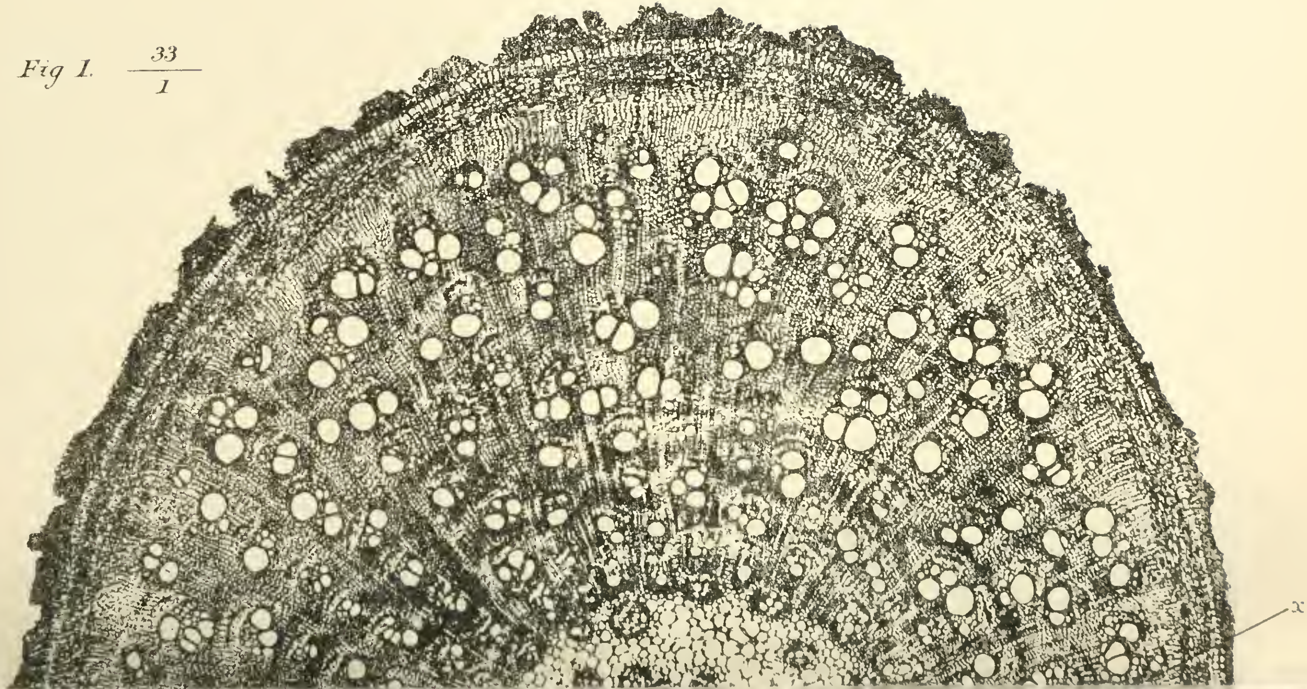
Fig. 3. Reticulated imperforate septum from the duct marked *x* in Plate III.(*a*), fig. 1; magnified 720 diameters.

Testudinaria elephantipes.

Fig. 4. Longitudinal section of portion of stem, magnified 79 diameters, showing portion of one of the large ducts with very oblique and much elongated imperforate septum, which is marked with transversely elongated pits in its middle portion, and finely dotted towards the narrowed extremities. The drawing from which this figure is a photo-lithographic reduction was made with assistance of camera lucida under high power (of course from a number of fields of view), and measures about thirty inches.

d. = Duct, the wall of which is surrounded by comparatively short parenchyma cells with dotted markings.
s. = Oblique septum across the duct. In this specimen the septum is one-tenth of an inch in length.
pm. = General parenchymatous matrix, consisting of finely dotted cells considerably larger than those immediately surrounding the duct.

Fig 1. $\frac{33}{1}$



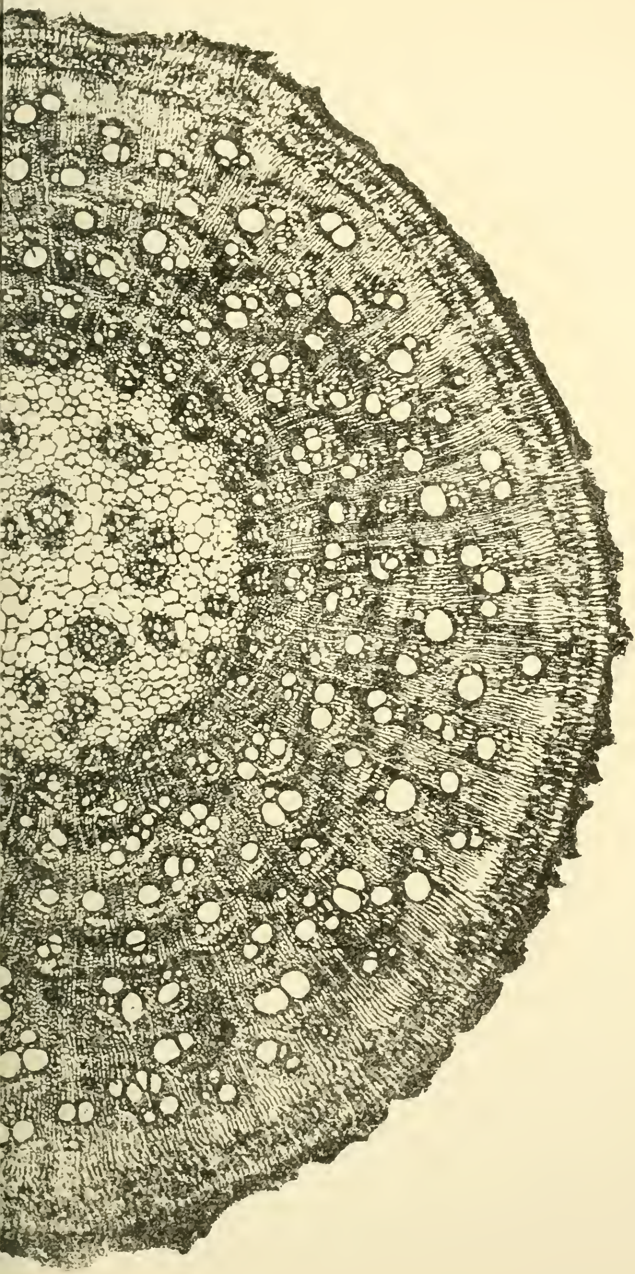


Fig. 2. $\frac{200}{1}$

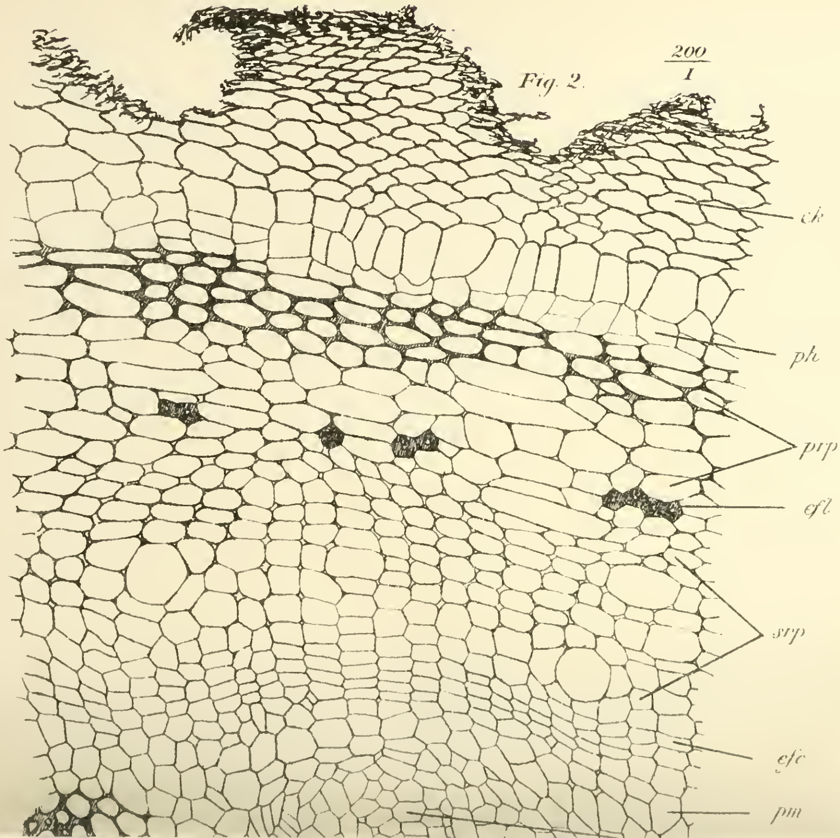
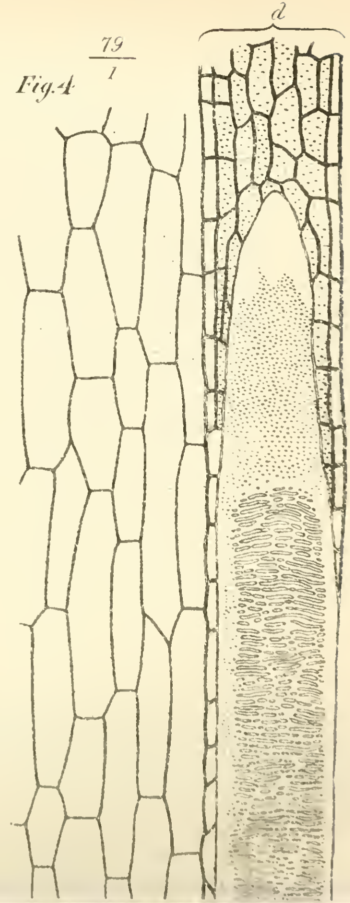
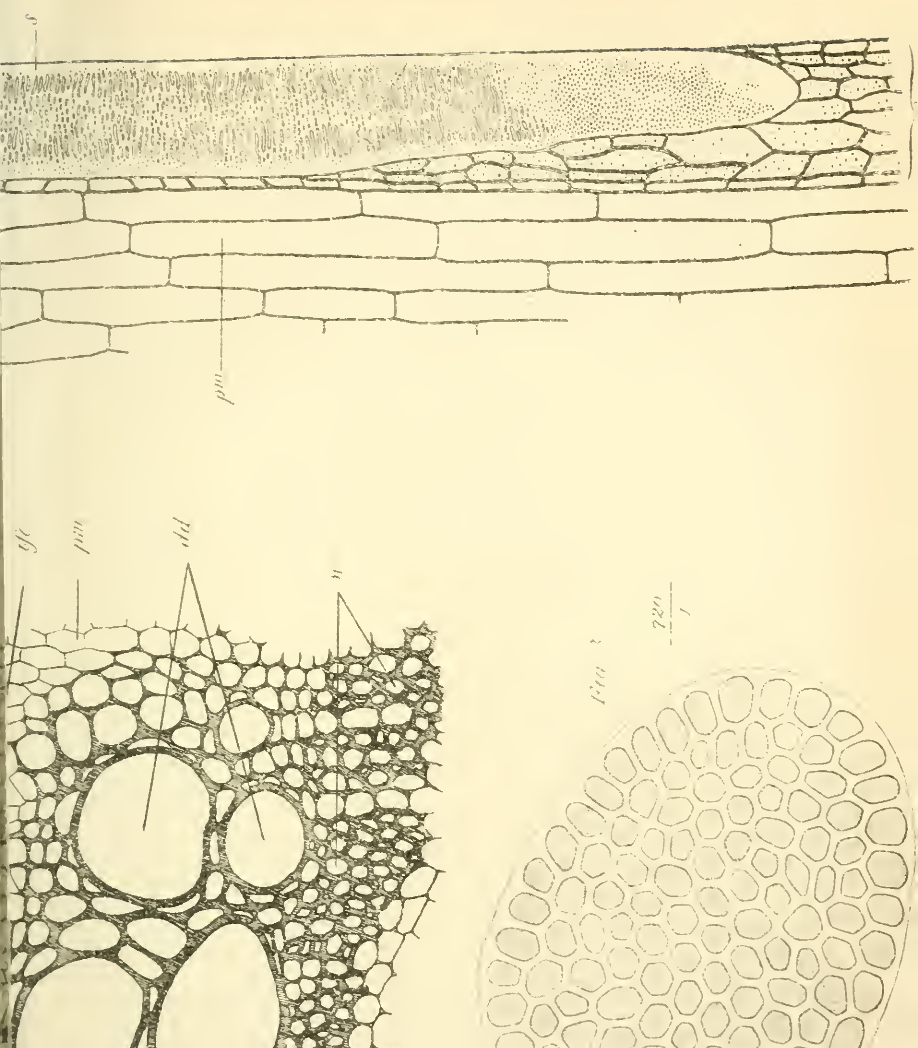


Fig. 4 $\frac{79}{1}$

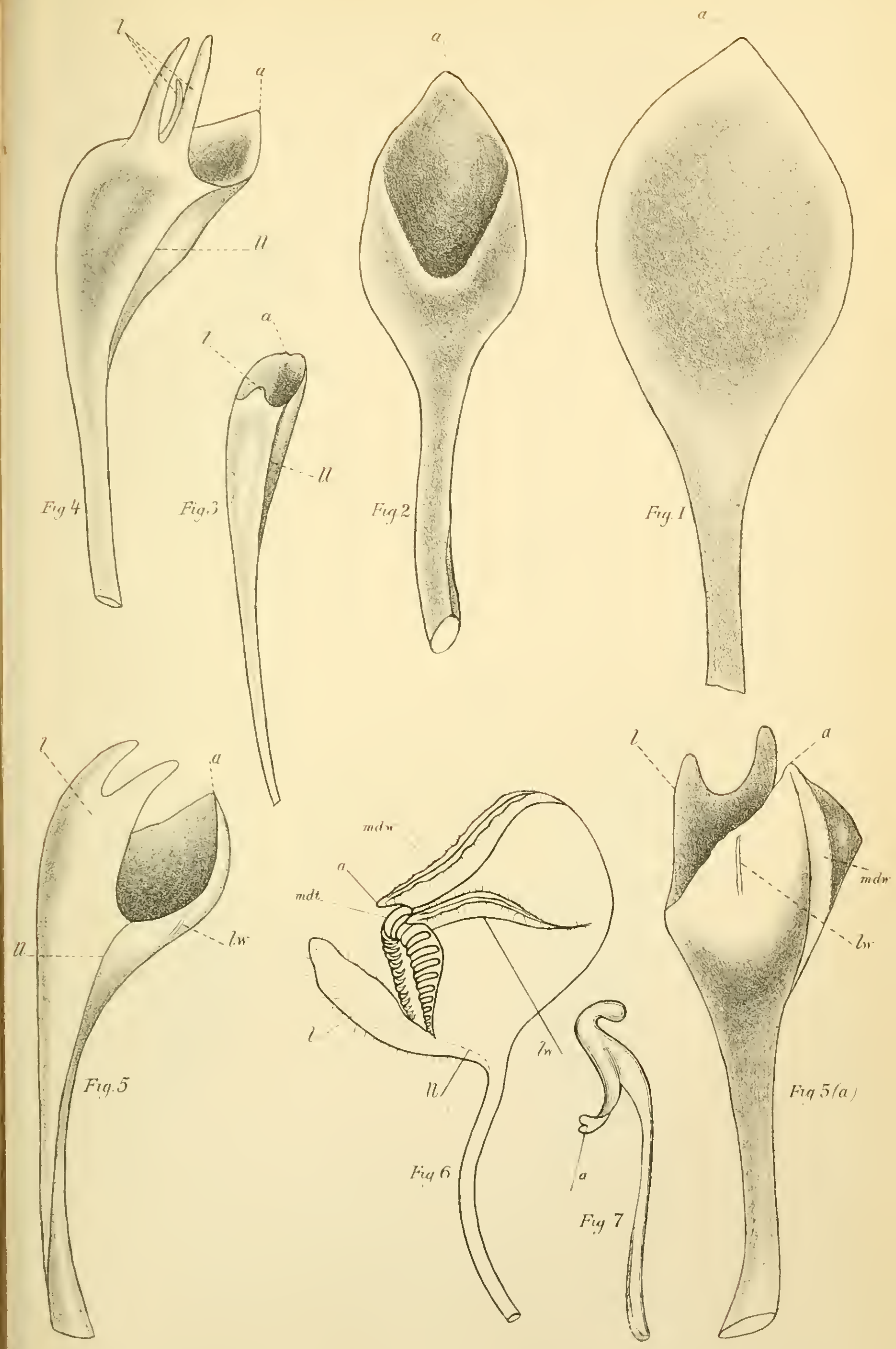


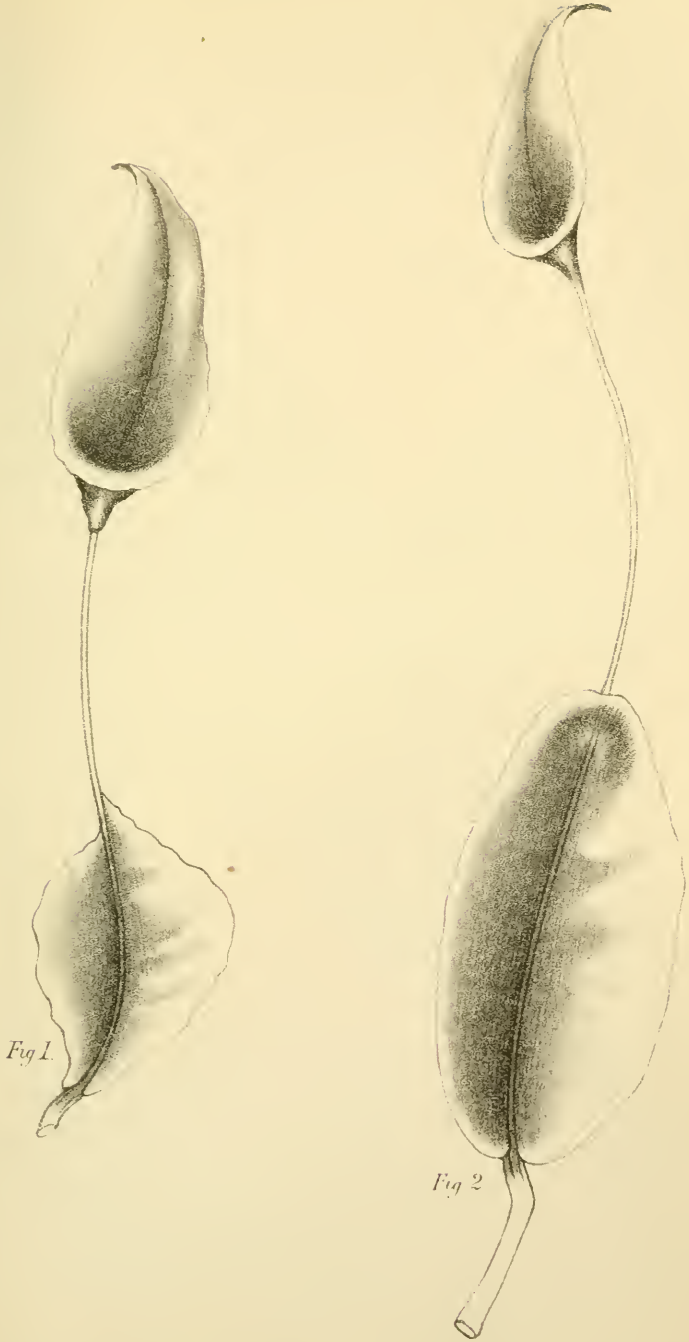


McFarlane & Erskine, Lithrs Edinr

RIVEN OAK. EAST GATE, DRUMMORE.

24TH JULY 1880.


l
a
ll
Fig 4
Fig.3
Fig 2
Fig. I
Fig.5
lw
mdw
mdt.
Fig 6
Fig 7
Fig 5(a)



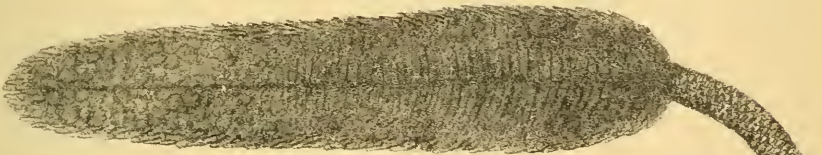
Waterston & Sons Lith^rs Edin^r A. Dickson, del^t

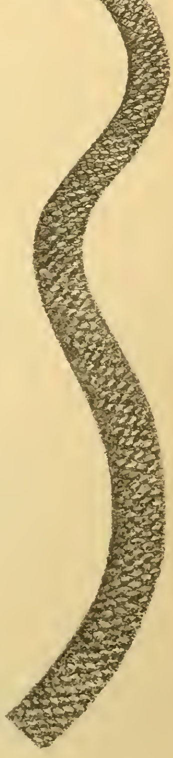
Robt Kidston, del et lith.

Fig. 5ᵃ

Fig. 5ᵇ

Fig 5ᶜ





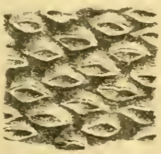


Fig 4 + 3

Fig 2

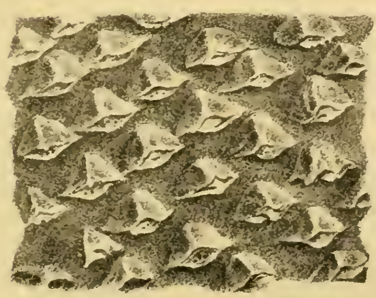
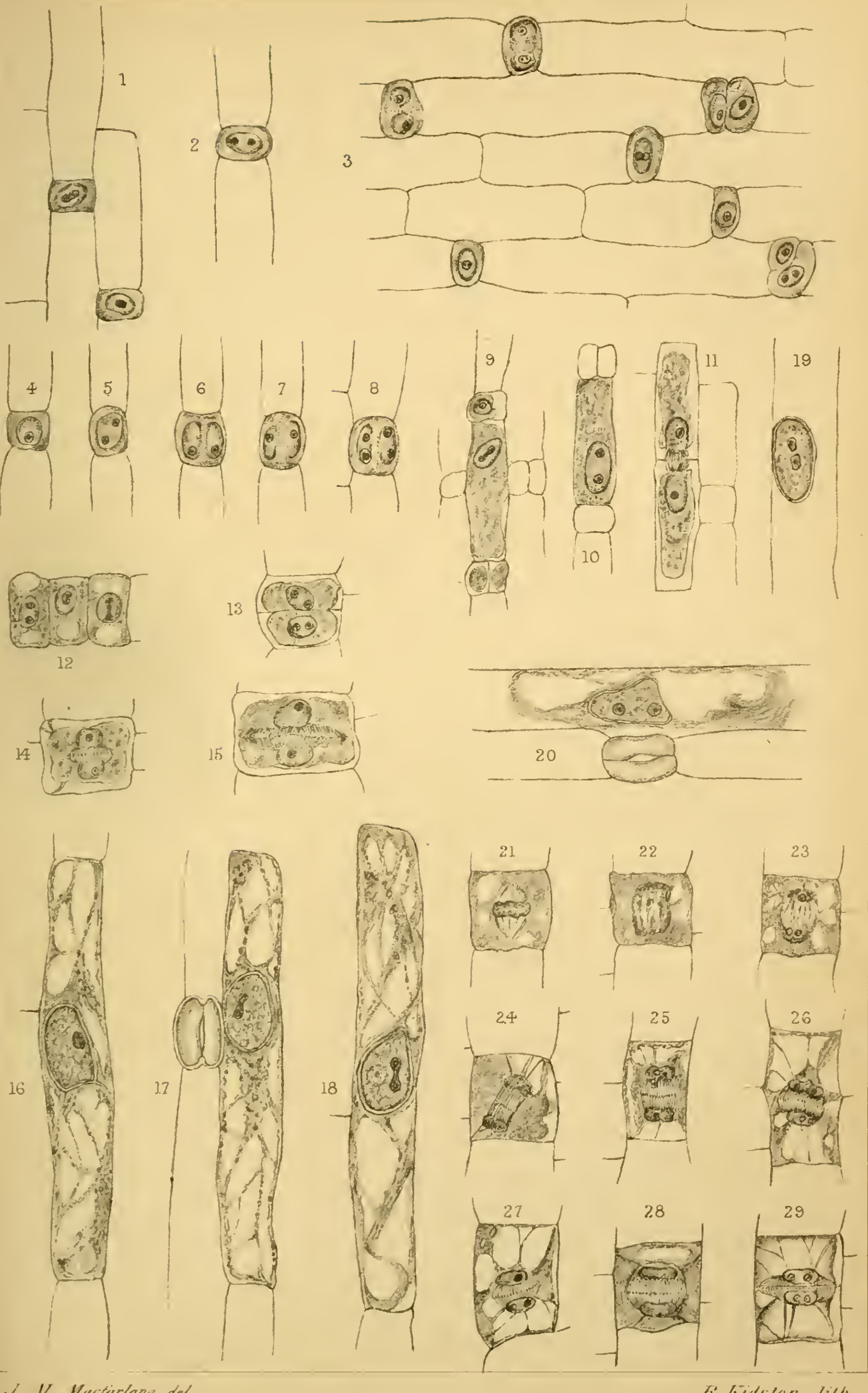


Fig 3.

Fig. 1.

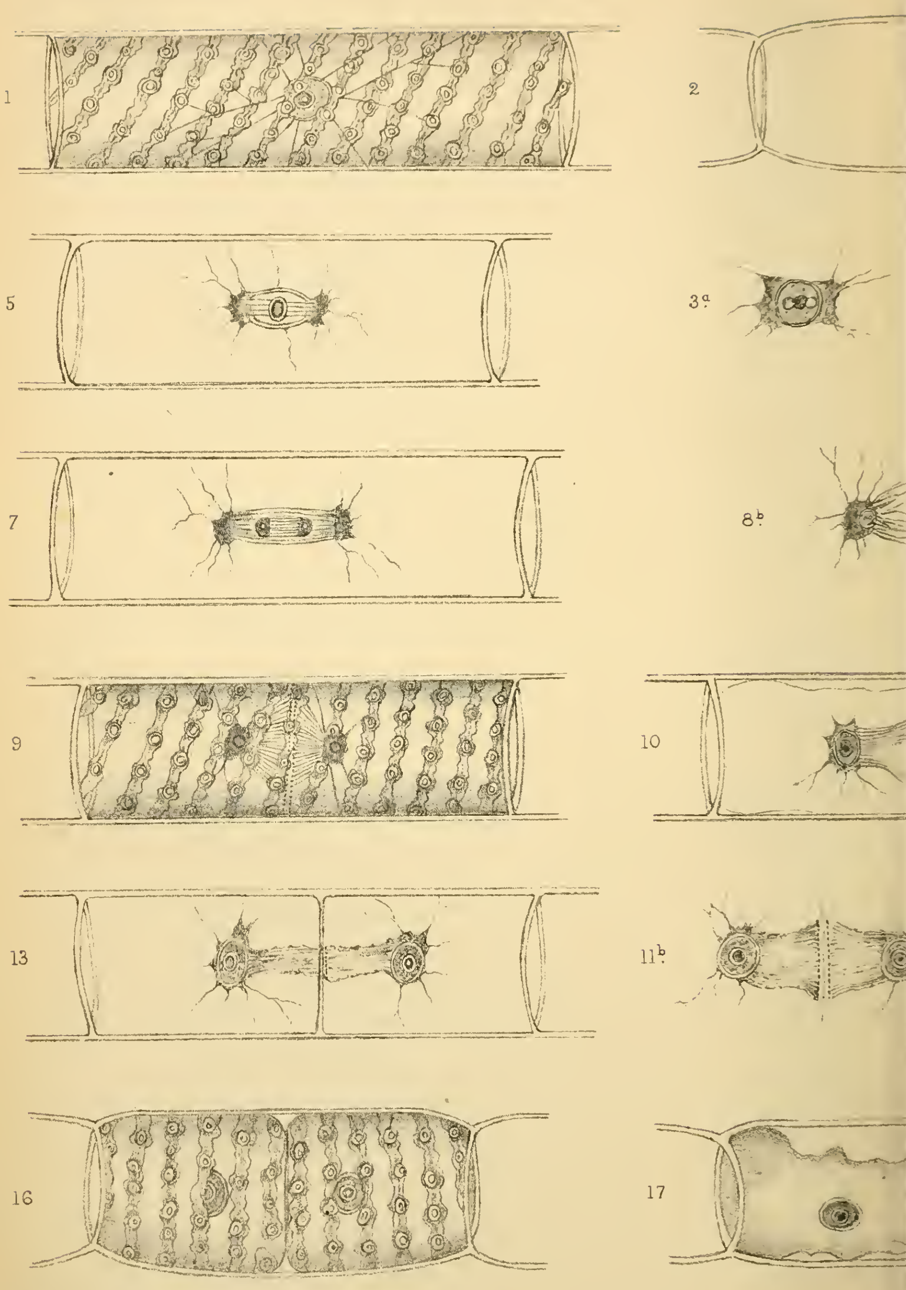
R. Kidston, del. et lith.

LEPIDOPHLOIOS LARICINUM.



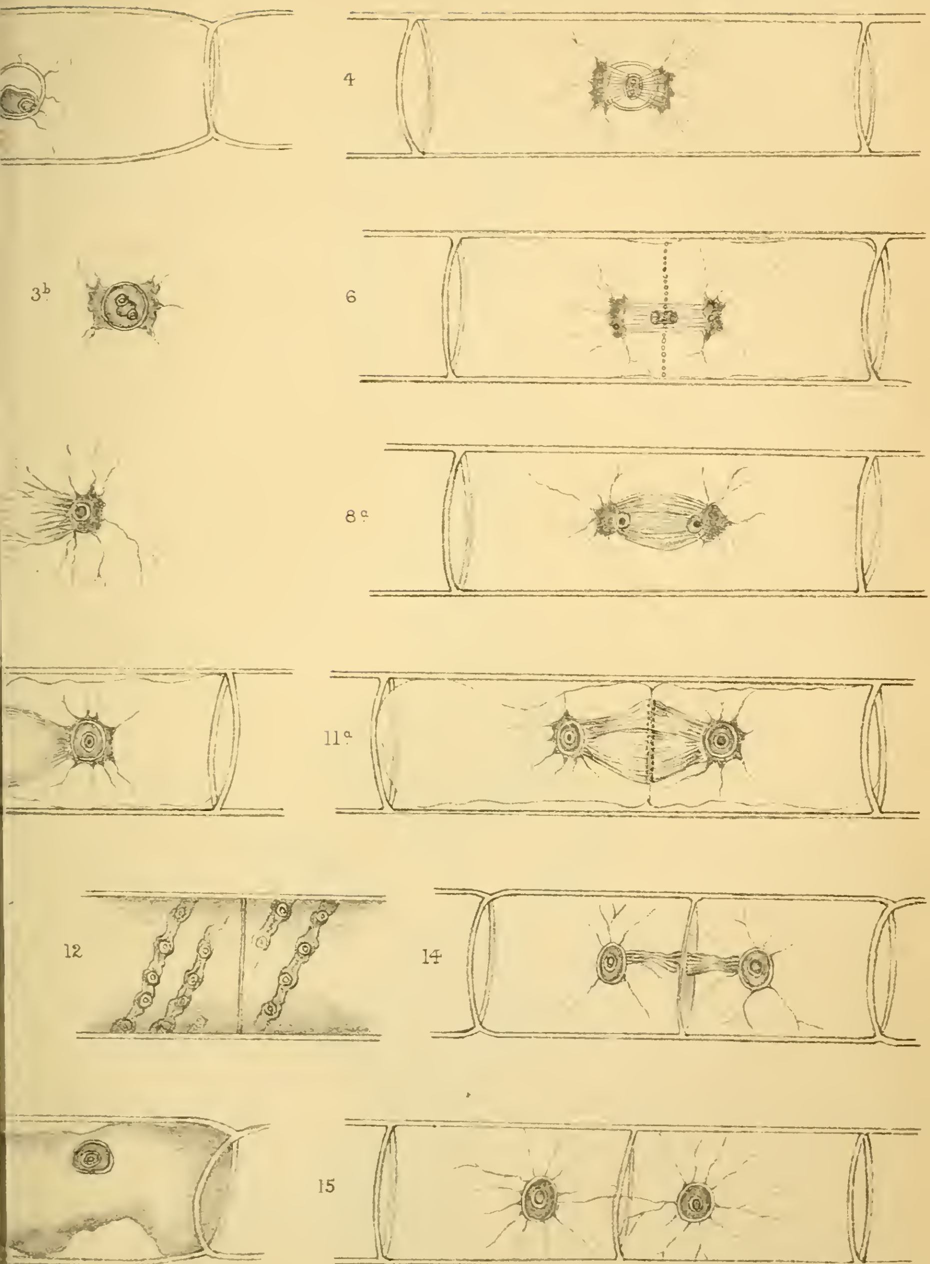
J. M. Macfarlane, del. R. Kidston, lith.

ORNITHOGALUM PYRAMIDALE. L; ETC.



M. Macfarlane, del

SPIROGYR



R. Kidston.

NITIDA (Kg.)

McFarlane & Erskine Lithogrs Edinburgh

KOHL RABI. p 225.

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY.

VOL. XIV.—PART III.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY.
MDCCCLXXXIII.

The Botanical Society of Edinburgh is prepared to make exchanges of plants with Foreign Botanists.

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

A complete copy of the Transactions, to Vol. XIV inclusive, can be had for £8 from the Treasurer.

TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

SESSION XLVI.

10th November 1881.—ALEX. BUCHAN, M.A., F.R.S.E. Vice-President, in the Chair.

The CHAIRMAN made some introductory remarks—

On the Results of Meteorological Observations on the Weather of the last Summer.

AT the outset he showed by statistics that the last decade had been remarkable for the recurrence of periods of cold weather more or less protracted, the last period being that from October 1880 to the present time. From October 1880 to the end of October 1881, there had been thirteen months of continuous low temperature, excepting May, which was above the average. There were no ten years during the last 118 years, except the period from 1780 to 1790, in which there had been so many periods of protracted low temperatures as during the decade from 1872 to the present date. Much had been done in recent years with the view of endeavouring to throw light upon the coming weather—to prognosticate not only for a few days, but for a few months or a season. A great deal had been done in India, and with some success; and Dr Hann, of Vienna, one of the most distinguished of living meteorologists, has shown that when cold weather set in, the longer it continued the less likelihood was there of a change. If the centres of cyclones passed to the south of us in winter, there was cold weather; if to the north, mild weather. It was one of the most difficult and one of the most pressing problems of meteorology to throw light on the causes that determine the paths of storms, on the one hand to the north, on the other to the south of us. The cold weather began in the first week of October last year, the mean temperature of this month being 4°·5 below the average. During the whole of the past 118 years there had been only two colder Octobers than that of 1880. November and December were each 2° below the average. The January that followed was, except in Shetland, Orkney, and the extreme north of Caithness and Sutherland, absolutely the coldest month of which there was any record in Scotland during the past 118 years. In the centre of Scotland, and particularly in the district between the Cheviots and the Lammermoors and Pentlands, it fell in many districts to 4° lower than in any previous month. Hence the great havoc done to the water pipes of houses, the arrangements of which had not been made to resist such a temperature. The greatest cold occurred on the two nights preceding the memorable snowstorm in London on January 16 and 17. The lowest temperature they had any record of occurred at Stobo, Kelso, and Paxton House. At Stobo it was—16° in the protected box; at Springwood, Kelso—15° below zero; and at Paxton House—13°. December 4, 1879, and January 16 and 17 last, were the occasions of the greatest cold that ever was known in the British Islands, and it occurred in that part of Scotland lying between the Cheviots and the Pentlands, which, during the last ten years, had been peculiarly liable to be attacked by severe cold. July was also a remarkable month. The temperature as regards Scotland was very unequally distributed, the lowest being in the south-west of Scotland, and the warmest in the east. He exhibited a map showing the distribution of temperature over the British Islands in July, bringing out this result among others, that in London the heat was about 3° above the average, but at Cork 3°·5 below it. This difference, he stated, turned on what were called anti-cyclones—that was, places where the barometer was higher than all round. Where there were high barometers in summer there was great heat. Thus in the south of England these anti-cyclones remained or succeeded each other so continuously that there was brilliant weather in July, while Scotland was involved in the clouds and cold, wind and rain of cyclones. In the previous year the circumstances were reversed. In August, a disastrous month over the whole of Scotland, the temperature was close on 4° below the average. There were only two colder Augusts in the last 118 years—those of 1782 and 1830. In October also the temperature was very unequally distributed, as was shown by maps exhibited. Mr Buchan also produced maps showing the rainfall over the country for the different months of the year, bringing out in these also interesting results as to the inequalities in the snowfall and rainfall in different districts. He mentioned that by far the heaviest rainfall occurred on the foreshores looking north when the wind was N.E. or E. By taking these differences of temperature and rainfall into account as regards August and subsequent months, an explanation was obtained of how it is that different results as regard the crops occur in different districts. He had no doubt that such results would be put by and by to considerable use in forecasting the yield of the harvest. In conclusion, Mr Buchan remarked that in connection with the last very extraordinary season, the Scottish Meteorological Society were fortunate in having an observer (Mr Wragge) on Ben Nevis.

The following Statement respecting the membership of the Society was read:—

Honorary Fellows.

Royal Personages, ...	4
British Subjects, . . .	6
Foreign, ...	21

Foreign and Corresponding Members, .	69

Ordinary Fellows elected during 1880–81.

James Brebner.
Patrick Geddes.
John M. Macfarlane.
Angus Alexander M'Leod.
John Whyte.
John C. Pottage.
James M. Anderson, S.S.C.
James Galloway.
James Alexander, Jun.
George Murray.
William E. Dixon.
Frank Curwen Beddard.
William Ivison Macadam

Non-Resident Fellows.

Robert Halliday Gunning, M.D.
Daniel Scott.

Members resigned, ...	3
Members deceased, ...	5

Total Number on Society's Roll of Fellows.

Resident, ...	155
Non-Resident, ...	221
Lady Associates, ...	10
Associates, ...	30

Obituary Notice of Sir Robert Christison, Bart. By John Hutton Balfour, M.D., Hon. Sec.

(Read 9th February 1882.)

We have to record this night the death of one of our most distinguished members, Sir Robert Christison, Bart. This event took place on Friday, 27th January 1882.

Robert Christison was born on 18th July 1797. His father filled the Chair of Humanity in the University of Edinburgh from 1806 to 1820. He was educated at the High School of Edinburgh, and afterwards prosecuted his studies, literary, classical, and medical, at the University of Edinburgh, commencing in 1811. He received the degree of M.D. in 1819. His twin brother was the late minister of Foulden, in Berwickshire. His elder brother, John, who is now also dead, was an Advocate in Edinburgh.

Before practising in Edinburgh, Dr Christison prosecuted his medical studies in London and Paris. In the latter city he had the opportunity of studying chemistry under Robiquet, and toxicology under Orfila. During

Christison's residence in Paris the following eminent "Pharmaciens" (thus entitled) were in the French School of Pharmacy, viz., Pelletier, Caventou, Desfosses, Lasaigne, Robert, Henri, Guibourt, Braconnot, Chevalier, Vauquelin, Robinet, and others.

On his return from the Continent of Europe he commenced medical practice in Edinburgh as a physician. In 1822 (when 25 years of age) he was appointed by the Crown Professor of Medical Jurisprudence in the University of Edinburgh as successor to Dr Alison. In 1823 he became a Fellow of the Royal College of Physicians, Edinburgh.

Christison married in 1827 Henrietta Sophia, daughter of Mr David Brown of Greenknowe, Stirlingshire. Mrs Christison died in 1849. Three sons were born of this marriage; the eldest, Alexander, born in 1828, now a Deputy-Surgeon General in the Bengal Army, succeeds to the baronetcy.

In 1829 Dr Christison published his excellent *Treatise on Poisons*, and was immediately recognised to be one of the most eminent of toxicologists. His opinion of the duty of a toxicologist at a trial is well given in the *Pharmaceutical Journal*. In reference to trials before the high criminal court, he remarks as follows:—"While the medical witness ought to be always prepared to give full effect to every medical circumstance favourable to the prisoner, he should at the same time recollect that very few trials indeed take place in Britain, where it is not in the highest degree probable that poison was given; and consequently that the main purpose of his inquiries must be to bring together the whole medical evidence to this effect, and to secure it against the doubts which the ingenuity of counsel is sure to throw over his conclusions, if the premises are anywhere false or defective."

In 1832 he vacated his Jurisprudence Professorship, having been elected to the chair of Materia Medica in the University, then vacant by the death of Dr Duncan, junior, and he kept this position till 1877, when he retired on account of the state of his health. He also discharged clinical duties in the Infirmary during most of his long professional career.

Christison was a distinct and successful lecturer, and the excellent museum which he founded in connection with his chair has contributed much to the study of Materia Medica. As a member of the Senatus Academicus, he was elected five times in succession by his colleagues to be their Assessor in the University Court. He was most untiring in his efforts to advance the interests of the University, whether in providing more building accommodation or in obtaining greater endowments. On two occasions, in 1838 and 1846, he was elected President of the Royal College of Physicians, and that body commissioned his portrait to be taken by the late Sir John Watson Gordon. About this time he was appointed Physician to the Queen. In 1857 Christison was nominated by the Crown to represent the profession in Scotland at the General Medical Council. On the death of Sir David Brewster he was elected President of the Edinburgh Royal Society, and held office from 1868 till 1873. At the close of his term, his portrait in oil was again commissioned to be taken for preservation in the hall of the Society. In 1875 he presided over the Edinburgh meeting of the British Medical Association. He was also proposed as President of the British Association in 1876, but declined an honour which threatened to overtax his strength at his time of life. In 1866 the University of Oxford conferred on him the degree of D.C.L.; and in 1871 the University of Edinburgh made him an LL.D.; while in November of the same year, on the recommendation of Mr Gladstone, he received from the Queen the rank of Baronet of the United Kingdom.

The jubilee of his professorial service in the University of Edinburgh was celebrated on the 23rd February 1872.

During his retirement from active work, Christison became specially interested in the growth of trees in various parts of Scotland and in the Edinburgh Botanic Garden. His sons, as well as Mr Sadler, assisted him much in his various measurements, which have been published in the *Transactions of the Botanical Society.* It is to be hoped that these observations, especially in the Botanic Garden, will still be continued, and the results periodically published.

Professor Christison took a deep interest in poisons, as shown in his published volume, and he made many experiments on their action and preparation. He sometimes went too far in making experiments on himself, of which the following occurrence, in reference to the Calabar bean (*Physostigma*), furnishes a remarkable instance. In the course of some experiments which he was making on this bean, not at that time ascertained to be poisonous, he brought home with him a piece of a bean, and finding it to be neither bitter nor acrid, he chewed a considerable portion. Soon, however, symptoms of poisoning came on, he immediately emptied his stomach by swallowing his shaving water, and he was only with difficulty saved by remedies applied by his friends Professors Simpson and Maclagan.

He was summoned as a scientific witness in the trials of Burke and Hare in Edinburgh, in that of Palmer in London, and, indeed, for many years in all important criminal cases of poisoning. In referring to such trials, the Lord Justice-General stated that Dr Christison was, perhaps, the only man he had ever met with in open court who refused to be brow-beaten by counsel endeavouring to undermine his evidence.

In 1861 Christison was elected Captain of the University Volunteer Corps. At the celebration of his professorial jubilee in 1872, his corps presented their chief with a valuable sword, at the same time emphasising the watchful care with which he had discharged his regimental duties, and his constant supervision of the drill.

Sir Robert was fond of music, and Sir Herbert Oakeley has well shown the opinion he entertained of Christison's musical tastes, in publicly speaking of the great loss which his decease had caused to Edinburgh, and especially to its University Musical Society.

As for myself, I cannot speak sufficiently of the happy days I have spent with him in the Botanic Garden. I have lost one who was also a kind physician to me during illness. *Requiescat in pace.*

Within little more than twelve months we have had to lament the loss of three important medical men in

Edinburgh—Dr Andrew Wood, Professor Sanders, and Sir Robert Christison; and I have the painful reminiscence that all the three who attended me during my serious illness of two years' duration are now departed.

The following is supplied by Mr TAYLOR:—

Dr Christison joined our Botanical Society on July 14, 1836,—just four months after its foundation,—and at once displayed that active interest on its behalf so much appreciated by all of us during his latter years. His work, as recorded in our Minute-books and Transactions, may be looked at under the following heads:—first, official service in the Council and in the President's chair; secondly, communications more or less in the line of his professional studies; thirdly, contributions mainly of botanical observations made during vacation tours; and fourthly, special papers on dendrology and dendrometry. We are also indebted to him for numerous donations to the Royal Botanic Garden, and to its associated Herbarium and Museum.

Professor Christison was elected a Vice-President in 1837–38, and from that time till 1853 he held office of some kind. He demitted his Vice-Presidentship in 1840, but Mr Daniel Ellis, F.R.S.E., his successor, having suddenly deceased, Dr Christison resumed office in March 1841, at the unanimous request of the Society, and was made President at next election. The Minute-books of those times show continuous well-directed effort, in regulating the affairs of the Library and Museum, in obtaining the Society's act of incorporation from the Town Council of Edinburgh, in effecting the housing of the Herbarium and Library within the walls of the University, and in introducing the innovation of tea after our evening meetings. A blank of such services appears from 1853 till the close of December 1873, when the new baronet was elected President, an office which he continued to hold for three successive sessions. Sir Robert Christison's name stood first in the present Council list.

Professor Christison's early communications, all short and pointed, whether papers or remarks made at discussion time, were chiefly in the line of his special branch of academic teaching. In 1837 he is reported as having given aid in conducting experiments by Dr Douglas Maclagan on a new root (Hiarry) from Demerara, used by the natives for intoxicating fish. And in 1838, after a paper by the late Rev. Dr James Hamilton, D.D., "On the Gardens of the Ancient Hebrews," Professor Christison presented "Some Observations on the Preservation of Fruits and other Botanical Specimens in the Moist State." A concentrated solution of common salt made with the aid of a boiling heat was recommended, and specimens thus preserved for one, three, or five years were exhibited. At the same time dilute pyroligneous acetic acid of a density 1008 was shown to be most suitable for pulpy fruits. This, with the well-known paper by Dr Greville on drying plants, read subsequently, was afterwards published by the Society as a separate pamphlet. In 1842 * Professor Christison called attention to the Assam tea plant, then a novelty of commerce, showing that different kinds of tea were produced by different modes of preparation. He showed by a set of examples of the preserved tea leaf, that the various forms were merely varieties of the same plant. The Society was also asked to inspect small rolls of tea sent twenty years previously as a present from the Emperor of China to King George IV. Again, in 1868, † Professor Christison directed notice to the physiological effect of the juice of *Scopolia lurida*, Dun. (*Anisodus luridus*, Link), in dilating the pupil of the eye to a great extent. In his own eyes dilatation so produced was visible for eight days. This remedy was a valuable addition to the Indian Pharmacopœia. In a communication laid before us in February 1871, ‡ Dr Christison related that somewhere between 1838 and 1842 he had memorialised the Board of Directors for India to introduce the Cinchona culture into that country. Even then the American forests of this valuable tree were being wasted, while the demand for the Cinchona alkaloids was so steadily increasing that the tree could apparently be successfully grown on great tracts of Indian waste lands at a remunerative profit. Though it was strongly backed by Dr Royle, the directors took no action

* Sixth, Seventh, and Eighth Reports, p. 25.

† *Trans. Bot. Soc. Edin.*, vol. ix. p. 482.

‡ *Ibid.*, vol. xi. p. 110.

on this memorial. The paper on the restorative and preservative virtues of the Peruvian cuca or coca-leaf (*Erythroxylon Coca*) in bodily fatigue from severe exercise,* is still a subject of popular conversation. The narrative of the ascent of Ben Vorlich by the experimentalist, quite out of the habit of much exercise for five months, and carrying the weight of seventy-eight years, together with its side hints of previous athletic performances, mark the unique nature of this most vividly interesting communication. Under this head also falls the paper "On the Botanical Source of the Turkey (or Russian) Rhubarb-root of Commerce";† also, the "Notice of a Polyporus from Canada with specimens."‡

The presidential addresses of 1874 and 1875, one "On the History of the Edinburgh Botanic Garden,"§ the other "On a Visit to Lochearnhead,"‖ well represent the nature of Sir Robert Christison's papers on general botany. There are also several notices by him of remarkable beeches and crab-apple trees at Eccles House,¶ Newbattle,** and Kelloe,†† as well as "On a Station for *Primula veris* in Coldingham Bay, Berwickshire."‡‡

The paper "On a Tree struck by Lightning,"§§ one of several on this subject, applies the skilled diagnosis of the consulting physician to such arboreal destruction. The research into "The Exact Measurement of Trees" extends over five papers; ‖‖ it indeed occupied Sir Robert's attention in his last illness. Beginning with an inquiry into the true age of the Fortingall yew, the first paper exposes the error of De Candolle's rule for measuring the age of old and middle-aged trees, after their first season of rapid and irregular growth, by decades of years; and then goes on to particularise a special method of dendrometry. The second paper attempts to fix the rate of growth of the adult beech and the young *Sequoia*, so far as the measurements of a single year go. While the third paper concerns the rate of growth

* *Trans. Bot. Soc. Edin.*, vol. xii. p. 478.
† *Ibid.*, vol. xiii. p. 403.
‡ *Ibid.*, vol. xii. p. 180.
§ *Ibid.*, vol. xii. p. 189.
‖ *Ibid.*, vol. xiii. p. 395.
¶ *Ibid.*, vol. xii. p. 110.
** *Ibid.*, vol. xii. p. 179.
†† *Ibid.*, vol. xii. p. 186.
‡‡ *Ibid.*, vol. xii. p. 46.
§§ *Ibid.*, vol. xii. p. 497.
‖‖ *Ibid.*, vol. xii. p. 497; vol. xiii. p. 217; vol. xiii. p. 394; vol. xiii. p. 410; vol. xiv. p. 79.

of the yew at various ages, concluding with special application to the Fortingall yew, according to De Candolle, "the most venerable specimen of vegetation in Europe." Two subsequent memoirs diverge into inquiries suggested by the recent abnormal seasons. And though death has arrested the original work of the venerable author of this new mode of dendrometry, other hands have taken it up, both in India and Scotland, with rich promise. Sir Robert also took an active part in the annual autumn meetings of the Scottish Arboricultural Society, having joined in 1876.

Sir Robert Christison's donations to the Museum at the Royal Botanic Garden, especially in the line of his new method of tree measurement, were very numerous. The uniquely beautiful printed labels, done by himself when over eighty years of age, at once attract the eye. His last contribution to the Herbarium, given so late as 7th October 1881, testifies partly in German, partly in Romaic print, that the specimen in question of *Allosorus crispus*, was gathered in Corry-na-Ciste, Ben Nevis, 3250 feet above the sea-level, at the foot of the great precipice, on August 29, 1881. This specimen was brought to him by his sons. At that time his strength was unequal to so arduous an exertion. But only two years previously, when, in his eighty-second year, he made the ascent of Ben Vrackie, near Pitlochry, without much fatigue.

Mr Sadler remarks that Sir Robert Christison, for some years past, took a great interest in the growth of certain trees in the Botanic Garden and Arboretum. These he had marked at a certain height from the ground and numbered by means of white paint, hence his periodical measurements of them were always taken at the same place, and duly recorded in a book which he kept for the purpose. These measurements will be continued and recorded in the same book, and thus become valuable for reference in after years. Near the entrance gate to the Botanic Garden, Sir Robert, in July 1861, planted a healthy young plant of *Sequoia* (*Wellingtonia*) *gigantea*. It was then a little over 6 feet in height. About eight years ago it unfortunately lost its leader, which was quickly succeeded by another. On having it accurately measured in September last, or over twenty years since it was planted, its height was found to be $24\frac{1}{2}$ feet, circumference at 3 feet from ground 47·50 inches, and at 5 feet 41·50.

Mr Alexander Buchan makes the following remarks:— Only a few days before Sir Robert Christison's illness, he called at the office of the Scottish Meteorological Society, and in the course of conversation mentioned that the Directors of the Highland and Agricultural Society had asked him to furnish them with a paper on the measurement of trees, with directions for the guidance of observers. About a year ago Sir Robert prepared a similar paper for the Council of the Meteorological Society, and as that paper was in type, I offered to forward a proof of it to Moray Place. The offer was declined, Sir Robert preferring to write, quite independently, the paper for the Highland and Agricultural Society. The paper, written during his last illness in his usual small and beautifully distinct hand, was drawn up with a clearness, directness, and precision equal to his best days, and showed that, though physically prostrated, his mental faculties and steadiness of hand were retained in unimpaired vigour. After revising the proof of this paper, he asked for a proof of the paper prepared for the Meteorological Society, which he finally revised, this being the last literary work done by him.

During the last three years Sir Robert paid particular attention to the effects of the memorable frosts of December 1879 and January 1881, as shown in the destruction of forest trees, one of the chief objects in view being to ascertain what trees pass uninjured through periods of such low temperatures as the experience of these winters shows to occur in our Scottish climate. The Hungarian oak was especially noted by him as coming unscathed through great frosts, and for these reasons was strongly recommended to be more extensively introduced into this country than has yet been done. During his last illness he asked me to prepare for him a statement of the climate, particularly the winter temperatures, of the districts of the Carpathian Mountains which are the habitat of this oak, but his death took place before there was time to collect the data required.

The following bibliographical list includes most of Sir Robert Christison's printed works:—

Volumes.

Treatise on Poisons—1st ed., 1829; 2nd ed., 1831; 3rd ed., 1836; 4th ed., 1845.

Treatise on the Kidneys. 1839.

Dispensatory—1st ed., 1842; 2nd ed., 1848.

Articles "Poison" in 7th ed., and "Orfila" in 8th ed., *Encyclopædia Britannica.*

Christison rendered assistance in the *Edinburgh Pharmacopœia*, and also for some time in the editorial work of the *Edinburgh Medical Journal.*

Papers read before the Royal Society of Edinburgh.

On the Effects of Poisonous Gases on Vegetation. By Edward Turner and R. Christison. 1827 or 1828.

Poisoning with Opium. Poisoning with Elder Flowers and Leaves. 1830.

Analysis of the Vegetable Milk of the Hya-Hya Tree of Demerara. 1830.

Chemical Examination of the Petroleum of Rangoon. 7th Feb. 1831.—*Trans.*, vol. xiii. p. 118.

On the Effects of Opium Eating on Health and Longevity. 1832.

Lettre sur différentes Sortes d'Opium. 1835.

On the Poisonous Properties of Hemlock and its alkaloid Conia. 1836.—*Trans.*, vol. xiii. p. 383.

On the Sources and Composition of Gamboge, with an Examination of some analogous Concrete Juices. 1836.—*Proc.*, vol. i. p. 123.

Notices regarding the Composition of Juices resembling Gamboge. —*Proc.*, vol. i. p. 151.

Notice upon the Alcoholic Strength of Wines. 1839.—*Proc.*, vol. i. p. 249.

Exhibition of Specimens of Tea from Assam. 1842.—*Proc.*, vol. i. p. 382.

On the Action of Water on Lead. 1842.—*Proc.*, vol. i. p. 358.

Observations of the Poisonous Properties of *Œnanthe crocata*. 1844.—*Proc.*, vol. i. p. 453.

On the Composition of Bones from Arthur Seat. 1846.—*Proc.*, vol. ii. p. 88.

The Influence of various circumstances in Vegetation in modifying the Physiological Actions of Plants. 1840–43.—*Proc.*, vol. i. pp. 286, 437.

On Scurvy: its connection with a purely Saccharo-farinaceous Diet. 1847.

Observations on a new variety of Gamboge from Wynaad, Mysore. 1847.—*Proc.*, vol. ii. p. 58.

Supplement to the Paper of Mr Robert Little on the Habitual Use of Opium, more especially the Mode of Cure. 1850.

On the Gamboge Tree of Siam. 1850.—*Proc.*, vol. ii. p. 263.

An Account of some Experiments on the Diet of Prisoners. 1852.—*Proc.*, vol. iii. p. 130.

On a new Source of Kino. 1853.

On the Properties of the Ordeal Bean of Old Calabar. 1855.—*Proc.*, vol. iii. p. 280.

On a new Poison from China. 1859.—*Proc.*, vol. iv. p. 163.

On the Capture of Whales with the aid of Poison. 1860.—*Proc.*, vol. iv. p. 270.

Opening Address—Sessions 1867, 1868, 1871, 1872.

Notice of a remarkable Mirage observed on the Firth of Forth. 1869.—*Proc.*, vol. vi. p. 472.

Observations on the Fresh Waters of Scotland. December 1871. —*Proc.*, vol. vii. p. 547.

On the Action of Water on Lead. 1872.—*Trans.*, vol. xv. p. 265.

Note on a White Sunbow.—*Proc.*, vol. ix. p. 542.

On the Composition of the Flesh of the Salmon in the "clean" and "foul" condition. April 1872.—*Proc.*, vol. vii. p. 694.

On Fossil Trees of Granton Quarry. 1871–72.—*Proc.*, vol. viii. p. 377.

Notice of Fossil Trees lately uncovered at Craigleith Quarry. 1872–73.—*Trans.*, vol. xxvii. p. 203.

For Papers read to the Botanical Society of Edinburgh, *vide* pages 271 and 272 previously.

Pamphlets.

Biographical Sketch of Edward Turner, M.D.

A Paper on Granular Degeneration of the Kidney, in 1839.

The Dispensatory: a Commentary on the Pharmacopœias of Great Britain, in 1842.

On Poisoning by Oxalic Acid. 1823.

On the Detection of minute Quantities of Arsenic in Mixed Fluids. 1824.

Accounts of several cases of Poisoning in the *Medico-Chirurgical Transactions*—

> Medical Evidence in the case of Mrs Smith.
>
> Cases and Observations in Medical Jurisprudence.
>
> Cases of Poisoning with Sulphuric Acid, and cases of Poisoning with Arsenic, Opium, and Elder Flowers.
>
> On Poisonous Properties of the Bark of Laburnum.
>
> On the Effects of Opium. 1832 and 1870.

On the Constitution of Oil. 1825.

On the cause of Milky and of Orange-like appearance of Urine. 1830.

On a variety of Dropsy. 1829.

On Typhoid Fever. 1846.

On a variety of Gamboge. 1846.

On Scurvy. 1846, 1847.

Observations on the System of Clinical Instruction in the Royal Infirmary of Edinburgh. December 9, 1848.

Clinical Lecture on Bright's Disease of the Kidneys. March 11 and 18, 1851.

On Medical Evidence. 1851.

Experiments on the Diet of Prisoners. 1852.

On the Effect of Cuca or Coca: the Leaves of *Erythroxylon Coca.* 1876.

Address on Public Health, delivered to the Association for the Encouragement of Social Science, held in Edinburgh, October 7, 1853.

On the Distribution of Fever Patients in Hospital. 1850.

On the Changes in the Constitution of Fevers and Inflammations in Edinburgh. 1858.

An Address on Therapeutics, delivered at Twenty-sixth Annual Meeting of the Medical Association in Edinburgh. 1868.

On some of the Medico-Legal Relations of the Habit of Intemperance, read to the Royal College of Surgeons. 1861.

Medical Lectures: The Faults with which they are charged, and the Remedy. 1862.

Action and Uses of Alcohol in Health and Disease. 1878.

Obituary Notice of Sir C. Wyville Thomson. By Emeritus Professor BALFOUR.

(Read 13th April 1882.)

Sir Charles Wyville Thomson was born at Bonsyde, near Linlithgow, on the 5th of March 1830. His early studies were prosecuted at Merchiston Castle Academy, under the superintendence of Mr Charles Chalmers. In 1845 he commenced his medical studies in the University of Edinburgh. But he soon stepped aside into the special pursuits of Natural Science. In 1847 he joined the Botanical Society; and soon after became Secretary of the Royal Physical Society. In 1850 he attended my class of botany in the University of Edinburgh. In the same year he obtained a Lectureship of Botany in King's College, Aberdeen; and in the following year he was appointed Professor of Botany in Marischal College and University. He afterwards received the degree of LL.D. from the University of Aberdeen. The subject of Natural History in its various departments was his study; and even at that period of his career he became an eminent specialist in these subjects.

A vacancy having occurred in the Professorship of Natural History in Queen's College, Cork, Thomson was appointed to the office in August 1853. Soon after, however, a vacancy occurred in the Professorship of Mineralogy and Geology in the Queen's College, Belfast, and Wyville Thomson was transferred to it in September 1854. He then taught all the branches of Natural History during a long residence at Belfast. During this period he also distinguished himself by many excellent papers on Zoology and Geology,—which were read at the meetings of the Royal Society of London, and were published in the *Philosophical Transactions*, the volume for 1865 bearing special evidence to Thomson's powers as a naturalist. He also took a deep interest in the Paris Exhibition for 1867, of which he was a Vice-President. He was elected a Fellow of the Royal Society of London in 1867.

In 1868 Dr Carpenter, one of the Vice-Presidents of the Royal Society of London, induced Thomson to join with him in the first deep-sea dredging expedition. For this purpose Government gave the use of the surveying ships the "Lightning" and the "Porcupine." Thomson gave the results of these researches in a handsome octavo, entitled *The Depths of the Sea.*

On the resignation of Professor Allman in 1870, Thomson was elected his successor in the Professorship of Natural History in the University of Edinburgh. He efficiently discharged his new duties until he became the scientific chief of the "Challenger" Expedition in 1872, which necessitated his absence from Britain for $3\frac{1}{2}$ years, and a world oceanic traverse of 68,189 miles, during which systematic observations were made at 362 stations in the open sea ; the results of which are only now being published, so far as yet elaborated.

Dr Thomson was elected President of this Society for the Session 1871–72, and opened our thirty-seventh Session with an interesting address.* On his returning to Edinburgh from his oceanic world voyage, Thomson was made a Vice-President for the Session 1876–77, during which he delivered an opening address in lieu of Sir Robert Christison, Bart., then an invalid.† He continued on our Council till his death.

Abundant honours also followed his return from the "Challenger" Expedition in 1876. Amongst these was a knighthood, and the award of one of its gold medals by the Royal Society of London. He was also, with his scientific staff, entertained at a public banquet in Edinburgh. He accompanied me to Upsala, as a representative of the Senatus Academicus of the University of Edinburgh, on the occasion of the Quartcentenary of the ancient University of Upsala, when the King of Sweden created him a Knight of the Order of the Polar Star. I also received a Royal Gold Medal.

A writer in the periodical entitled "*Nature*" thus remarks :—

"After his return in 1876 from the voyage of the 'Chal-

* *Trans. Bot. Soc.*, vol. xi. p 401.

† *Ibid.*, vol. xii. p. 115.

lenger' Expedition, it was remarked that his long spell of travel had not brought increased physical vigour; but it was not until 1879 that his condition gave his friends serious cause for uneasiness. In June of that year he was prostrated by an attack of paralysis, and unable to conduct his class of Natural History in the University of Edinburgh, and the important undertaking in which he was engaged, of directing the working out of the 'Challenger' researches, with the view of furnishing to the world a complete record of the results, had to be laid aside, only to be intermittently touched again before the time came when he had to resign it entirely into other hands. In October last he resigned his chair in the University, and arrangements had just been completed by the Senatus in respect to his retiring allowance. Some four months ago he had a second paralytic attack, and since then his health has been feeble. He died on Friday morning, 10th March 1882, at three o'clock.

"The departments of zoology to which he devoted most attention were those which included the corals, crinoids, and sponges, and upon these his opinion was regarded as of great weight. In the University he was held in esteem by his colleagues of the Senatus, and among the students he was exceedingly popular. In private life he was regarded by his friends as possessed of a kindly and hospitable disposition.

"Sir Wyville Thomson married a sister of the late Mr Adam Dawson of Bonnytoun, Linlithgowshire, for some years Provost of Linlithgow, whose father also occupied the same honourable position for the greater part of his life. He is survived by Lady Thomson and one son, an M.A. of the University of Edinburgh, who is at present engaged in his study of law."

Besides the Presidential Addresses above referred to, Sir Charles W. Thomson has made the following communications to the Botanical Society:—

1. "On some Scotch Fresh Water Algæ, found in the West of Scotland, and specially Ayrshire." December 1849.

2. "On Lichens collected near Kilcreggan, Argyllshire, during the Summer of 1850." March 1851.

3. "On the Analogy between the Processes of Reproduction in the Plant and in the Hydroid Zoophyte." July 1854.

4. "Notes on the Character of the Vegetation of Fuegia and Southern Patagonia." May 1877.

Since this notice was read to the Society, the Commissioners of Supply for the County of Linlithgow unanimously passed a minute of condolence with Lady Thomson and her son. The meeting further agreed to set on foot a Committee charged to take steps to rear a monument to Sir Wyville Thomson in his native parish, and probably to take steps also to perpetuate his name in some suitable way in connection with the University of Edinburgh. At this meeting Mr Chalmers thus spoke of his lamented fellow-commissioner and former pupil at Merchiston Castle School:—

"When a boy he was a universal favourite with his school fellows, and was highly esteemed by his teachers for his conscientious discharge of every duty. In his riper years every one who was favoured with his acquaintance and friendship can bear testimony to the delightful urbanity of his manner, and his charming social qualities. He was no pedant; he never bored people with his scientific lore; but whether at his own table entertaining guests, or joining in the innocent hilarities of a garden or lawn-tennis party, he was remarkable for the pleasantry and geniality of his conversation. At the same time, if one introduced any scientific subject, or wished information, he was ever ready to impart it, and entered into the question *con amore*. . . . When at home, and even after his return from the Challenger expedition, when, owing to the vast amount of work he had on hand, under the burden of which his health and strength too prematurely gave way, he might have been excused from attending our meetings, and those of the Justice of Peace Courts, he was found invariably at his post if his health permitted; and it is with melancholy regret I recall the last public occasion on which he presided on the bench, on the 22nd of February last, just sixteen days before his death, spending two or three hours in trying some comparatively trifling cases. On my return home from court that day I found his medical man calling at my house, and on my mentioning that Sir Wyville had been presiding at the court, Dr Hunter shook his head, and said he ought not to have been there. His fears were, alas! too soon realised. On the morning of the Fiars Court day, the 10th of March, he was called away to another world and land at rest. . . . It was a real pleasure to meet him in his own home. So universally known among men of science, one frequently met there men of the highest distinction in all the varied departments of natural history. One met, however, men of very varied opinions at his hospital board, and on rare occasions some of the more *advanced* (I would call it *retrograde* school) so far forget themselves, foolishly estimating their knowledge on all subjects by their acknowledged attainments in science, as to assail the impregnable fortress of our Christian beliefs, whose bulwarks are surely founded on historic events, the truth of which cannot be gainsaid. On such occasions Sir Wyville never by word or assent gave countenance to such assaults."

Obituary Notice of Professor George Stoddart Blackie, M.D. By John Sibbald, M.D., F.R.S.E.

(Read 9th February 1882.)

Dr Blackie was born on the 10th of April 1834 in Aberdeen. He was one of a family of fifteen children, five of whom survive. One of these, a half brother to the subject of this notice, is the distinguished Professor of Greek in Edinburgh University.

Dr Blackie studied medicine in Edinburgh University, and received the degree of M.D. in 1855, distinguishing himself at the time by taking one of the gold medals awarded to the best theses. At the commencement of his curriculum he showed a fondness for botanical studies, and gained the gold medal for the best herbarium in Professor Balfour's class in 1850, when he was only sixteen years of age.

In 1851 he spent the summer in Bonn on the Rhine, and there he prepared a catalogue of flowering plants and ferns observed within fifteen miles of that town, during the months of May, June, and July.

He was elected a Fellow of this Society in June 1851, and during the time he was resident in Edinburgh he was one of the most active of our members. In 1851 he read a paper on "The Discovery of *Saxifraga Hirculus*, near Walston, Lanarkshire," one on "A List of Plants found in Peeblesshire," and a third on "The Flora of the Rhine." This tour was undertaken during the summer of 1853. I had spent some weeks with Dr Blackie in Bonn, and afterwards we made a tour of two months' duration, chiefly pedestrian, through South Germany and Switzerland. Much of the advantage that I reaped from that tour was due to Dr Blackie's mastery over the German language, which was indeed very remarkable; and his high spirits and good humour made it a time of unmixed enjoyment. He deserves any credit that was due to the "Account of a Botanical Tour in Switzerland in 1853." Shortly afterwards Dr Blackie was made Curator of the Botanical Museum in succession to his friend Dr Thomas Anderson, afterwards of Calcutta.

The chief part of Dr Blackie's life was spent in America. He went there in 1856, and was appointed almost immediately Professor of Botany and Materia Medica in the University of Nashville, Tennessee. He held this appointment until the occurrence of the American Civil War, in which he took the side of his adopted city. This rendered all scientific work for the time impossible, and he suffered much in health after the war was over from the hardships which he had undergone. He was, however, able to do much useful work in various capacities during the remainder of his life, and, though obliged latterly to relinquish some of his occupations, he remained till the time of his death Professor of Chemistry in the Nashville Medical School, and one of the Editors of the *Southern Practitioner*. He died on the 19th of June 1881.

Dr Blackie was remarkable all through life for the earnestness with which he pursued any work which he undertook. The enthusiasm with which he devoted himself to the science which this Society is formed to cultivate, was a conspicuous illustration of this. His earnestness, although it made him a hard worker, did not, however, make him what could be called a plodder. He went to work with a rush of joyous emotion which carried him on in waves. Those who have been with him as his companions, will remember how he would break out at intervals into declamation or into song, and then return to his work refreshed and eager.

But there was more than anything else visible to those who knew him best, a constant flow of pure and generous feeling which characterised his conduct. He was not remarkable for caution and deliberation in forming opinions, and would often have been led wrong had his delicacy of feeling not made him instinctively recoil from any shade of meanness or unrighteousness.

By his death science has lost one of its most zealous votaries, and this Society a distinguished ornament. Dr Blackie was the author of several short treatises on medical and other scientific subjects. One, which was published before he left this country, and which was very favourably known at the time, was a careful essay on the Nature of Cretinism.

Obituary Notice of Charles Robert Darwin. By John Hutton Balfour, M.D., Hon. Sec.

(Read 11th May 1882.)

We have to lament the death of the late Charles R. Darwin, M.A., LL.D. Cantab., F.R.S., Hon. F.R.S.E., F.L.S., and Honorary Member of the Edinburgh Botanical Society. Darwin was born at the Mount, Shrewsbury, on 12th February 1809. His father, Dr Robert Waring Darwin, F.R.S., was an eminent physician in that town. His mother was the daughter of Josiah Wedgwood. His grandfather, Dr Erasmus Darwin, was a very eminent man of science, whose earliest publication was entitled *The Botanic Garden.* He was author likewise of the *Temple of Nature* and *Zoonomia.*

Charles Darwin was educated at Shrewsbury School under Dr Butler, afterwards Bishop of Lichfield.

In his early days he was a zealous naturalist. He went to the University of Edinburgh in 1825, and he attended a course of Natural History under Professor Jameson, and spent two sessions in Edinburgh. He studied specially marine zoology, and he became a member of the Plinian Society, which embraced all departments of natural history; and he read papers to the Society, one of which was on the Ova of Flustra. He also gave an account of the worm of *Ponto della Muricata.* One of the eminent young men who met Darwin at the Plinian was Dr Greville. Both made excursions near Edinburgh, specially to Inchkeith and the Isle of May. I had the pleasure of being an associate with Darwin at the meetings of the Plinian. The Society held its meetings in a low room on the north-western side of the University building.

Darwin, after this, became a pupil of Henslow, Professor of Botany at Cambridge, and he also derived much information on geology from Professor Sedgewick, also at Cambridge.

Darwin was early appointed Naturalist to Her Majesty's ship the "Beagle," under the command of Captain (afterwards Admiral) Fitzroy. The ship sailed in December 1831. It circumnavigated the globe, and did not return till 1836. The Report of the voyage was drawn up by Captain Fitzroy and Mr Darwin; the latter furnishing the geology and natural history of the various countries which had been visited. His publications, on the return from this voyage, of works *On the Structure and Distribution of Coral Reefs*, *On Volcanic Islands*, and on *The Geology of South America*, at once gave him eminence as a geologist; while *The Naturalist's Voyage Round the World*, published in 1839, became one of the popular favourites amongst general readers. In *The Zoology of the "Beagle" Expedition*, issued in 1840, Mr Darwin had the assistance of Professor Owen, Mr Waterhouse, the Rev. L. Jenyns, and Mr Bell. During the progress of the voyage, Darwin had addressed interesting narratives to Professor Henslow from time to time; a printed epitome of which was issued to the members of the Cambridge Philosophical Society. The letters composing this pamphlet date from Rio Janeiro, 18th May 1832; Monte Video, 15th August 1832, and 24th November 1832; Falkland Islands and the Rio Nigro Colorato, 11th April 1833; Monte Video, 12th November 1833; E. Falkland Islands, March 1834; Valparaiso, 24th July 1834, and March and April 1835.

After a long lull in publications, Darwin gave to the world, in 1867, his *Origin of Species*, which has given rise to so much discussion. This was followed by numerous monographs, many of them specially botanical, such as *On the Fertilisation of Orchids*, *The Habits of Climbing Plants*, *Insectivorous Plants*, &c. His published writings have been circulated far and wide, and have been translated into various languages.

Darwin was certainly one of the greatest naturalists; and he was endeared to all who had the honour of his acquaintance, which included many who were not prepared to accept the doctrine which was associated with his name.

He was a naturalist of great observation, and continued to study natural phenomena during his whole life. His theory of progressive development has received much attention and has given rise to much discussion. As Mr Spottiswoode remarked before the Royal Society, he lived to a good old age, to see the work of his life enthusiastically recognised.

Darwin was highly prized, not only as a physiological botanist, but as an excellent cultivator. Mr Isaac Anderson-Henry corresponded with him for many years, and I have perused with much interest and pleasure the excellent and kind replies sent by Darwin. I subjoin extracts from some of these letters:—

"*January* 20, 1863.—. . . . . I may mention that this past spring I tried again two crosses on Primula, with the same result rather more strongly marked, and that I have gone on now for three generations, breeding them what I call homomorphically, with some curious results, which I shall publish whenever I have time. I have sent a paper on *Linum* to Linn. Soc.; when it is published I will do myself the pleasure of sending to you a copy, and it will, I should think, be in good time for your experiments. I cannot say how glad I am that you will make some experiments on this subject. It does not absolutely follow, in making a cross between distinct species, that the same rule would follow in the fertility of the pollen. I hope that you will try and mark separately (excluding insects, as you know better than I do the necessity), the *two* kinds of pollen of one species on the stigma of the other, and see in making hybrids what the difference is in *fertility*, and in the character of the hybrid seedlings.

"This would be an entirely new field for observation and discovery. You will see in my paper that some species of *Linum* are *not* dimorphic, and are self-fertile; and so it is in some other genera.

"You refer to *L. rubrum;* I am not a botanist, and have called one of the species on which I have experimented

L. grandiflorum, which is crimson, and not uncommon in flower gardens; I hope I have not made a mistake in name. . . . .

"My few crosses in Pelargonium were made to get seed from the central peloric or regular flower (I have got one from peloric flower by pollen of peloric), and this leads me to suggest that it would be very interesting to test fertility of peloric flowers in three ways—peloric pollen on peloric stigma, common pollen on peloric stigma, peloric pollen on common stigma of same species. My object is to discover whether, with change of structure of flower, there is any change in fertility of pollen or of female organs. This might also be tested by trying peloric and common pollen on stigma of distinct species and conversely. I believe there is a peloric and common variety of Tropæolum, and a peloric or upright and common variety of some species of Gloxinia, and medial peloric flowers of Pelargonium, and probably others unknown to me.

"To recur to *Linum;* if you cross distinct species it would, I think, be advisable to take two dimorphic species, and not one dimorphic and the other self-fertile. I have reason to *suspect L. trigynum* is dimorphic, but it has not yet flowered with me."

In another letter Darwin says:—

"I do not know whether you have used the microscope much, yet it adds immensely to the interest of all such work as ours, and is indeed indispensable for such work. Experience, however, has fully convinced me that the use of the compound without the simple microscope is absolutely injurious to the progress of natural history (excepting of course with *Infusoria*). I have as yet found no exception to the rule, that when a man has told me he works with the compound *alone*, his work is valueless."

Mr Poole, in his *Index of Periodical Literature*, gives an extensive list of Darwin's publications, which is reproduced in *The Athenæum* for 13th May 1882, along with remarks on Darwin.

Mr Darwin, after his return from the voyage of the "Beagle," was very much a life-long dyspeptic invalid, able to work continuously at most only three hours daily. And this was because of the constant, watchful ministering care of his wife (his own cousin). He received the Royal and Copley Medals from the Royal Society; the Wollaston Palladium Medal from the Geological Society; as well as honorary titles from the Prussian Government, and from the Academy of Vienna.

His extreme candour was an outstanding characteristic. This was well shown by an annual contribution to the funds of the South American Missionary Society; the result, it is said, of a discussion on the futility of such missions between himself and a pious young lieutenant, during the voyage of the "Beagle;" his opponent having shown him, after thirty years, what good had been done by Christian missions amongst these savages.

Darwin's death took place on Wednesday, 19th April 1882, at his house near Fanborough, in Kent, in his seventy-fourth year. His funeral took place on the 26th April, and his body was interred in Westminster Abbey. Amongst the numerous mourners present were dukes, earls, lords, baronets, knights, canons, clergymen, professors, naturalists, students.

Obituary Notice of Deputy Surgeon-General Jameson, C.I.E. By Hugh Cleghorn, M.D., F.L.S.

(Read 13th July 1882.)

William Jameson, F.R.S.E., for many years Superintendent of the Government Botanical Gardens in the North-West Provinces of India, was one of our oldest members; he attained celebrity by the efforts he made for the promotion of tea culture in North India, and his name will always be associated with the successful establishment of this new industry in our great Eastern Empire.

Mr Jameson was born at Leith in 1815, and received his early education at the High School, and his medical training at the University of Edinburgh, where his distinguished uncle, Professor Robert Jameson, filled the chair of Natural History for half a century from 1804 to 1854. While the two nephews Lawrence and William, the subject of our sketch, assisted in the class and in arranging and keeping the Museum, William imbibed a love for natural history which characterised all his subsequent career.

He passed Surgeon in 1838, and on August 30th of the same year he was appointed to the Bengal Medical Service and proceeded to Calcutta. The experience Mr Jameson had gained in the Edinburgh University Museum was not long of being utilised in his new sphere. Soon after reaching Calcutta he was called to officiate as Curator of the Museum of the Asiatic Society, and a report of the state in which he found it, with suggestions for placing it on an improved basis, was presented to the Society. Mr Prinsep, editor of the *Bengal Asiatic Society's Journal*, thus writes of Mr Jameson's report (vol. viii. p. 241) :—

> "During the few weeks Mr Jameson held the office of Curator, his exertions have accomplished more than could be readily believed in reducing the chaotic materials of the Museum into systematic arrangement and disposition. His suggestions will doubtless receive the attentive consideration they are so strongly entitled to, and we trust before long that our Museum will be guaranteed from such reproaches as Mr Jameson now too justly inflicts on it."

Mr Jameson's first destination after a short residence in Calcutta was Cawnpore, where he was attached to a battery of artillery; but he was soon directed to proceed to Amballa to join the Governor-General's Agency, under Mr, afterwards Sir, George Russell Clerk.

In 1839 we find Mr Jameson communicating a paper to the *Journal of the Asiatic Society*, vol. viii. p. 321, on what was in his early days his favourite branch of natural history. The paper bears the title "On the Geographic Distribution of the *Vulturidæ*, *Falconidæ*, and *Strigidæ;* being the first of a series of memoirs intended to illustrate the Geographic Distribution of the Ornithological Kingdom."

In 1841 Mr Jameson was Civil Surgeon at Amballa, but his scientific reputation led to his being selected by Mr G. R. Clerk, Envoy to the Court of Lahore, to ascertain the cause of the great "débacle" of the Indus, which had taken place a few months before (June 1841), and caused vast destruction to life and property. Mr Jameson was also to visit Iskardo and Gilgit, and to report on the geology and zoology of those parts of the Punjab through which his course lay. Unfortunately an attack made upon him and the escort with which he had been provided by the Maharaja Shere Sing, when he was examining the Khuttuck Hills, prevented the fulfilment of the main object of the expedition. He lost everything he possessed, including note books and specimens, excepting the clothes he wore, and nine of his servants and contingent guard were killed or desperately wounded. He himself was taken prisoner and kept for four months in the Kohat fort, until Col. Mackeson arranged for his liberation on ransom. The results of this interesting mission are contained in a report on the Geology, Zoology, &c., of the Punjab and part of Afghanistan, in *Jour. As. Soc. Beng.* (vol. xi. p. 183).

In the following year Mr Jameson was rewarded for these services by being appointed to officiate as Superintendent of the Botanic Garden at Saharunpore in succession to Dr Falconer, who had been seriously ill, and who was removed to Calcutta. Soon after he was confirmed in that appointment, and thus he entered on that work with which his name will ever be associated, viz., tea cultivation in North India.

Under Lord Dalhousie's enlightened Government, Mr Jameson's proposals for the introduction of tea culture received great encouragement. Tea plants, tea seeds, even tea manufacturers, were imported from Chusan, Ningpo, and other districts of China, while plantations on a large scale were formed at Deyrah Doon, on the hills near Mussouri, in Kumaon, in Gurhwal, and in the Punjab in the Kangra valley, and as far north-west as Hazara. Gradually the attention of settlers was attracted to this new industry, and tea seeds and plants were distributed to all who were prepared to engage in their cultivation.

We let Jameson's enthusiasm speak for itself in his report for 1855:—

"The tea plant is now thriving over $4\frac{1}{2}$ degrees of latitude, and 83 degrees of longitude; or from Hazara in the west, to the Kali Nuddi in Kumaon in the east, and from Deyrah Doon in the south to Ramaserai in the north, over a tract containing upwards of 30,000 square miles. In this mighty tract there is a sufficient quantity of land fitted for tea cultivation, as, if so used, would not only produce teas capable of supplying the whole of India, but the whole European market. The crops now grown in the hills yield but a small return to the zemindars, and, as already stated, they look to other sources than the sale of the produce of their lands, in many quarters, to procure means to pay their revenue. The Kumaon and Gurhwal provinces, covering a tract of upwards of 19,000 square miles, yield only about two lacs of rupees annually to the state and that, too, with difficulty collected, showing the poverty of the country. Tea on the other hand, is a highly remunerative crop, and occupies the time and attention of millions of beings in the adjoining kingdom of China, and is the means of yielding a large revenue to the state. India possesses within itself capabilities equally advantageous, in having abundance of land fitted for tea cultivation, an unlimited supply of cheap labour, admirable rivers for transmitting the produce to good marts, and last, though not least, a climate equally well fitted for the growth of the plant. In China, the priests carry on the trade of tea making with as much zeal as the lay portion of the community. To them in the Kumaon and Gurhwal provinces we owe in a measure the miserable state of the peasantry, as nowhere is their influence more powerful, and that too directed against any innovation. By the press it has been stated that the land fitted for tea cultivation was limited and labourers scanty. Both, however, are great errors. Nor, as already stated, is it necessary to occupy lands now used in growing grains; let but the forest land and the waste land be employed, and from them alone will be produced a supply equal to the consumption of Europe. The thriving state of the Paoree plantation, which four years ago was an extensive oak and rhododendron jungle, shows how admirably this land so uselessly employed (as but few of the virgin forests can be made available for their timber, owing to the inaccessible nature of the country, and impracticable roads), is fitted for tea cultivation. Let tea, therefore, be encouraged in these places, and a produce will be reared which will yield means to open up the mountainous regions. I have pointed out certain routes by which the teas could be removed to the plains, and I may also add, that with a little skilful engineering, a road might be made from Hurdwar to Nitti, the frontier British town, fitted for camels and bullocks. Difficulties there are none, barring the bridging of a few streams. This great road would act like a great artery in developing the resources of the western British hills, and with a little trouble and tact on the part of the Assistant Commissioner, the shawl wool, which is of such vast importance to the manufacturers in the great British towns of Loodianah, Amritsur, Lahore, Julalpore, Noorpore, &c., might be brought down by this route and sold at a cheap rate, and free of the heavy duties levied on it when imported through the passes belonging to the Jummoo Raja. The great breeding district of the shawl-wool goats is in the vast plains of Tibet, immediately behind the British passes. The breeders have more than once brought down quantities of wool to Sreenuggur, but at a loss, and they still bring down a small quantity to the Bageswur fair. But were the road from Nitti to Hurdwar to be opened up and fitted for bullocks and camels, not only would tea be exported to the plains at a cheap rate, but also the shawl-wool buyers and other traders would be induced to frequent Sreenuggur, and thus induce the Tibet traders to bring their wool to the British territory, instead of looking for a market in Cashmeer, by the lengthy and circuitous route of Leh, &c. For the development of the trade of Tibet one great road is being opened up through Simla, Rampore, &c., but nature has already, as it were, marked out the Gurhwal route as one of the great arteries by which the trade of the Trans-Himalayan countries should flow into British India, and it only requires to be a little more opened up to cause it to be more generally frequented. By the Bhotias our teas are highly appreciated, and for them they are prepared to barter their produce. As a mart, therefore, in the great high road for them and other merchants to frequent, a more appropriate place could not be met with than Sreenuggur, distant six miles from the factory of Paoree. It, however, can never come into general use until the road is made."

Mr J. H. Batten, of the Bengal Civil Service, formerly Commissioner of Kumaon, thus epitomises Jameson's work in India :—" William Jameson came to India with all the *prestige* derived from the reputation in science of his celebrated uncle, and right nobly has he sustained and extended, from Edinburgh and Europe to the Himalaya and Asia, the honours of his family.

" Having assumed full management everywhere as superintendent, Jameson paid his first visit to Kumaon in April 1843 ; and made his first official report on the tea nurseries of that province in February 1844. From that date until the final abandonment of the Government exploitation, and the successful establishment of private enterprise, the progress of the whole cultivation of the tea plant, and of the production and disposal of the manufactured tea, formed the subject of the most complete and exhaustive reports, furnished annually by the superintendent, and published at first in the *Transactions of the Agricultural and Horticultural Society of India*, and, after the introduction of the system of annual administration reports by the several governments of British India, in the official records of the North-Western Provinces."

" The year 1847 was an important year for the tea experiment in the Himalaya. Dr Jameson submitted a full report on the subject,* in which he reviewed the progress of

* This report, illustrated with numerous drawings, was printed and extensively circulated by Government, and subsequently published by authority (No. xxiii.) for general information.

the operations, giving the results of his experience as to soil, elevation, and system of cultivation found most suitable in the districts under his superintendence; and appended a lucid account of the methods adopted in manufacturing green and black teas, packing tea, preparing sheet lead, buildings, tea stores, implements in use, &c., making also valuable suggestions for the improvement of plantations" (Nassau Lees, LL.D., p. 51).

The difficulties Jameson encountered and the great results that followed his labours are thus alluded to by Col. Nassau Lees, in his *Cultivation of Tea in India*, (p. 61):—"It is impossible, if due consideration be allowed for the natural difficulties Jameson had to contend with, the bigoted prejudices he had to overcome, and above all, for the entire want of anything like *sound* local experience to guide him, to over-estimate the value of Dr Jameson's services in connection with the cultivation of tea in the Himalaya Mountains; and the highest credit is due to him for the energetic zeal with which he pushed on, and followed through all its vicissitudes, the development of an experiment, of the success of which he alone from the commencement never had any misgivings. A conscientious discharge of his duty, and a high sense of the great natural importance of the interesting experiment which he had been entrusted by Government to superintend, were doubtless the main incentives to Dr Jameson's exertions; at the same time (says Col. Nassau Lees) it is proper to record the great value of his services to tea interests in North-West India, and to point out to those who are now profiting so largely by his labours, the great obligation they are under to him. In the complete success which finally crowned Dr Jameson's labours, he had his reward, and though, from the general distrust in his prognostications, and the consequent shyness of private speculators to aid in the experiment, he had the mortification to see other parts of India (Assam and Cachar) shoot ahead of the districts under his superintendence, it must have been gratifying to him that experience has verified in all important particulars the principles laid down by him in 1847, when tea cultivation was almost in its infancy, and a satisfaction to him that tea planters in all parts of India are at last beginning to awake to the value of his early reports."

Jameson had the satisfaction before he died of seeing his lifelong labours crowned with success, and tea forming one of the staple commodities cultivated on the lower Himalaya; the many plantations affording occupation to thousands of the peasantry, and prosperity introduced to what were previously waste and almost uninhabited regions. In acknowledgment of his valuable services, the Viceroy conferred on Jameson the distinction of Companion of the Indian Empire.

On the 31st December 1875, Mr Jameson retired from Saharunpore to a small tea garden at Deyrah Doon, which he had purchased from Government, and there he ended his useful life on 18th March 1882. His widow resides at Deyrah Doon, and two sons who survive are in the Staff Corps of the Indian Army.

Chronological List of Memoirs and Official Reports.

On the Distribution of European Birds.	*Jour. As. Soc. Beng.*, viii. 21.
Report on the Museum of the Asiatic Society. 1839.	*Jour. As. Soc. Beng.*, viii. 241.
On the Geographic Distribution of the *Vulturidæ*, *Falconidæ*, and *Strigidæ*, being the first of a series of memoirs intended to illustrate the Geographic Distribution of the Ornithological Kingdom.	*Jour. As. Soc. Beng.*, viii. 321.
Report of his Deputation by Government to Examine the Effects of the Great Inundation of the Indus. March 1842.	*Jour. As. Soc. Beng.*, xii. 183.
Report on the Geology, Zoology, &c., of the Punjab, and of a part of Afghanistan. June, 1842.	*Jour. As. Soc. Beng.*, xii. 192.
Report on the Cultivation and Manufacture of Tea in Kemaon. 1844.	*Jour. Ag. Hort. Soc. Ind.*, ii. 323.
Report on the Cultivation and Manufacture of Tea in Kemaon and Gurhwal. 1845.	*Jour. Ag. Hort. Soc. Ind.*, iv. 173.
Progress of Tea Culture in Kemaon, Gurhwal, and the Dehra valley. Cultivation of the Hop Plant in the Himalaya. 1846.	*Jour. A. H. Soc. Ind.*, v. App. 147.
On the Tea Plantations in Kemaon and Gurhwal, the Manufacture of Black and Green Teas, with Account of Implements used (figures). 1847.	*Jour. A. H. Soc. Ind.*, vi. 81.
Report on China Tea Plants (from Mr Fortune in Ward's Cases) and on American Fruit Trees (imported with a cargo of ice) received at Saharunpore. May 1850.	*Jour. A. H. Soc. Ind.*, vii. 175.
Results of the Trial at the Hill Station of Mussooree of the North American Fruit Trees imported in Ice. 1853.	*Jour. A. H. Soc. Ind.*, viii. 152.

On the Physical Aspect of the Punjab, its Agriculture and Botany. 1854.	*Jour. A. H. Soc. Ind.*, viii. *App.* 162.
On the Cultivation of Tea in the District of Kangra. April 1854.	*Ed. N. Phil. Jour.*, lvii. 76.
Papers on the Tea Factories and Plantations in Kemaon and Gurhwal. May 1854.	*Agra.* (*Published by Government.*)
On the Culture of Flax in the North-West Provinces for the sake of its Fibre. Jan. 1855.	*Jour. A. H. Soc. Ind.*, ix. *App.* 31.
Papers regarding the Cultivation of Hemp in India. March 1855.	*Agra.* (*Published by Government.*)
Report of Botanical Gardens of the Government North-Western Provinces. 4to, p. 429. 1855.	*Roorkee.*
Report on the Present State and Future Prospects of Tea Cultivation in the North-Western Provinces and Punjab. Calcutta, 1857.	*Government of India Records* (*Home Dept.*), No. xxiii.
Correspondence regarding Tea Plantations in the Punjab Provinces. Lahore, 1859.	*Selections from the Correspondence of the Punjab Government*, vol. iv., No. 2.
Correspondence respecting the Cultivation of Flax in the North-West Provinces. 1861.	*Jour. A. H. Soc. Ind.*, xi. 597.
Letter to Professor Balfour, dated Saharunpore. July 9, 1863.	*Bot. Soc. Trans.*, viii. 66.

Obituary Notice of Joseph Decaisne, Member of the Institute of France, Honorary Fellow. By Andrew Taylor.

(Read 8th June 1882.)

Joseph Decaisne died on the 8th February 1882, aged 73. He was a native of Brussels, the celebrated Charles Morren being his playmate. Both were eager butterfly hunters as children; both, when men, became leaders in horticulture, one in France, the other in Belgium. He entered the *Jardin des Plantes* at the age of seventeen, and gradually worked his way up till he succeeded Mirbel as Professor de Culture and Director of the Garden. A working gardener in the department of the Museum in 1821, M. Decaisne was elected President of the Academy of Sciences in 1864, and a Member of the Royal Society of London in 1880. He was enrolled in our list in 1867.*

Decaisne's attachment to his beloved *Jardin des Plantes* was a life passion; and there, of course, we look for the results of his long studies. He managed this establishment, not on the idea of its being a public recreation ground for tired city holiday seekers, but rather as a

* A portrait and notice of his labours are in *Gardener's Chronicle*, 1871, p. 377.

working place for earnest students. Some of the members of our Society can testify to his individual courtesy, which was always available, whether to obscure students of theoretic botany or poor peasant farmers troubled by pomological puzzles. Even the terrible siege of Paris in 1870–71 did not drive the Director from his post. He wrote to Dr Masters in 1871, when in January over eighty shells had fallen within the precincts of the garden, how the Pandanus, the Cyclanths, and the Dracænas had their leaves torn to ribbons, while the Bromeliads were not only uninjured by the explosions, but were not hurt by the frost which destroyed so many nearly allied plants. And for ten years after this terrible ordeal, Decaisne managed his great Institution with more activity than many a younger man accustomed only to the fair side of life.

His printed works also kept pace with his administrative energy. The English reader knows Sir Joseph Hooker's translation of his beautifully illustrated conjunct *Traité generale de Botanique*, 1868 ; and further proof of his systematic work may be found in various monographs in De Candolle's *Prodromus*, in the *Revue Horticole*, or in the *Annales des Sciences Naturelles*, of the botanical department of which he was long joint editor. Decaisne, probably incited by his Herbarium work, early published *Florula Sinaica* (Paris, 1834) from plants collected by Bové, and *Plantes de la Arabie Heureuse* (Botta, Paris, 1841). From such studies, Decaisne turned to Algology, and may be ranked as its founder in the sense patent to our physiological laboratòries. He studied, along with his friend Thuret, Fuci originally obtained in the Paris fish market, though afterwards at the sea-coast. In a joint paper, published in 1844, the relations involved in the fertilisation of *Fucus vesiculosus*, bladder wrack, were first made clear ; the common coraline of our shores was also shown to be not a polype, but a sea-weed. This morphological method of study soon influenced his horticultural studies, the summation of which will be found in *Le Jardin Fruitier du Museum*, with its splendidly coloured plates. There, the so-called calyx tube of the *Pomaceæ*, the eatable portion of the apple and pear, is shown to be really the top of the flower stalk rendered swollen and succulent. Decaisne, however, believed in the existence of genera and species, as understood in pre-Darwinian days, and in their limitation by definite, though extremely wide and elastic, boundaries. He did not make every variation a distinct species. He held that the countless varieties of pears, apples, strawberries, and the like, all proceeded from a few original forms. But he had no faith in the alleged transformation of the wild radish, carrot, or cabbage into the cultivated varieties. He held strongly that nature acts in the fields as she does in the garden. Yet with him the apple (*Malus*) and the pear (*Pyrus*) were two absolutely distinct genera; botanists who, after Linnæus, combine the two, contradict the direct teachings of nature. Mr Thistleton Dyer says Decaisne's turn of mind was essentially precise and matter of fact. He would triumphantly show crops of a cruciferous plant raised in front of the physiological laboratory under wire gauze for many successive years. There is no departure he would say, so far from the specific type, and beyond this kind of evidence he did not seem to care to go.

Altogether Decaisne stands out a typical man in botany, a combination we have more frequently seen in the engineering profession, embodying all the best qualities of the *savan* and the *ouvrier.*

M. Pierre Decaisne, Honorary Inspector-General du Service de Santé of the Belgian army, has given to the State Botanic Garden at Brussels his brother Joseph Decaisne's herbarium, manuscripts, and drawings. Among the manuscripts is one of Tournefort given to Decaisne by his friend G. Thuret, and another by A. L. de Jussieu, picked up for a franc at a Paris bookstall. Decaisne's botanical correspondence, with part of Riocreux's drawings, are given to the Library of the Institute; the rest of these inimitable illustrations being a bequest to the National Library.

The foreign necrology for the past year includes the names of Schleiden, an Honorary Fellow, and of Rabenhorst and Hildebrandt, Foreign and Corresponding Members.

Matthius Jakob Schleiden was born on 5th April 1804 at Hamburg, and died at Frankfurt am Main on 23rd June 1881, having lived to see his cell theory mark an important epoch in botany. He was successively Professor of Botany at Jena, Dresden, and Dorpat, and published at least fifteen original works, several of which have appeared in an English dress, exclusive of papers in Journals. A full sketch of his career, with a corresponding bibliography, will be found in *Botanische Centralblatt*, Nos. 31 and 32, 1881, and in the *Botanische Zeitung* for 12th August of the same year.

Gottlob Ludwig Rabenhorst was born on the 22nd March 1806, at Treuenbrieken in Brandenburg, and died near Meissen on 24th April 1881. His works on *Algæ*, the *German Cryptogamic Flora*, and *Mycologia Europæa* are classical. He founded *Hedwigia*, and edited it until 1878.

Dr J. M. Hildebrandt, the German traveller, to whose long explorations the public herbaria of Europe owe many representative plants of Eastern Africa, died in May 1881, at Tananarivo (Madagascar), of a malady induced by the climate on a European constitution.

William Gorrie, whom many of us had previously been inclined to reckon as well-nigh a silent member, gave proof of his sound wisdom and valuable experience in the presidential addresses he delivered to this Society. The quiet individual influence he exercised in the extension of scientific arboriculture and horticulture had been long recognised. William Gorrie unexpectedly passed away in a railway carriage when returning from a professional engagement in Dumfriesshire, in January 1881, at the age of sixty-nine. He early made a name for himself in horticulture, and joined the Botanical Society in 1864, having previously contributed to our *Transactions* short notes on the introduction of foreign trees into Britain ; these notes being communicated by his friend James M'Nab. Mr Gorrie's family have made their mark in the literature of Scottish agriculture and gardening. His father, Archibald Gorrie, of Annat Gardens, Perth, was enrolled an Associate in 1839, and his brother David, who sent papers to our Society, and also to the *Journal of Agriculture*, published a small treatise on *Biblical Botany*, still held in esteem.

After his novitiate as apprentice gardener, Mr Gorrie accepted service with the late Charles Lawson of Edinburgh in 1834, and was Curator of the great collection of vegetable products which afterwards became the celebrated Museum of the Highland and Agricultural Society, now incorporated with the Museum of Science and Art. In the preface to the first edition of Lawson's *Agriculturist's Manual*, published in 1836, the valuable aid of Mr Gorrie is duly acknowledged ; while a similar tribute is given in the treatise on the *British Cultivated Grasses*, issued by the same firm. He described the Grasses in Morton's *Cyclopædia of Agriculture.* Mr Gorrie's subsequent history comprises few details : he was factor at Prestonhall, Midlothian, from 1843 till 1859 ; then returning to the charge of the Lawson nurseries for a few years, he afterwards became a landscape gardener and adviser on estate management. The dignity of tree study has to be insisted on in days when the microscope has so absorbing claims on botanists. Our town gardens and public parks alike, even yet remain too much swathed in arboreal cerements, emblematic of the stiff gardening formalism of a by-gone age. Why not adapt the varied forms and foliage of trees, as our lamented friend put it, to the high aims of his art of making straight lines rugged, and rugged lines straight,—all combining to give that abandonment of mind so delicious to weary workers near the crowded city's ceaseless roar. And graceful foreign trees, such as the New Zealand novelties so well known to visitors at Rait Lodge, might be thus advantageously introduced, though not in the fashion of the rows of *Araucaria imbricata*, in various shades of brown, adorning our suburban villas. Mr Gorrie's matured views will be found in a remarkable paper, " On the Advantages of Planting in Groups, or in Mixed Plantations, so as to combine profit with landscape effect," *Trans. Scot. Arb. Society*, vol. vii., 1874–75. The practical demonstration of these views may be found in the grounds surrounding the Hydropathic establishments at Melrose and Pitlochry, besides those of many private mansions, and especially at his own residence of Rait Lodge, Trinity. If, as Ruskin has it, the artist appeals to a wider public than the author can possibly do, so, too, may our scientific forester have taught botany.

During twelve of the seventeen years Mr Gorrie was a member of the Botanical Society, he was an office-bearer. He joined the Council in 1865, and was elected a vice-president in 1867; and for one year he occupied the president's chair.

Hewett Cottrell Watson, chief amongst English geographic botanists, departed this life on the 27th July 1881, after nearly six months' illness, at his residence of Thames Ditton, Surrey, aged seventy-eight. For the last forty years Mr Watson lived in quiet seclusion. He rarely passed a night away from his cottage. Of so unobtrusive and nervous a temperament as to fear that a casual visitor might find him a bore, he usually preferred solitude, enlivened sometimes by gardening, or, in answering correspondents, who had no other calls upon him than a common enthusiasm for his favourite science. Mr Watson would sometimes astonish a casual looker-in by a torrent of thanks for the personal favour thus so unexpectedly conferred. His later works were not placed in the hands of a publisher, while the impressions were so limited as to cause them to be amongst the desiderata of the botanical book-hunter. Yet M. Adolphe De Candolle reckons the publication of the *Cybele Britannica* as marking an epoch in botanical history.

Mr Watson's social position, idiosyncrasies, and scientific training, admirably qualified him for his special life-work. In early life he pursued preparatory legal, and then medical studies, but without the zest caused by a purse *vergens ad inopiam*, and ill-health, together with the incidence of a legacy while a student, abruptly cut short his University course. He was one year president of the Royal Medical Society of Edinburgh, though he never took his degree. And along with his contemporaries, John Hutton Balfour, Robert Greville, Patrick Neill, and Sir Walter Trevelyan, he botanised with Professor Graham in Sutherlandshire, then gaining first ideas of the relations of altitude to plant distribution, the elaboration of which was to be his life-work. Watson also took advantage of the botanical lectures and excursions of Sir William Hooker then of Glasgow. He joined the Botanical Society as a Non-

Resident Member in 1837. A remarkable paper he read before us will be found in the first volume of our *Transactions*, "On the Geographical Distribution of Ferns in the Azores," giving the results of a botanising trip made to these islands in H.M. surveying war steamer "Styx," in which Mr Watson paid his own expenses. He gave great aid in the distribution of specimens amongst our members, at one time an important feature of our institution. The London *Catalogue of British Plants*, together with the Botanical Exchange and Record Clubs, received much of his later efforts in this direction of labour. An interesting correspondence with the late William Brand, W.S., now in the Society's archives, indicates how Watson would have had our Herbarium arranged so as best to demonstrate geographic distribution, in his opinion the chief object of such a collection. He remarks, in *Topographical Botany*, —on finishing which he once intended to burn his own unsurpassed herbarium,—"I do not believe that there are fifty English botanists who sufficiently comprehend the philosophy of plant distribution to take any great interest in such illustrations. The majority amongst botanists are simply collectors of specimens; an innocent amusement of rather limited science." Mr Watson held advanced opinions on many subjects. Early initiated to the love of plants by the kind words of Bishop Stanley of Norwich, the *fidus Achātes* of his schoolmate the late Dean Stanley, and the coadjutor with George Combe in missionary enterprises for promulgating phrenology, can we wonder that he was ever to the front, with the rolling wheels of intellectual change so characteristic of his times? Space forbids discussion of his views of species and varieties; but as more than one obituarist has claimed him as a Darwinian, nay, a reformer before this great so-called reformation, let us allow him explanatory utterance. In *Topographical Botany* he thus writes:—"I do not recognise in the clever arguing and strictly conscientious writings of Charles Darwin, any guiding clue truly sufficient to account for the origin of the British flora, or anything which satisfactorily explains well-ascertained peculiarities in the distribution of its constituent plants either internal or external. At the same time, I would not be understood to declare that the known facts are irreconcilably adverse to that theory, ingeniously invented to explain the so-called origin of species, or to those views of their past dispersion and present distribution which are closely connected therewith; but perhaps it would be alleging a double truth, were it declared impossible to prove, and equally impossible to disprove, those views on species introduction which are now familiarly known as Darwinism." In a similar fashion he had previously demitted the editorship of the *Phrenological Journal*, because the zealots for the then new science could not bear Watson to expose its weakness when viewed from a logical standpoint. Speaking as a botanist, he says: "As for my own ideas, it is wished here to make a final declaration, up to present date (1874), that I have not seen any hypothesis truly adequate to account for the origin and present distribution of plants in Europe generally, or in Britain specially."

Mr Watson's works are—

Outlines of the Distribution of British Plants belonging to the Division Vasculares. 8vo, Edinburgh (privately printed), 1832.

Remarks on the Distribution of British Plants, chiefly in connection with Latitude, Elevation, and Climate. 8vo, London, 1835.

New Botanist's Guide. 2 vols. 8vo, London, 1835–37.

Cybele Britannica. 4 vols. 8vo, London, 1847–59.

Supplement to Cybele Britannica. 8vo, London, 1860.

Compendium. 3 vols. 8vo, London, 1868–70.

Topographical Botany. 2 vols. 8vo, Thames Ditton, 1873–74.

Papers in Loudon's *Magazine of Natural History;* Sir William Hooker's *London Journal of Botany; Phytologist*, old series, 1841–54.

Mr Watson edited the *Phrenological Journal*, from 1830–1840.

On 21st October 1881, the busy town of Falkirk showed all befitting municipal respect as the funeral of Mr JOHN RUSSEL, its ex-provost and our former fellow member, was being conducted through its mourning streets. Mr Russel, during a twelve years' chief magistracy, had done more than most to improve the old borough. Of the leading legal firm of the town, yet he found time to make himself a name in orchid growing. His first collection, scattered in Steven's rooms in 1875, was probably the finest lot of orchids ever so disposed of. Though surrounded by tall stalks of chemical and other factories, Mr Russel's residence at Mayfield was long known to plant lovers, as showing how much material bustle is not incompatible with strong enthusiasm in their favourite pursuit. Mr Russel joined the Society in 1867. The Botanical Club, as well as the Edinburgh Naturalists' Field Club, more than once shared in his hospitality at Mayfield.

Dr Randle Wilbraham Falconer, twice Lord Mayor of Bath, and a president of the British Medical Association, died on May 6, 1881, aged 65. He joined our Society in 1837, the second year of its existence, and was then president of the Royal Medical Society. A learned paper "On the Ancient History of the Rose," afterwards printed in the *Gardener's Magazine*, vol. xv. p. 379, formed one of several papers which he laid before the Society. He was appointed local secretary for Pembrokeshire in 1847, and published anonymously *A Catalogue of Tenby Plants*, 1848.

John S. Innes, M.D., a Non-Resident Fellow, died at Forres on 15th April 1881. He joined our Society in 1838, being proposed by the well-known local botanists, Rev. Dr George Gordon of Birnie and Mr Stables of Nairn, doubtless in compliment to his reputation as a passionate cultivator of flowers, especially the rose. Dr Innes was born in Ceylon, but commenced practice in Forres in 1833, and continued there for nearly half a century.

Address by Professor Bayley Balfour, President.

(Read 8th December 1881.)

(*Abstract.*)*

The President remarked that the subject of chlorophyll had, alike in its morphological and physiological aspects,

* This address was delivered from notes, which the President stated he proposed to develop into a series of papers to be read before the Society, giving an account of the subject of chlorophyll, and a condensed abstract is therefore only given here. The portion relating to Pringsheim's researches is a condensation of Pringsheim's most recent paper, "Untersuchungen über Lichtwirkung und Chlorophyllfunction in der Pflanze," Leipzig, 1881. See also *Quart. Jour. Micr. Sc.*, new ser. xxii. 75.

for the past century attracted the attention of botanists and chemists, and now the zoologist also found that it fell within his domain. Although a vast amount of literature on the subject existed, yet we were still far from having an accurate knowledge of its character, of its origin, and of the part it plays in the plant economy. Recently a systematic investigation from an entirely new standpoint by Pringsheim had resulted in the elaboration of a new hypothesis, which had been termed the "screen hypothesis" of the function of chlorophyll and of its use to plants, and he (the President) proposed to give to the members of the Society a brief account of Pringsheim's work and hypothesis.

In the first place, however, he gave an historical résumé of the subject, and explained the views current regarding it up to the present time. He pointed out, as regards the occurrence of chlorophyll in plants, that with few exceptions it is found in parts to which light has access, and that in the simpler plants the green colour is often diffused through the whole protoplasm of the plants, but in highly differentiated forms it is usually relegated to isolated portions of the protoplasm, which constitute chlorophyll-corpuscles. Since Pelletier and Caventon gave the name chlorophyll to the green colouring matter of plants some confusion has attended its application. By some authors the term has been used as including both the green colouring matter itself as well as the protoplasm skeleton in which it is incorporated, by others to designate the former of these only, whilst recently Wiesner has retained it for a portion only of the actual colouring matter. Böhm introduced the term "chlorophor" for the protoplasmic groundwork, and the cumbrous expression "materia viridis" for the impregnating green matter, but these have not come into general use. Writers now speak of the skeleton as the body or corpuscle, which may be coloured or colourless, otherwise true or false,—(Sachs first showed, and after him the subject has been worked out by Dehnecke and Schimper, that the corpuscles may exist without the green colouring matter, and these he designated leucophyll or false, as contrasted with those which are green, the true or chlorophyll),—of the chlorophyll colouring matter or chlorophyll, and of the contents of the corpuscle, *i.e.*, the additional matter, such as starch, &c., present in the corpuscle, the whole being the chlorophyll apparatus.

As to the nature of the chlorophyll apparatus:—and first the skeleton. Earlier observers held this to be a vesicle. Treviranus first spoke of it as a proteid mass permeated by a green colouring matter, but Von Mohl laid the foundation of our rational knowledge indicating different characters of corpuscles, and enunciating their solid nature. His views have been accepted generally until Pringsheim's work appeared.

The chlorophyll itself, in the days of the vesicular theory regarded as a fluid enclosed in the vesicle, has now generally come to be recognised as a substance permeating the corpuscle. This view Pringsheim modifies. The chlorophyll colouring matter can easily be removed in solvents such as alcohol, and has definite physical characters. Its spectrum is a distinct one, the most prominent absorption bands lying in the more refrangible part of the spectrum, seven bands being recognised. It also, as Brewster first fully demonstrated, possesses the power of fluorescence. Of its constitution we are still much in the dark, notwithstanding many investigations both by chemical and by spectral analysis. In earlier times regarded as a single chemical substance, Fremy first suggested its compound nature, but his investigations, like those of Filhol, Jodin, and others, are valueless on account of the methods of experimentation followed. N. J. C. Müller proved the existence of different pigments in chlorophyll, and in later times Stokes, Kraus, Sorby, Wiesner, and others have attempted to arrange the constituent pigments in groups, and to give them distinct names with an approximate composition. Much controversy has taken place, but the general result has been the recognition of two series of pigments, a yellow (Xanthophyll) and a blue (Cyanophyll), each of which is made up of several minor groups, and these combined form the chlorophyll colouring matter which can be extracted from the corpuscle. In its chemical composition it contains carbon, hydrogen, oxygen, and nitrogen; Sachsse, from his recent investigations, holding that the cyanophyll series alone contain nitrogen, the xanthophyll having none. Iron is present in the chlorophyll, and various observers have found organic substances of a fatty and starchy nature in it.

Of the contents some are visible in the corpuscle, others only after reagents have been applied. Starch is almost universal; Pringsheim first, and after him Nägeli, proved oil globules to occur; sugar has been supposed to exist, though never actually proved; and Pringsheim has claimed to have found organic acids. In his new work Pringsheim adds some other substance—"hypochlorin" and "tannin vesicles."

As to the formation of the chlorophyll apparatus. Firstly, of the corpuscular skeleton. Sachs first distinctly described it as an aggregation of molecules round specific centres (under conditions requisite for growth), which subsequently become coloured. At a very early period it was urged by Mohl that in some cases the starch particles were the primary factors round which the corpuscle became aggregated, and this view apparently has some warranty from recent investigations by Haberlandt, Mikosch, Stohr, and others into the history of false corpuscles.

For the development of the colouring matter two external conditions are necessary—(*a*) Light of not too high or too low intensity. Seedlings of some plants develop chlorophyll in darkness, this being a primary condition only. If light insufficient, a blanching is seen, Etiolin being formed, a substance which has given rise to controversy; Kraus holding it to be identical with xanthophyll, Pringsheim, on the other hand, regarding it as a different substance. (*b*) Temperature of a certain degree, the limits varying in individual cases. Both inorganic and organic substances are required for the composition of the colouring matter. Amongst the former iron is important. The various organic matters, both nitrogenous and non-nitrogenous, formed in or taken into the plant supply the chief material for the chlorophyll, and their application to this purpose, and the time and place relations of the formation of the chlorophyll, has been the subject of great controversy and much speculation, being intimately bound up with the question of the function of the whole chlorophyll apparatus. In like manner, the formation of the various contained bodies is involved in a discussion of the function of the apparatus.

Two series of phenomena exhibited by the chlorophyll apparatus, or its parts, under the influence of light, are of importance. Firstly, heliotropic phenomena are exhibited. As Böhm first observed, the corpuscles in daylight coat the upper and under surface of the cell-walls of horizontal leaves, and in darkness are only found on the side walls, producing thereby a variation in intensity of colour on the surface of the leaves. Secondly, chlorophyll and the contents of the corpuscles are constantly undergoing destruction and reformation. As regards the colouring matter, this destruction is a local effect due to light (yellow rays), as Batalin, Sachsse, Askenasy, and others have shown. Leaves become yellow under this process owing to the more sensitive cyanophyll portion of the chlorophyll having been destroyed. The destruction is supposed to be a process of oxidation. This is not to be confounded with tinting of leaves in autumn. The reconstruction of the colouring matter is dependent upon the nutrition of the plant, and is thus involved in the question of the function of the chlorophyll. As regards contents of the corpuscles, Sachs first showed how starch disappears during the night and appears during the day, and oil globules also disappear.

What is the physiological significance of the chlorophyll apparatus, has been, and is still, a question of much discussion. Sprengel and Turpin, who supported the vesicular theory (globuline they termed the corpuscles), considered each corpuscle an Alga, and these by division and apposition formed tissues. Amici and Dutrochet recognised in the corpuscles the scattered elements of a diffused nervous system. By all other observers the apparatus has been associated with the vegetative life of the plant, and it has been generally assumed that its property is to separate in light the carbon from the CO_2 of the atmosphere, the C then combining with the elements of water forms a substance which is applied to the purposes of the plant's growth, the O being given off. Sachs first termed this assimilation—we now speak of it as carbon-assimilation. It is a feeding process, and must be carefully distinguished from respiration. This carbon-assimilation is by all admitted as a fact, and as in some way or other connected with the presence of chlorophyll, but what is the relation, and what are the first products formed in the assimilation, have been the basis of numerous and conflicting hypotheses advanced. That starch and oil and other substances in the corpuscles are products of the carbon-assimilation is accepted—the process by which they result, and how far the chlorophyll is concerned, is the matter for discussion. There has also been controversy as to the light-rays which bring about the assimilation. Lömmel advanced a purely physical hypothesis, assuming that the rays most strongly absorbed and of the greatest mechanical intensity, were efficacious. But this has been quite disproved, and the rays most efficient are the yellow and adjacent ones.

The chemical assimilation hypothesis may be arranged in three groups according to the part the chlorophyll is supposed to play in the process:—(*a*) Those which assume chlorophyll to be formed before assimilation, and to cause it directly. To this we have subscribing Liebig, Böhm, Sachs, Pfeffer, Risler, Horsford, Bayer, Erlenmeyer, and others. (*b*) Chlorophyll is formed in the process of assimilation, and is both a consequence and a cause of it. The chief supporters of this hypothesis are Kraus, Wiesner, and Timarjaseff. (*c*) Chlorophyll is formed in assimilation, and is a consequence only. Meyer, Mulder, and Morot, and recently Sachsse, have advanced this view. The details of the process are regarded by those supporting the same hypothesis by no means in the same way, and the first assimilation product is different in the opinion of the several observers. Thus Liebig supposed a gradual deoxidation taking place, resulting in the primary formation of organic acids. Risler and Horsford attributed the process to iron salts in the chlorophyll, the former maintaining that iron protoxide becomes converted into peroxide; the latter regarding iron phosphate (of which Fremy's phylloxanthine, one of his supposed constituents of chlorophyll, consists) as the main agent by which the chlorophyll reduces the CO_2. Bayer and Erlenmeyer assume a dissociation of the CO_2 the former recognises a likeness between chlorophyll and hæmoglobin of the blood, in that it can fix carbonic oxide, and sunlight then reaching the CO_2 a dissociation takes place, oxygen is given off, and the CO remains fixed with the chlorophyll, and then the simple reduction of CO to formic aldehyde takes place, and this last is the primary assimilation product; the former holds that formic acid and hydrogen peroxide result, and then subsequently the formic acid is broken up and methyl aldehyde ultimately formed. Böhm, Sachs, and Pfeffer regard the action as catalytic, the details of the process being unknown, and assume that starch is the primary assimilation product. Of those who take chlorophyll to be a consequence as well as a cause of assimilation, Timarjaseff assumes a dissociation of the CO_2, and the CO combines with one of the elements of chlorophyll which has been decomposed by the light, and more chlorophyll is formed. Kraus assumes a substance, leucophyll, which with chlorophyll exists in a plant; the latter results from the former by its combination with the product of a reduction of CO_2. This reduction is effected by leucophyll in light, and the combination takes place by a predisposing affinity. Wiesner assumes that as in light and air a chorophyll solution is oxidised, the like must go on in the plant, with this difference, that no free oxygen but the oxygen from the CO_2 is used for oxidation of the chlorophyll, and the chlorophyll is thus the reducing element of the CO_2, a carbohydrate being ultimately formed. Sachsse revives an old hypothesis of Meyer, Mulder, and Morot. Chlorophyll is, he says, one of the first assimilation products, and the mother substance of starch, and, on the other hand, starch may be converted into chlorophyll. The xanthophyll element is first formed, and thereafter, with the taking up of nitrogen, the true green matter is formed.

From amongst these conflicting theories, and the irreconcilable statements made in their support, it is difficult to form a satisfactory opinion as the true process of assimilation. By chemists especially, however, the influence of the protoplasm in the decomposing and synthetic processes has been practically ignored. Sachs and Pfeffer recognise that it is a factor to be considered, and Borodin's investigations upon asparagin show the important relation between carbohydrate and nitrogenous-compound formation.

Perhaps the most widely accepted hypothesis of carbon-assimilation and the physiological significance of chlorophyll is a modification of that supported by Sachs and Pfeffer, whereby the chlorophyll is recognised as the cause of the process (how is inexplicable at present), and the first visible product is either starch or oil. The process by which this is brought about being probably that suggested by Bayer, the formation as the primary product of formic aldehyde.

This brings us to the publication of Pringsheim's views. For some years past he has been engaged with an investigation of the character of chlorophyll-corpuscles, of the action of light upon them, and the function performed by chlorophyll in the plant. His investigations, whether we agree or disagree with his conclusions, form a most valuable contribution to the elucidation of a complex subject, and his hypothesis regarding the part performed by the green colouring matter is an ingenious and a very interesting one.

His method of investigation, in addition to that of ordinary micro-chemical observation, has been what he terms microscopical photo-chemistry, by which the action of light on the contents of the plant cells, and the light and heat absorption in the several elements of the cells, and the activity stored up within the tissues by the sun's rays, may be observed directly under the microscope. Light is concentrated on the plant-cells under the microscope, and the effect of the sun's rays and the component parts thereof are readily studied.

And, firstly, must be noticed his observations on

Structure and Composition of Chlorophyll-corpuscles.

In micro-chemical investigations of chlorophyll-corpuscles hitherto made a solvent has been generally used for separating the colouring matter from the ground-substance of the corpuscle, a method possessing the disadvantage that other substances besides the colouring matter are extracted in the solution from the corpuscle, and these have not been sufficiently distinguished and separated from the colouring matter. In Pringsheim's investigations a new method, against which such objection cannot be raised, has been employed. It consists in warming green tissues in water or subjecting them to the action of steam or treating them with dilute acids. Different effects are produced according as one or other, or a combination of these agencies, is made use of; but they coincide in this general effect, that they cause the colouring matter, along with certain fluid or semifluid substances accompanying it, to exude from the chlorophyll-corpuscles in the form of larger or smaller drops, while these coat the periphery of the decolorised skeleton or ground-substance which itself retains the original form of the corpuscle.

If a portion of green tissue be warmed for fifteen minutes to an hour in water of a temperature of 50° to 80° C., or if it be suspended during fifteen minutes to several hours in a flask, so as to be in contact with the steam of boiling water (the degree of temperature and the time required for the action varies with the tissue taken; in most cases boiling the tissue for five minutes is the quickest and most convenient procedure), viscid drops of varying size become visible at the circumference of the chlorophyll-corpuscles. They may be watched exuding from the substance of the corpuscle, in number depending upon the duration of the operation. Always coloured, they are usually chlorophyll-green, but this may be brighter or darker, and the tint in some cases is yellow or blue-green, occasionally olive-green, more seldom reddish-brown. They are completely soluble in alcohol and ether, and consist of the colouring matter with an oily basis, which is the vehicle holding it and the substances accompanying it in solution.

In proportion as the exudation proceeds, the ground-substance is decolorised, and the colouring matter may be completely removed from it. The structure of the ground-substance then becomes visible, and it appears under a high magnifying power as a skeleton, having the shape of the original chlorophyll-corpuscles, composed of a soft substance differentiated to form a hollow body, the circumference of which is abundantly pierced in a sieve-like manner. It has, in fact, the character of a hollow sponge. It is difficult to accomplish complete decolorisation by heating in warm water alone, and this is best and most easily brought about by a combination of warmth and dilute acids. The character of the tissue must be taken into account, as for different tissues one or other method may be more favourable. This character of the ground-substance becomes evident if the corpuscle be decolorised by alcohol or other solvent, and also, as will be presently described, by the action of intense light; and the fact that the operation of these different agencies demonstrates the same structural characters in the decolorised chlorophyll-corpuscles is strong evidence that this is also the structure of the corpuscle under normal conditions. Chlorophyll-bands, plates, and masses show equally well this structure.

These, the normal effects of heating a tissue in water or exposing it to steam, may be complicated by the temperature being so high as to affect the starch contained in the chlorophyll-corpuscles, and by causing the granules to swell and rupture the corpuscle, thus destroy its form. All tissues are not equally sensitive in this way. Some may be subjected for hours to the action of water at a high temperature, or to steam, without the chlorophyll-corpuscles losing their structural character, whilst in others a few minutes suffices to cause them to lose their form and to coalesce; or, and perhaps more usually, whilst retaining their individuality, they swell internally and rupture, and then appear as irregularly burst hollow spheres. The amount of starch present in the chlorophyll-corpuscles determines to a certain extent the rapidity of this effect. The more starch present the more certainly and the more easily will it be produced; but there are many tissues in which starch is present, and yet there is complete immunity from this action. This rupturing of the chlorophyll-corpuscles, due to the starch, must be distinguished from the exudation of colouring matter and its accompanying substances already mentioned, which is quite independent of the starch content, and is brought about at a much lower temperature.

The exudation of the coloured drops appears to be the mechanical effect of a simple swelling of the ground-substance due to its absorbing water, and it thereby exercises a pressure upon and squeezes out the vehicle holding the colouring and other matters in solution which fills its meshes.

The effect of treating green tissues with dilute acids is somewhat different, and has led to the discovery of a universally present constituent of the chlorophyll-corpuscles,—hypochlorin. Hydrochloric acid, in the proportion of 1 vol. to 4 vols. of water, is the most favourable for the detection of this substance. But others may be used, *e.g.*, sulphuric acid, 1 vol. to 20–40 vols. of water; glacial acetic acid, 1 vol. to 2–4 vols. of water; picric acid, 1 vol. to 3–6 vols. of water; these, however, require much care in application, and are less certain in their effect than hydrochloric acid, which has been chiefly used in these investigations. Glacial acetic acid, 1 vol. to 2 vols. of water, is specially favourable for bringing out the perforated wall structure of the chlorophyll-corpuscles.

In specimens preserved for some years in Hantz's fluid, in dilute glycerine, and in chloride of calcium, hypochlorin was observed to have exuded from some chlorophyll-corpuscles.

If a green tissue be treated with dilute hydrochloric acid, a sudden change in colour is the only immediate effect apparent; the whole tissue, like the chlorophyll-corpuscles in the cells, acquires a yellow-green, gold-yellow, or brownish tint. No decomposition of the green colouring matter has taken place, nor is it dissolved by the acid, and the chlorophyll-corpuscles are unchanged in form and structure, But after a few hours there appear in the substance of, but chiefly near the periphery of the chlorophyll-corpuscles, dark reddish-brown or rust-coloured, soft, greasy masses, hardly of the nature of drops, being of irregular form, and sometimes showing a firmer limiting layer or pellicle. These, which are distinguished by their larger size, irregular form, colour, and denser consistence, from the drops exuded after warming with water, appear invariably in all plants, whatever their position in the vegetable kingdom, and whatever be their habitat, whether land, fresh or sea water, that contain chlorophyll, be it attached to isolated chlorophyll-corpuscles or to variously shaped masses, and they appear equally in those which contain starch or oil in their corpuscles and in those which have no starch. The following are some of the plants in which these have been specially observed:—Amongst *Algæ*, species of *Ulothrix*, *Draparnaldia*. *Chætophora*, *Aphanochæte*, *Coleochæte*, *Mesocarpus*, *Spirogyra*, *Cladophora*, *Œdogonium*, *Bulbochæte*, *Closterium*, *Miasterias*, *Pediastrium*, and in *Enteromorpheæ*, *Cladophoreæ*, from the German Ocean. Amongst mosses, in the protonemata, leaves and stems of *Mnium*, *Hypnum*, *Fontinalis*, and *Sphagnum*. Amongst vascular cryptogams, in pro-embryos of *Pteris*, *Blechnum*, and *Gymnogramme*, and in leaves of species of *Selaginelleæ*. Lastly, amongst Phænogams, in leaf tissues of *Taxus*, *Zostera*, *Vallisneria*, *Elodea*, *Ceratophyllum*, *Heliconia farinosa*, *Tilia*, and *Ampelopsis*. This effect is not observed in plants that are not chlorophyll green, *e.g.*, in *Phycochromaceæ*, *Diatomaceæ*, *Phæosporeæ*, *Fucaceæ*, *Florideæ*, and *Fungi*,—traces of it only were observed in some stages of their life history in diatoms,—although the exudation of colour drops after warming in water may be observed. The *Vaucherieæ* are a curious exception, as in them frequently no trace of the action is visible.

After a short exposure to the acid, in from six to sixty hours, the rust-coloured masses begin to change in appearance. They become angular and spikey, and form on the surface of the corpuscle more or less broad scales or nests, with an indistinct crystalline texture, from which sharp-edged and pointed prolongations develop, or they form cloud-like precipitates with firmer embedded pieces. At a later period still further changes take place, and these go on equally well if the specimen be left in the acid or removed to pure water. From the irregular masses are developed short, stiff, straight (often rhombic), or crumpled or wavy rods, like the so-called rods of the waxy coating on *Musaceæ*, having blunt or pointed ends; or the productions are long, firm, straight, or coiled needles; or delicate flexible filaments. No differentiation is observed in these crystalloidal masses, except occasionally in some of the rods, when, owing to a slight condensation of the periphery, a double contour is shown.

As the rust-brown masses first appear within the periphery of the chlorophyll-corpuscle, they have the appearance of confluent oily drops, in consistence, outline, and movement resembling a volatile rather than a fatty oil. And the subsequent formation from them of the crystalloidal processes probably results from the conversion, at least in part, of the oily substance into resin. The whole of the exuded mass does not assume the crystalloidal form, but there is always a remnant of the original substance left like a mother liquor, out of which the crystalloidal bodies have solidified. There is, then, here a mixture of substances with which the colouring matter of the chlorophyll-corpuscle is in part incorporated, which being insoluble in water, dilute salt solutions, and acids, and completely soluble in alcohol, ether, benzol, bisulphide of carbon, petroleum, volatile oils, &c., must be referred to the group of resins and fats. The colour of the mixture depends upon the modified chlorophyll, for the more highly-developed crystalloidal processes, if exposed for a short time to light, change colour and get lighter, often bleaching slowly from the point backwards, and in this way may become quite colourless. The crystal-like projections and the short rods are often from the first destitute of colour.

It is that constituent of these extruded masses which forms the crystalloidal bodies, or rather the form in which it pre-exists in the chlorophyll-corpuscle, that is termed hypochlorin. Is it an independent constituent of the chlorophyll-corpuscle, or is it derived from the green colouring matter by the action of the acid?

Were it a product of the action of the acid on the green colouring matter its presence should be indicated in every chlorophyll-corpuscle when treated with the acid, for there is no reason to doubt that the characters of the chlorophyll-corpuscles in a normal tissue, in one and the same cell at least, are essentially alike. But this is by no means the case. Often the crystalloid bodies develop only upon a few chlorophyll-corpuscles in a cell, and are absent from the others, or they may be entirely absent from one or more cells in a tissue otherwise rich in the substance. Again, in the majority of *Algæ* where the chlorophyll is attached to masses of various forms, whilst hypochlorin is rarely entirely absent from a cell or from a filament, the amount present varies much both with the season and with the stage of development of the cells.

This sporadic distribution of the hypochlorin, while it indicates the existence of this substance as a general constituent of the chlorophyll-corpuscles, independent of the colouring matter, points also to its function as a formative material, like starch and oil, in the chlorophyll-corpuscle, and its detection will depend upon whether it has accumulated or been used up in the chlorophyll-corpuscle; the amount discoverable at any time representing excess of supply over demand at that particular moment.

In plants with chlorophyll-bands or plates, further evidence of the presence of hypochlorin as a distinct and independent body is afforded by definite anatomical relationships of the crystalloid outgrowths to the chlorophyll-masses. In *Spirogyra*, for example, they appear at widely and almost equally distant points on the edge or middle line of the bands. The same is observed in those *Œdogonieæ* that possess chlorophyll-bands, and in *Draparnaldia* the crystalloids, always few in number, occur on the crossing chlorophyll-bands. In all cases, too, they appear preferably at the periphery of the amylum-bodies in the bands, and before starch is visible in these. So universal is this that any spot where hypochlorin is observed not in relation to an amylum-body may be assumed to be a seat of election for one. The constancy of the appearance of hypochlorin on the periphery of the amylum-bodies, suggests a genetic connection between them, and seems to indicate that hypochlorin plays an important part in the nutritive function of green cells.

An anatomical fact, hitherto unrecognised in the organisation of *Spirogyra*, may here be noticed. The threads of protoplasm extending outwards from the central plasma mass in each cell do not, as was supposed, end in the general protoplasmic lining of the cell wall, but each passes directly or by its branches to the internal surface of a chlorophyll-band, and there dilates in a trumpet-like manner, and grasps, as it were, an amylum-body. If, as sometimes occurs, there is no amylum-body visible at the point where the thread is in contact with the chlorophyll-band, the spot may be considered one where such a body will subsequently appear. As the amylum-bodies increase by division, the grasping protoplasmic thread also divides by forking, and thus each daughter amylum-body is grasped by a protoplasmic thread; and, on the other hand, the protoplasmic threads may divide in the first instance, and a new amylum-body is subsequently formed in the chlorophyll-band at the extremity of the new protoplasmic thread. As an outcome of this mode of increase, the adjacent amylum-bodies are often connected bridgeways by threads of protoplasm; and as longitudinal division of the chlorophyll-bands often proceeds synchronously with the multiplication of the amylum-bodies and the forking of the protoplasm threads, the amylum-bodies so connected may be in different spires of the chlorophyll-band. In the angles of the forks of the branching protoplasmic threads there is usually visible in strongly growing *Spirogyra* filaments a thickening of the substance of the thread in which a vesicle, perhaps a kind of amylum-body, lies. There is, then, in *Spirogyra*, a direct connection through the threads between the amylum-bodies themselves, and also between them and the nucleus.

These very definite anatomical relationships render *Spirogyra* a very favourable subject for future investigation of the condition in which hypochlorin exists in the fresh cell when unacted on by acids. It is not, indeed, difficult to observe in its chlorophyll-bands before they are treated with acid, signs betraying the existence of some peculiar substance. If a cell of *Spirogyra crassa*, or other large species rich in hypochlorin, be slightly injured, either by mechanical pressure or by warming (up to 30°–40° C. according to the species), so that but little disturbance of cell-content is produced, there are seen in the projections at the edge of the chlorophyll-bands and beside the amylum-bodies, that is, at the exact position where hypochlorin becomes visible when an acid is employed, large clear vacuole-like spaces filled with strongly refractive oil-like matter. These, which have not been hitherto generally noticed, differ from the small fat-particles abundantly distributed through the bands by their larger size, more fluid content, and the possession of a limiting pellicle. A slight contraction of the band in breadth is associated with their appearance, and the projections on the edge of the band disappear. After very slight warming the large vacuoles may be readily observed at the edge of the band to rupture their skin, and their fluid content is disseminated in the surrounding protoplasm lining the cell wall. In large species of *Spirogyra* a spontaneous coalescence of the vacuoles may often be witnessed.

The position of these vacuoles leads to the conjecture that it is their oily content which forms the hypochlorin excrescences, a conjecture quite conformable with the easy destructibility of hypochlorin in green tissues. For this accumulation of oily matter in vacuoles, the ready escape of the same, and its dissemination in the protoplasm under slight mechanical or thermal influences, affords an explanation of those cases where the hypochlorin reaction is absent or suppressed, and further explains the results, now to be described, that follow when green tissues previously warmed in water are treated with dilute acids. After such treatment the hypochlorin reaction is suppressed.

If a tissue which has been warmed in water, and in which the characteristic exudations have been developed, be treated with dilute hypochloric acid, no hypochlorin masses are formed, neither on the coloured drops nor on the ground-substance of the chlorophyll-corpuscle, provided that the duration of warming and the temperature have been sufficient for the tissue and species examined Usually the only visible effect is a slight change to a browner tint of the coloured drops. The time and temperature limits vary considerably with the species. Thus, for *Mesocarpus scalaris*, which is very rich in hypochlorin, five minutes' exposure to a temperature of 42°–43° C. suffices; *Cladophora* requires five to fifteen minutes at 50° C.; in *Spirogyra*, *Ulothricheæ*, *Coleochæteæ*, *Œdogonieæ*, and their allies, a temperature of 45°–50° destroys the reaction. For plants with isolated chlorophyll-corpuscles, such as *Chara* and *Nitella*, and soft-leaved plants as *Elodea*, *Callitriche*, &c., a quarter to half an hour in water of 50° is enough. *Fontinalis* also takes fifteen minutes at 50° C. In *Mnium*, fern embryos, *Selaginella*, and in *Vallisneria*, a longer time at 50° C. is required, or the temperature must be raised to 60°–80° C. Boiling or steaming brings it about more rapidly. Fifteen minutes steaming is enough, as a rule, though at times half an hour or an hour is wanted. It would appear that in all these cases the hypochlorin is destroyed by heat, and vanishes without damage to the colouring matter or destruction of the chlorophyll-corpuscle or mass itself.

Other hurtful influences, which only to a slight extent change the normal character of the cell-content, destroy the hypochlorin without there being any visible change in the chlorophyll-corpuscle itself. Cells in such an abnormal or unhealthy state occur frequently in cultivated specimens of *Spirogyra* or of *Nitella*. They can easily be produced artificially if the conditions of life are made unfavourable. If a cell of *Spirogyra* be injured mechanically, or if the conditions for its existence are not suitable, the first sign of unhealthiness is seen in the chlorophyll-bands, which lose their outline, contract, and if the conditions be continued disintegrate to formless particles. Such signs are very frequently indication of a faulty nutrition only. The colour of the bands is not in the least affected, and the amylum-bodies and oil-drops remain undestroyed. Many cells in a filament may be quite healthy, and others may show all stages of commencing sickness. On treating with hydrochloric acid, the healthy cells alone show hypochlorin, none is found in the unhealthy cells, or only a slight trace when the diseased state is not very pronounced. It is possible that some of the cases already referred to where one or more cells in the midst of a tissue rich in hypochlorin show no trace of this substance, and in which the hypochlorin was supposed to have been completely used up in the nutritive process, are instances of disease. The cells, though not visibly so, may be really in an abnormal condition, which has resulted in and is made known by the loss of their hypochlorin.

Associated, then, with the colouring matter, hypochlorin is a substance universally present under normal conditions in chlorophyll-corpuscles, whatever their shape. These having the structural character of a hollow sponge or network, their meshes are permeated by the hypochlorin and the oily vehicle with the colouring matter, which can, by the methods mentioned, be readily extracted. In the interior, too, of these hollow perforate chlorophyll-corpuscles, the secondary deposit of starch and such like formative material takes place. The whole organisation of the chorophyll-corpuscles is thus admirably suited for the performance of their function, and they are peculiarly fitted for absorbing and condensing gases.

Next may be noticed his observations on—

Effect of Light.—Paralysis and Death from Light.

The time which elapses before visible effects appear in a cell exposed to intense light varies according to the specific energy of the cell. In most plants, and without exception in green plants, a few minutes suffice for their appearance, and the extent of the action can be regulated so that transformations may be brought about in the cell-content without injury to the life of the cell, or paralysis and death of the cell may be produced. Some cells, however, especially non-green ones, for example, colourless swarm-spores which are very sensitive to heat are but slightly affected, and may remain for half an hour or more exposed to the concentrated white light without injury,—an important fact, as showing that a cell is not of necessity killed or injured when exposed in water to the heat which is generated in the focus of a large lens.

For investigation of the effect of intense light on green tissues, *Algæ*, *Characeæ*, moss leaves, hairs and soft leaf-tissues of *Fluviales*, are favourable subjects, as in them the effect is generally apparent in from two to six minutes.

If species of *Spirogyra*, such as *nana*, *jugalis*, *quinina*, or *Weberi*, be exposed to intense light, the effect immediately observed is complete disappearance of colour from the chlorophyll-bands. The ground substance remains unchanged in form and disposition, and the marginal projections and amylum bodies persist. The band appears as if acted upon by alcohol, and the decolorisation is limited to the insolated area, though at times there may be a slight halo. It is possible to restrict the action of the light to one coil of the chlorophyll-band or to a portion of it, or, if a plant be employed with isolated chlorophyll-corpuscles, some or a single corpuscle may be acted upon.

But, besides destroying the colouring matter, the light affects the cell-contents also, and especially those elements concerned in respiration and nutrition. In *Spirogyra*, which, in consequence of its organisation (with the nucleus embedded in a central plasma from which threads radiate to the periphery, and with a granular motion in the protoplasm between the chlorophyll bands), is very suitable for study, either before or after complete decolorisation of the bands, an extending destruction of the cell-contents is observed. The motion of granules in the protoplasm of the cell-wall ceases. The threads of protoplasm contract and pull thereby the middle part of the coils of the chlorophyll-bands deep into the lumen of the cell, and at the same time a portion of their substance withdraws to the central plasma-mass, which swells into a large vesicle with a distinctly double-contoured membrane of considerable thickness. Then the threads rupture, and the proximal ends remain as fragments attached to the central plasma, whilst the distal portions adhere to the amylum bodies. Whilst these changes are progressing there appear upon the threads small, defined, vesicle-like formations, which are undoubtedly distinct morphological structures, and in the normal uninsolated cell are occasionally seen, as before mentioned, at the forks of the threads. These plasma-knots, as they may be called, which are also to be seen in *Spirogyra* cells killed by other means, are withdrawn with the substance of the thread to the central plasma, and coat its surface, often in great numbers. Through the contraction and rupture of the threads the nucleus is pushed from its central position and displaced to a greater or less extent, always surrounded by the central plasma with its coating of plasma-knots. It, along with the nucleoli, retains its form, but sometimes, at least in one-spired species of *Spirogyra*, appears to have lost portion of its substance, whilst in other cases it becomes granular in aspect and acquires a red tinge. The turgescence of the cell is markedly affected, and alterations in the substance of the layer of protoplasm lining the cell-wall, which are chiefly recognisable by colour changes, occur.

Many of these effects in the protoplasm are familiar as appearances connected with death of the cells from other causes, *e.g.*, from heat or mechanical injury; but in such cases the changes are not identical in their whole course with those just described. Here the effects are the result of a definite photochemical action, and many of them are specific of death from light, although they are combined with the general changes in the protoplasm, which appear after death from any cause.

Effects similar to those seen in *Spirogyra* occur, with modification dependent upon organisation, in other *Algæ*, with so-called formless chlorophyll-masses; for example, in *Mesocarpus*, *Œdogonium*, *Draparnaldia*, *Vaucheria*, &c., always varying in extent, up to complete death of the cell, according to the duration of exposure to light. Also in cells with definite chlorophyll-corpuscles, such as occur in *Characeæ*, *Musci*, ferns and phanerogams, like results obtain. Amongst these, *Characeæ* are most favourable for investigation on account of the power of recovery of their cells even after considerable injury, the structural relationships of these, and especially their great length, which permits of a small portion of one cell being insolated.

If a portion, ·3 mm. in diameter, of a *Nitella* cell, which is about 1 mm. long, and not too thick, be insolated, it is more or less completely decolorised in a few, usually three to eight, minutes. Quite independently of the decolorisation, except in so far as the chlorophyll colouring matter acts as a screen, the destruction of the cell-contents begins, and may extend until the whole content is killed. It is possible, however, to regulate the action so that death of the cell shall precede complete decolorisation of the insolated area, or shall succeed it, or that the only effect shall be the destruction of the colouring matter without injury to the life of the cell. This depends, in the first instance, upon the specific energy of the plant, but also upon the depth and the size of the cell.

In deep plant cells, such as those of adult leaves, or the internodal cells of *Nitella*, which are lined with a dense persistent layer of chlorophyll-corpuscles, the depth of the cell and the protection of the layer of chlorophyll-corpuscles have great influence in modifying the action. The cell in such a case lies with its lower, or an ideal median, or its upper surface in the plane of most intense illumination, and the parts above or below such plane must be affected in a different degree. The layer of chlorophyll-corpuscles on the lower surface of the cell will protect in great measure the portions above so long as the chlorophyll colouring matter is not destroyed, and in like manner the centre of the layer of chlorophyll-corpuscles on the upper wall of the cell will be sooner decolorised than the sides of the cell, where many rows of chlorophyll-corpuscles lie over one another. In *Spirogyra* like circumstances have to be considered, but only in small degree even in the species with deep cells, because of their small diameter, and also because the lower flexures of the bands afford but a small protection to the upper. Yet one finds that the points on the upper flexures where the lower flexures cross them, especially at the edges of the cell-wall, and the spots where the bands commence to bend on the lower surface of the cell, are later in being decolorised than the freely-exposed and unprotected parts. A simple unscreened layer of chlorophyll-corpuscles, or a chlorophyll-plate, such as that of *Mesocarpus*, when it lies in a plane at right angles to the light, is decolorised in from one and a half to two minutes. The layer on the upper wall of a *Nitella* cell requires in light of equal intensity five to eight minutes of insolation.

But the length of the cell modifies the destruction of the cell-content when exposed to intense light. As the protoplasm in the cells of *Nitella* is in constant slow streaming movement during examination, any one portion of the protoplasm is only subjected for a relatively short period to direct insolation, dependent, indeed, upon the size of the insolated area as compared with the size of the whole cell, and thus the protoplasm is acted upon by the light interruptedly. Each portion of the protoplasm, as it rotates round the sides of the non-illuminated part, is protected from light, and only again is acted on when it reaches the insolated area.

In *Nitella* the destruction of the chlorophyll colouring matter depends therefore mainly upon the depth of the cells, whilst the destruction of the protoplasm is also influenced by the length of the cell; so that the immediate appearances in the local destruction of a *Nitella* cell may be very different.

If the cell be a long and strongly-grown one, the complete decolorisation of the insolated part may occur without any trace of further destruction of content. The chlorophyll-corpuscles in the non-illuminated part remain normal in form, colour, and disposition. The neutral zone persists, and there is no retraction of the protoplasmic utricle from the cell-wall. Rotation of the protoplasm and contained bodies shows, as a rule, no visible disturbance; there may, however, occasionally be a momentary cessation of the movement.

In other cells, and specially if the insolation of a limited area be rapid, death throughout the whole cell may occur long before complete decolorisation of the insolated part, or even before the chlorophyll-corpuscles in this position show much trace of it. The first striking change in such a case is stagnation of rotation, with which is associated an irregular aggregation of the protoplasm at the insolated area which hinders the movement. Upon this follows an extending destruction of the cell-content. The green chlorophyll-corpuscles throughout the non-illuminated portion fall into disorder, lose their arrangement in rows, and swell in a manner commonly seen in them when they escape from the cell; they change their polyhedral or oval form and become, by the absorption of water, transformed into vesicles such as Göppert and Cohn describe, and their contents, hitherto hardly recognisable, now appear sharply circumscribed. Finally, the protoplasmic utricle separates from the cell-wall, and all the signs of death from light are apparent. In the insolated part the chlorophyll-corpuscles exhibit none of these changes, nor does the protoplasmic utricle separate from the cell-wall; and this portion may remain in this condition for months, long after the adjacent chlorophyll-corpuscles have disintegrated.

If before death is set in and before the chlorophyll corpuscles are completely decolorised the light be interrupted, then the partly or almost entirely decolorised chlorophyll-corpuscles separate from the utricle and fall into the rotating protoplasm, and with the formed elements circulate uninterruptedly in its current, forming often small heaps of corpuscles without disturbing the rotation; and though they gradually lose colouring matter, and after a time are quite colourless, they suffer no further change in form or substance. By degrees in this way the insolated part becomes deprived of chlorophyll-corpuscles, and may get quite bare of them; and *Nitella* cells in this condition may be kept for months unchanged, the rotation continuing vigorous, and the formed elements in the protoplasm and the chlorophyll-corpuscles in the non-illuminated area retaining their normal form, colour, and arrangement.

In other cases, again, if the action of light is of a high intensity, and the insolated area is decolorised without the rotation being stopped, there are often developed, especially in long cells and when the insolated area is in the middle of the cell, two currents instead of one, which rotate at opposite ends of the cell, each independent of the other, and separated from one another by the insolated area, which is a barrier to the movement.

But this action of light is not confined to green tissues. Non-green cells—for example, the blue-sapped hair cells on the stamen of *Tradescantia virginica*—are affected in the same way, and paralysis and death may be produced. Paralysis may occur before or after destruction of the blue colouring matter of the cell-sap, and the circulation, which is temporarily suspended, may after a longer or shorter time return without the cell having suffered at all. Death occurs in them also before complete destruction of the colouring matter. Whenever the colour changes to violet the protoplasm is killed, circulation is stopped and never returns, and the protoplasm threads become granular, in part disappear or rupture irregularly, and the protoplasmic utricle, separating from the cell-wall, collapses. A slight separation of the cuticle over the insolated area is sometimes seen.

All these effects just described are dependent not only on the high intensity of the light, but also upon its colour and the affinity for oxygen of the cell-contents. All of them are produced rapidly and energetically in white light. In coloured light, on the other hand, there is not only a marked retardation in rapidity of their appearance, but in red the light effect is suppressed, although in dark green and blue the changes are completed in a few minutes. The decolorisation and death of the cells, which in white light are brought about in two or three minutes, are accomplished in about five minutes in green and blue light. All these researches show that in any yellow, green, or blue light it is easy to decolorise and kill the cells of many *Algæ*, *Characeæ*, *Musci*, *Filices*, and *Phanerogamæ*, provided the colour employed is not too dark; whilst in red light of the same intensity, and after twice or four times as long exposure, no changes take place, and the red rays therefore appear to be protochemically inactive, or at least only very slightly active, on plant-cells.

That these effects are not due to the heat, considerable as it must be in some coloured lights, generated at the focal point of the large lens used, is evident from a comparison of the changes accompanying death in cells from heat with those here described. The destruction of the colouring matter will not be confounded in the two cases, but the changes in the protoplasm, the paralysis and actual death of the cells, are alike, though not identical, from both causes.

The relation of the action of light to the chemical processes in plant cells is made more clear when the plants exposed to the intense light are placed in different gases or gas mixtures. If *Spirogyra* or *Nitella* cells are exposed to light of any colour, and the ordinary atmosphere of the gas chamber is replaced by one of hydrogen free from oxygen, or of a mixture of hydrogen and carbonic acid, they show after twenty minutes no change of colour or their normal character, and may be kept in this condition for weeks, provided other detrimental agencies are excluded. Indeed, green and non-green cells which, in presence of oxygen, even in the relatively cold green and blue light, are killed after an exposure of three to five minutes, remain uninjured when oxygen is excluded in light of any colour, so long as the exposure is not so protracted as to allow of development of hurtful heat effects. The temperature obtaining in such cases in the cell-contents, in each chlorophyll-corpuscle and in each plasma-molecule, high as it must be, cannot then be the essential cause of the appearances produced. The substitution of hydrogen for the ordinary air is accompanied by no reducing action causing warming of the object. The light and heat absorption of the chlorophyll-corpuscles and the other constituents of the protoplasm remain unchanged, and heat effects and conduction are essentially alike in both atmospheres. If, therefore, the destruction of the cell-contents takes place in an atmosphere containing oxygen, but is in abeyance when no oxygen is present, those molecular changes, through which dark heat rays kill the cell at a lower temperature, do not proceed in the protoplasm. The correct explanation of the appearances seems to be that the light influences the relation of the plant to the oxygen of the atmosphere, and that the illuminating rays increase the chemical affinity of the cell-contents for oxygen. The amount of this action is dependent on the colour of the illuminating rays, and increases with their refraction from the red to the blue end of the spectrum.

The red rays have been shown to have no distinct photochemical effect. This is true, however, only for rays of a very definite position in the spectrum, from the extreme red to those of a wave length of ·00061 mm. But even under these, after prolonged exposure, or if the cells are very sensitive, small effects are visible, though it may be doubted whether all are purely chemical and some are not thermal. The absolute non-activity of the red rays is not maintained, but what is established is this, that the amount of the oxidising action of light on the plant cells sinks in a very striking manner towards the red end of the spectrum. The increase in activity towards the blue end has not as yet been quantitatively estimated, and a curve, expressive of the relative amount of respiration in the cells for the different rays of the spectrum, cannot therefore be drawn. Indeed, the varying intensity of illumination which must occur in the concentration of light upon dense masses, the great difference in intensity produced by slight deviations of the object from the plane of intense illumination, and the want of a standard for finding the amount of action within the cells before they are killed by the light, make such a quantitative determination almost impossible. All that can be said from a consideration of the light absorption in the chlorophyll colouring matter is, that generally a rise, and a decided rise, of effect takes place in the blue.

But careful consideration of the intensity of the active colour is necessary, for it is found that in high intensities the cells are killed more rapidly in yellow and green. A dark and light solution of copper chloride, which differ little in breadth of their absorption spectra, show a great difference in their effect upon the plant cells. Thus, light produced by transmission through a 10 mm. thick layer of copper chloride solution, acts very slightly; whilst one with a spectrum produced by a 5 mm. thick layer of the same solution, and which has a trace of blue, causes a much stronger light effect. Blue light produced by a solution of ammonia copper sulphate, although this absorbs blue rays to a great extent, and therefore in a concentrated condition allows but a feeble blue light to pass, acts equally strongly. If a comparison is to be made between the light action of blue and green rays so produced, the blue light solution must not be too dark, for this has led to many errors concerning the energy of colour in assimilation; and it must also be remembered that the light solutions of ammonia copper sulphate allow a little of the dark green to pass, and brighter copper chloride ones give passage to even more blue. The feebly illuminating blue rays appear then more active than the more strongly lighting green; and this throws an unexpected light on the significance of green colour to vegetation, for the blue rays which are most active in producing oxidation of the cell-contents are almost completely absorbed.

The destructive action of intense light in plant cells proceeds only in presence of oxygen. Some only of their constituents are oxidised, others, even in the most intense light, are incombustible. One is justified in assuming that amongst the substances in the cells which, by their behaviour in intense light, show great affinity for oxygen, are to be found the special combustible elements of normal respiration in the green tissues of plants, and that those contents which remain unchanged in presence of oxygen in intense light, can in no way under normal light conditions serve as supporters of respiration. The behaviour in intense light of the larger and well-known formed constituents of cell-contents is easily made out, but more observations are required to determine which among the more minute yet definitely-formed bodies in the protoplasm are stable and which are unstable.

(*a*) *As to the colouring matter of cells in intense light.*—The changes which the colouring matter undergoes are easily witnessed. The colour vanishes from green cells in a few minutes when exposed in presence of oxygen to intense light, though this does not occur when the light is red. No new substance is found in the cell as a product of this destruction, nor is there increase of the pre-existing constituents. It may therefore be conjectured that the colouring matter passes over directly into gaseous product of respiration. The carbonic acid present is not implicated in the destruction of the colouring matter, for in atmospheric air deprived of carbonic acid the decolorising process proceeds as quickly and energetically as in ordinary atmospheric air containing carbonic acid, whilst in a mixture of carbonic acid and hydrogen all photochemical effects are in abeyance. It would appear, therefore, that green cells placed in a mixture (varying quantitatively) of carbonic acid and hydrogen, free from oxygen gas (in which assimilation is quite possible), and exposed to the influence of intense light (which in other conditions kills and decolorises them), remain, notwithstanding the carbonic acid present, unchanged and green. This fact, that carbonic acid plays no part in the destruction of the green colouring matter, is of considerable importance in view of the theory of the function of chlorophyll colouring matter here advanced.

The cells once colorised, whether to a great or slight extent, never, even though they be not killed, regenerate the chlorophyll colouring matter. The decolorisation sets in relatively slowly, becoming manifest only after a minute or so of exposure. The case of *Nitella*, as previously described, is a very typical one.

It may, then, be concluded, from such facts, that the destruction in nature of chlorophyll is a pathological process, hurtful to the plant, and not, as has been supposed, a normal process associated with the breaking up of carbonic acid, and the fixing of carbon in the green tissues.

Ever since the days of Senebier opinions have widely differed upon the destruction of chlorophyll in light, upon the relative energy in the process of the different rays of the spectrum, and upon the significance of the process, in the life of the plant; the decolorisation is ascribed by one to frost, by another to heat, and by others to light. The only accurate method of investigation is to study the changes in the plant cells, and, as a result of the investigations here recorded, the possibility of the destruction of chlorophyll colour ing matter by intense light in the light in the living cells is proved.

Not only chlorophyll colouring matter, but also yellow, blue, and red, are in presence of oxygen destroyed within the plant cells when exposed to intense light. Yet all colouring matter found in plant cells is not so acted on; different colouring matters under like conditions behave differently. Observations are still wanted to show which are destructible and which are indestructible, and to supply the key to the relation between destructibility of these colouring matters of the cells in light and their genetic connection with chlorophyll colouring matter. As illustration: the red colouring matter of many resting spores of *Algæ*, especially oospores, is not destructible, or only with extreme difficulty, by exposure to intense light. On the other hand, the steel-blue colouring matter of the *Phycochromaceæ* (*Oscillariceæ*, *Nostocaceæ*, &c.), the brown of *Diatomaceæ*, *Phæosporeæ*, and *Fucaceæ*, and the red of *Florideæ*, in all their modifications, are, it appears, as easily destroyed in intense light as the chlorophyll colouring matter of green plants.

Colouring matter of flowers seems to behave differently. The yellow-red colouring matter of the ligulate flowers of *Calendula* is with ease completely destroyed in intense light, whilst that of *Narcissus poeticus*, in the same circumstances, remains unchanged. The blue cell sap of *Tradescantia virginica* loses its colouring matter easily, whilst other blue flowers are decolorised with difficulty, or not at all.

(*b*) *Of the ground substance of the chlorophyll-corpuscles and its included substances in intense light.*—The chlorophyll-corpuscles serve not only as organs of assimilation, as has hitherto been supposed, but also as organs of respiration. This, their double function in gas interchange, is evidenced by the morphological and microchemical changes which their ground substance and contained bodies undergo in intense light. Though green organs under the influence of light give off oxygen, yet the chlorophyll-corpuscles, by reason of their structural and chemical characters, fix oxygen in a high degree and at once transfer it to the forming products of assimilation. The physiological value of these substances, formed and deposited within the chlorophyll-corpuscles, falls therefore to be considered after the behaviour in oxygen and in light of the bodies themselves.

The ground substance of the chlorophyll-corpuscles and masses after insolation resembles in appearance the condition in which it is left after alcohol or other solvent has decolorised and removed the oil from it. It is a colourless skeleton, unchanged in form, and presents the same sponge-like structure as results from the action of solvents, acids, and moist warmth. In *Spirogyra* the marginal projections on the band (so changeable in the living cell) remain; only sometimes when an excess of heat has operated, or a considerable time has elapsed before the death of the band, are the projections withdrawn and the band contracted in width, or the margins, still marked by the projections, become revolute. Chemically little can be said. The skeleton shows a protoplasmic character, and takes up iodine and colouring agents more readily than before, possibly on account of its porosity. Insolation, however, produces a change in the nature of the substance, in virtue of which it offers greater resistance to external influences. Such a change is well illustrated by the case of *Nitella* cells killed by rapid insolation of a limited area, in which the decolorised chlorophyll-corpuscles of the insolated area remain unchanged in form and shape long after the green corpuscles and contents of the non-illuminated portion of the cell are completely disintegrated. The chlorophyll-bands of *Spirogyra* and the chlorophyll-masses of other plant cells, which, as is known, are extremely sensitive to injurious influences, such as increase of temperature, mechanical irritation, &c., losing their form, contracting, rupturing, or swelling into variously-shaped bodies, behave when decolorised by insolation in the same way as the chlorophyll-corpuscles in *Nitella*. The light-killed bands stiffen while retaining their normal form and configuration. The ground substance of chlorophyll-corpuscles and masses appears thus under the influence of light to have lost its power of swelling in water and watery solutions, and in this, as in the retention of its form and shape, we have a marked difference between the destructive effects of light and of heat.

The different elements and constituents of the chlorophyll-corpuscles behave differently when exposed to intense light. Some are affected, others are not, and it is the merit of this method of investigation that it enables a direct study to be made of the relations of these constituents to respiration.

Starch and oil have, from their easy recognition, been often hitherto regarded as the only products of the function of the chorophyll-corpuscles. In some cases, when neither starch nor oil has been found, and abundance of glucose or mannite has been discovered in the leaves of a plant, these substances have been considered as the product of the chlorophyll-corpuscles. But neither starch, oil, nor sugar are the only products, nor, indeed, the only visible ones. Pringsheim in one case observed highly oxidised bodies of the group of organic acids directly formed in the chlorophyll-corpuscles, and this makes it probable that of the bodies hitherto considered to be fat or oil-drops may consist of substances of a very different character. Again, in *Mesocarpus scalaris*, at all stages of development and in every cell, there may be seen numerous (almost covering the chlorophyll-plate) small, oil-like, glistening globules of different sizes, and very like the small oil globules in the bands of *Spirogyra*, which, as they disappear on the addition of alcohol and ether, might at first be regarded as fat or oil globules. They are clearly formed in and secreted by the chlorophyll-plate, and pass out from it into the protoplasm of the cell. These are not oil globules, but vesicles with a resisting pellicle, enclosing a content in greater or less part consisting of tannin. They may be termed tannin vesicles. The dark coloration and coloured precipitate formed with iron salts, potassium bichromate, and with Millon's reagent, conclusively indicate their nature. The form of these vesicles is easily destroyed by slight warmth, mechanical irritation, or any decomposition which will end in the death of the cell, and when destroyed the contents disappear, mixing with the cell sap, and the pellicle is then indistinctly seen appressed to the chlorophyll-plate, and giving its surface a netted or froth-like aspect.

In addition to all these substances the oily vehicle of the chlorophyll colouring matter and the hypochlorin must be reckoned as contained elements of the chlorophyll-corpuscles and as normal products of their function.

Of the constituents just mentioned, those which are rich in oxygen and occur as grains, globules, or vesicles,—the starch grains, the oil globules, the tannin vesicles,—are unaffected by exposure to intense light.

Starch grains in the chlorophyll-corpuscles have the same appearance, and exhibit the same reaction with iodine, after, as before insolation, and the same is true of the starch in the amylum bodies of *Spirogyra*. With the destruction of the chlorophyll colouring matter no formation of starch is associated. If starch was present in the chlorophyll-corpuscle before insolation, it is found in like amount afterwards; if there was none before insolation, none is found afterwards. There is neither destruction nor formation of starch as the result of exposure to intense light. This is no contradiction to the well-known fact of the accumulation of starch in the chlorophyll-corpuscles during the day. For the explanation of that is very simple. Starch is not directly formed from the decomposi tion of carbonic acid and water; and, if in light of no great intensity there is an accumulation of starch in the chlorophyll-corpuscles, it happens because the light was not sufficiently intense to destroy the formative material out of which the starch is constructed.

Oil globules, both within and outside the chlorophy llcorpuscles, behave in every respect like starch. At least all the colourless and oil-like globules, such as occur in the bands of *Spirogyra*, in the chlorophyll-corpuscles of *Characeæ*, *Vaucheria*, *Fontinalis*, &c., which are to be considered as of a fatty and not of a volatile oil, do.

Tannin vesicles of *Mesocarpus* are indestructible by light alone. They are, as already noticed, very sensitive to hurtful agencies, and when the cell is killed by light they are, of course, decomposed; but this is rather a secondary effect, the result of the death of the cell, which has been already brought about by light.

Hypochlorin, on the other hand, disappears from cells exposed to intense light, and no trace of it remains. If a filament of *Œdogonium*, *Spirogyra*, *Cladophora*, or *Mesocarpus* be exposed to intense light, there is decolorisation of the insolated area; the cells of the rest of the filament are unchanged. If now dilute hydrochloric acid be added hypochlorin appears in the usual way, after from six to twenty-four hours, in the non-exposed areas, but none is seen over the insolated portion. If, in *Spirogyra*, insolation is interrupted before the chlorophyll colouring matter of the bands is dissipated, no hypochlorin is found on the slightly or half decolorised bands, though it is present on the non-insolated bands. Five or six minutes of insolation suffice to decolorise the bands of *Spirogyra jugalis;* under the same conditions two or three minutes are enough for the destruction of the hypochlorin. Where there are isolated chlorophyll-corpuscles the same is observed, *e.g.*, if a portion of a cell of *Nitella* be exposed. In this plant, however, it sometimes happens that no hypochlorin shows on the green chlorophyll-corpuscles of the non-isolated portion of the cell. The light effect in this case, it would appear, has spread beyond the immediately exposed area, and this may be explained by the fact that hypochlorin is one of the most easily affected bodies in the cell. Small increments of temperature, mechanical stimuli, spontaneous disease, as already shown, are, even when the chlorophyll colouring matter is intact, able to destroy it in the cell. From these facts we may conclude that the disappearance of hypochlorin is the earliest indication of a hurtful influence affecting the plant cell, and its destruction results in intense light earlier than does the destruction of the chlorophyll colouring matter.

(*c*) *The protoplasm of the cell and turgescence as affected by intense light.*—The turgescence of cells is diminished by exposure to intense light. In large-celled *Algæ* this is shown by the vertical division wall between insolated and non-insolated cells becoming curved into the former. The tension of the insolated cell is decreased relatively to the non-insolated by the greater permeability (as shown by its behaviour to coloured solutions) for cell sap of its protoplasmic utricle. If a filament of *Spirogyra*, some cells of which have been insolated, be laid in a watery solution of aniline blue, the insolated cells become rapidly coloured, the non-insolated are, even after some days, still uncoloured. *Nitella* is very favourable for such an observation, as the differences, owing to the length of the cells, may be observed in one and the same cell, and moreover, as the rotation is not stopped, one may study the difference in permeability between the cell wall and the protoplasm, the former becoming rapidly coloured, whilst beneath it the rotating protoplasm remains for a time unchanged.

The greater permeability after insolation is associated with a distinct change in structure and in mass of the protoplasm lining the cell wall. It loses, as has been shown, a considerable amount of its contractile power. The addition of plasmolytic agents, such as iodine in iodide of potassium, causes little or no retraction of the utricle in an insolated cell, and it depends upon the intensity and duration of exposure to light, as well as upon the thickness of the layer of protoplasm, to what extent the power of contraction is lost. In *Nitella* this may be well studied. Here, as has been already described, the contraction consequent upon death from insolation advances gradually over those portions of the cell which have not been insolated and are green, the protoplasm at first slowly separating from the cell wall and then subsequently collapsing. Only at the insolated part does the utricle show no, or almost no, contraction, and may be found with embedded skeletons of chlorophyll-corpuscles still lining the cell wall months after insolation. The reason for this is a partial destruction of the protoplasm, which is the immediate effect of the light, and as light only acts in presence of oxygen it is clear that the oxygen must combine with certain elements of the protoplasm of the utricle, and, as a result of the combustion, that change and diminution of its substance occurs which produces a loss of contractility.

The loss of substance by oxidation in light may at times be made directly visible. If a filament of *Spirogyra* (one-spired species are more suitable, as in them the utricle is not strongly developed), some cells of which have been insolated, be treated with a reagent which stains protoplasm deeply (iodine solutions, for example), a more or less striking difference is observed between the contracted protoplasm of the insolated and the non-insolated cells. In the non-insolated cells the former lining protoplasm of the wall no longer forms a continuous uniform layer or plasma-utricle, but is a contracted plasmodium net, in which are embedded, as in a matrix, small dense granular or globular bodies. These, especially, are deeply stained by the iodine. If the protoplasm lining the wall was originally thick, they are numerous; if it were thin, they are few in number, sparingly distributed, and may be almost absent. But their number depends on the species examined, as well as upon the thickness of the utricle. In the insolated cells one can recognise with certainty a diminution in the number of these small bodies. In them is doubtless to be recognised the element that so readily takes up oxygen under the influence of light, and by its combustion causes the loss of substance in the protoplasm, whereon depends the diminution in contracting power. It is often difficult to determine the loss of protoplasm substance, and it can only be done by careful comparison of insolated and non-insolated cells.

Other striking changes after insolation in the protoplasm have already been referred to as occurring in *Spirogyra* and in *Nitella*. In the former there is the displacement of the nucleus, vesicular swelling of the centre plasma concurrently with a granular coagulation of its substance and the occasional colouring of the same, and finally, the rupture and knotting of the protoplasm threads. In the latter there is the aggregation of the streaming protoplasm at the area of insolation, &c. Many of these changes doubtless occur in general death of protoplasm from other causes besides light, for example, from heat or electricity, and it is therefore difficult, if not impossible, to distinguish amongst them the specific action of light.

Amongst the phenomena which fall to be noticed here is paralysis of protoplasm, or temporary stoppage of its movement by light.

If insolation be interrupted just at the moment when the motion ceases, in many cases the movement will sooner or later recommence and go on normally. This may be observed in all kinds of movements, alike in the motion of granules in the protoplasm between the chlorophyll-bands of *Spirogyra*, in the circulation in *Tradescantia* hair cells, and in the rotation in *Nitella*. The condition of paralysis in the cells of staminal hairs of *Tradescantia virginica*, and in suitable (short) cells of *Nitella*, may develop long before they are decolorised. Careful study of the gradual cessation of movement in intense light convinces one that the light at the place where it reaches the protoplasm creates directly a hindrance to the movement a fact explicable by the changes (just described) it brings about in the substance of the protoplasm. As soon as light has operated sufficiently long, one sees, *e.g.*, in *Nitella*, the movement slowing at the insolated spot, and the streaming protoplasm in consequence aggregates in large, often striated, masses about it. Then, especially if the cell be long and the isolated area near its middle, as the current cannot cross the insolated area, two currents frequently arise in one cell, each following a course of its own, separated from the other by the insolated part.

These phenomena are to be explained by the greater immobility of the protoplasm which has been exposed to light. Because protoplasm aggregates at the insolated area, it does not necessarily follow that it is as it were drawn by the light, but only that in certain intensities the motion of the protoplasm is slowed at the insolated area. And so also the opposite effect, the aggregation of the protoplasm at the shaded spots, is to be explained by the commencing immobility of the insolated portion forcing the protoplasm into other channels. The disposition of the moving masses in the cell shows only the relative motility of the protoplasm in different, relatively darker and lighter, places corresponding with the oxidation of its substance as influenced by light.

(*d*) *The membrane of the cell in intense light.*—The cell wall exhibits no very striking changes. At times, in more delicate *Spirogyra* cells a slight swelling may be seen. If, however, delicate speeies of *Spirogyra*, *e.g.*, *Sp. Weberi* or species of *Mesocarpus*, be exposed to light until death of the cells sets in, the isolated cells separate more or less completely one from another, and in *Sp. Weberi* the infolded ends of the cells unfold. The changes in turgescence of the insolated cells appear to have nothing to do with this appearance; nor is any perceptible shortening or lengthening of the cell walls apparent. But at the moment of separation a slight torsion of the threads is observable, and possibly an inequality in tension between the cuticle and the inner layers of the membrane, developing under the influence of insolation, may cause the torsion and consequent separation. It is possible, however, that chemical changes of the membrane at the limits of the cells may contribute to the result.

Pringsheim then discusses

Respiration in Light of Green Tissues and the Function of Chlorophyll.

All the forementioned results (he says) lead to the conclusion that the amount of oxygen inhalation exercises a very definite influence upon the assimilation by chlorophyll-corpuscles, and hence the green colour is of physiological value to assimilating organs, even if it play no direct part in the decomposition of the carbonic acid. The illuminating light rays exercise an immediately observable effect upon the colourless protoplasm of the cells, especially upon the ground substance of the chlorophyll-corpuscles and on their enclosed substances. The destructive action within cells in intense light, when oxygen is present, and the immunity observed in its absence, indicate that the injurious effect of light is due to increased combustion of the cell elements necessary to life. It is still a moot point whether the cell elements which absorb oxygen in darkness are the only ones that have their affinity for the gas increased, or whether the elements which, under normal conditions of darkness, remain unoxidised are not also consumed in light. It is certain, however, that the amount of respiration in green cells increases *pari passu* with the intensity of the light, and at the higher intensities may reach such a degree as to kill the cell, and the light affects the contents directly and not through the medium of the green colour.

The degree of sensibility to light of the tissues of different plants varies greatly, and may be ascribed to the anatomical character of the contents and the dimensions of the illuminated cells. The great difference between green and non-green cells is specially noteworthy. The former are always more sensitive than colourless cells, and, indeed, than cells having any other colour besides green. It is, for example, more difficult to produce light paralysis and death in blue and colourless cells of *Tradescantia*, or in the filaments, sporangia, or oogonia of *Saprolegnia*, than in the larger cells of *Spirogyra* and *Nitella*, or in cells of the leaves of *Mnium* or *Vallisneria*.

Naturally the cause of difference is sought for in the green colouring matter, and such an explanation would be quite in accord with the relation of the colour to the action of light in assimilation as here demonstrated. As the seat of the action of light in assimilation is usually misplaced in the chlorophyll colouring matter, so likewise might the destruction of the cell-contents of the green cells in intense light be referred to the colouring matter as the starting point and, by its light absorption, agent of the decomposition, or, the cell-contents might be regarded as not sensitive to light, and the changes taking place in them as merely secondary effects of the destruction of the colouring matter. But such assumptions are improbable, and, indeed, are contradicted by the facts that red light, in spite of its stronger absorption in chlorophyll, is inactive; that the visible changes, whether paralysis or death, in intense light in the protoplasm of the cell are seen to be the direct effect of the light; and that in non-green cells there is an undeniable light-effect. Direct proof that the colouring matter plays no necessary part is afforded in the possibility of destroying green cells by the insolation of a portion where there are no chlorophyll-corpuscles, *e.g.*, in a pro-embryo or branch pro-embryo of *Chara*, where there are but few corpuscles lining the wall, or the part of a living *Nitella* cell bared of chlorophyll-corpuscles. In such cases destruction proceeds as rapidly as it would if chlorophyll were present. Again, those species of *Spirogyra* are the most sensitive which have feebly coloured chlorophyll bands, and the most widely separated bands. Cells with approximated and deeply coloured bands are not more strongly affected by light, as would be the case were the destruction of cell contents a consequence of that of the chlorophyll colouring matter; on the contrary, there is greater immunity from light effect. Differences in this respect are often very marked in one and the same species of *Spirogyra*. The effect of dissemination and aggregation of chlorophyll in retarding the action of light on the shaded part is easily observed in all green cells. The colouring matter is less sensitive to light than the other sensitive elements of the cell; and this is the case, as experiments in red light show, not only for lights of different intensities, but also of different spectral breadths.

The destruction, then, of protoplasm and the death of cells in light is a true light effect, independent of the destruction of chlorophyll colouring matter, taking place in green cells, as well as in those otherwise coloured, before complete destruction of the colouring matter, and it is not brought about through light-absorption in the chlorophyll-corpuscles. It is developed by absorption in the protoplasm itself of all the illuminating rays of the spectrum, the red rays up to those of wave lengths of ·00061 mm. being excluded from the action, and the chlorophyll colouring matter, instead of increasing the light-effect upon the cell-contents of the part it shades, lessens the same. This, the evident, and, indeed, necessary effect of the colouring matter, has been hitherto entirely overlooked in estimating its physiological importance in respiration.

As death of the cell is not always accompanied by such striking changes as displacement of the nucleus, cessation of movement, &c., which are seen in *Spirogyra*, *Nitella*, and *Tradescantia*, whilst the slightest colour-change is at once manifest, it is not always easy to detect the proper succession of changes in the cell which mark the difference in sensibility to light between the elements; but between the chlorophyll colouring matter with its vehicle, and the ground substance and its contained matters this difference is very conspicuous. Hypochlorin disappears more quickly than chlorophyll colouring matter, and the ground substance of the chlorophyll-corpuscles, after almost momentary exposure, loses all its vital peculiarities, whilst the colour remains still unchanged.

If, then, a green tissue is more sensitive to light than a not-green one, the cause does not lie in the colour but in the presence of easily oxidisable assimilation products which arise in the chlorophyll-corpuscles, and spread thence into the protoplasm. The action of light on the colouring matter is an incidental phenomenon, and the essential one is the far stronger destruction which the ground substance of the chlorophyll-corpuscles and their included substances suffer. The chlorophyll-corpuscles are, therefore, extremely sensitive plates having a green screen. The actions stirred up within them by light are both reducing and oxidising, and for the latter their spongy construction and the possession of bodies such as oil and hypochlorin, easily converted into resins, renders them specially well fitted. To the green colouring matter no other share in these processes can be assigned than a physical one due to its colour; it diminishes the intensity of light, and thereby the amount of oxidation in the cell. This protection, however, fails in intense sunlight, as then the colouring matter is itself destroyed.

How far extends and wherein consists this protection under normal conditions of plant existence? Protection from danger to life of the cell from intense light has not to be considered. That is never or rarely required by the plant. It is only a protection of assimilation products in the chlorophyll-corpuscles from too rapid destruction in daylight that has to be provided.

The amount of respiration in green tissues must necessarily, from what has been said, increase in daylight with increasing brightness; assimilation also rises in amount in light, but nearly reaches its maximum in medium day-brightness. Now, supposing the green tissues could perform their functions without chlorophyll colouring matter, the respiration would, in all intensities of daylight, and especially in the brighter light, greatly exceed in amount the assimilation. An accumulation of carbon would then, even with this uninterrupted decomposition of carbonic acid, be quite impossible. The presence of chlorophyll colouring matter changes at once the condition to one favourable for such accumulation; for the absorption of oxygen increases in the more refrangible part of the spectrum—that part which is especially absorbed in the chlorophyll colouring matter—and proportionally too to the intensity of illumination. Even a single layer of chlorophyll-corpuscles in the cell absorbs in diffuse daylight, more or less strongly according to the depth of their coloration, all the blue up to the line F, although in direct sunlight a considerable portion of the blue pass through. The amount of respiration in green tissues must, therefore, decrease in daylight, in consequence of their colour, and proportionally to its depth; and this, not only on account of a general reduction of illuminating power effected upon the whole spectrum, but specially through the selective absorption of the rays most refrangible and most active in respiration, which is characteristic of the chlorophyll colouring matter. In this way the respiration curve sinks in all higher intensities of light below that of assimilation, for this latter process is but slightly influenced by reduction of light-intensity through the colouring matter, because it already has nearly reached its maximum in daylight of medium intensity, and also because the blue rays absorbed in the colouring matter are of less effect in destruction of carbonic acid. In daylight, chlorophyll colouring matter, by reducing the amount of respiration, allows assimilation to surpass it in amount, and thus enables an accumulation of carbon compounds to take place; and in thus diminishing the respiration of green tissues in light lies the value of green colouring matter to plants.

Previous analytical researches have only slightly insisted upon this increased respiration in daylight. In green organs, as the concurrent assimilation always exceeds, except in the very lowest intensities, the respiration, it is necessarily, in light of the intensity of daylight, concealed. In spite of the great oxygen absorption proceeding there is observed a constant giving off of oxygen only, and in order to make the increase of respiratory action evident by the accumulation of carbonic acid resulting from it, assimilation must either be suppressed or light (direct sunlight) of greater intensity must be employed. Sometimes, indeed, in direct sunlight the increment of respiration may be recognised, not by the accumulation of carbonic acid, but by the lessening of amount of the oxygen given off. Often observed, this fact has been misinterpreted. Famintzin, for example, took this as proof of the diminution in amount of destruction of carbonic acid in sunlight, and of its being less than in bright diffuse daylight. But it is more rationally explained by an increased combustion in direct sunlight, so that the assimilation and respiration curves approach.

Tissues which are not green, and plants, such as phanerogamous Saprophytes and Fungi, as they want the elements, especially the easily oxidised assimilation products of the chlorophyll-corpuscles, which, in green cells, so readily absorb oxygen in light, are not so sensitive to light. A marked increase of carbonic acid accumulation does not take place in them, even in diffuse daylight of low intensity. Some researches in this direction by Drude on *Monotropa*, and by Wolkoff and Mayer upon germinating plants, have shown an increase in respiration in light. The latter found the differences very small, and considered them as tending to show that light had no important influence on respiration. But their results may be taken as supporting the theory here set forth. In experiments on respirating germinating seeds and green organs cannot be fairly compared as regards the substances used up. In the former it is the reserve materials—starch, fat, &c.—which, after metastatic change, are oxidised, whilst in the active green cells these substances, as has been shown, take no share in the respiration, but it is the primary assimilation products or their immediate derivates which undergo combustion. If, therefore, with such unfavourable objects, an increase in the carbonic acid formation is observed, it is the more a distinct indication of the influence of light on respiration.

On the Relation of Assimilation and Colour,

Pringsheim has some interesting remarks :—

The known facts regarding assimilation in plants are not in opposition to the view here advocated, that the colour only indirectly, through respiration, takes part in this process, and that the colouring matter has no share in decomposing carbonic acid.

Out of the general notion that chlorophyll colouring matter plays a direct part in assimilation, has developed the idea that its substance enters directly into the process of decomposition of carbonic acid, and that in this processs it is constantly being destroyed and regenerated. This must be the basis of any chemical hypothesis of its function in assimilation. It not only assumes the destruction in light (and in daylight of medium brightness) of colouring matter, but also that this destruction is a consequence of appropriation of the carbon drawn from the carbonic acid decomposed. The carbon compounds formed through assimilation in the plant body would therefore be derived from the chlorophyll colouring matter as a mother-substance. This is, however, entirely hypothetical, and has no support from the side of organic chemistry, nor from direct experiment. The assumed genetic relations of the carbon compounds to the chlorophyll colouring matter are not explained, and, indeed, the constitution of the colouring matter—notwithstanding recent work on the so-called chlorophyll crystals—is still as good as unknown. For the red and green crystals which can be extracted from artificial chlorophyll solutions are by external characters, and by their spectra, proved to be in no way identical with deeply-coloured green drops which exude from the chlorophyll-corpuscles, as described in this paper, or which, after the solvent has been removed, can be obtained from a solution of chlorophyll; and in them the normal colouring matter as it occurs in the tissues is obtained, still attached to its vehicle, from which, indeed, in the unchanged condition it has never yet been separated, and with which, after separation from the tissue, it is easily altered and converted into resin. This is the weak point in all chemical considerations of the genetic relations between chlorophyll colouring matter and the other contents of the cell, and at the present time the formation of carbo-hydrates out of the chlorophyll is entirely hypothetical. The destruction of chlorophyll colouring matter in daylight of medium intensity in which assimilation is possible, is quite unproved, improbable, and against all experience, and the whole chemical hypothesis based on such destruction of the chlorophyll colouring matter in light in direct connection with the decomposition of carbonic acid, is quite untenable.

To the purely physical theory of chlorophyll function here brought forward, the origin of the chlorophyll colouring matter and its genetic relations to the other cell-elements, are of incidental significance, but the facts adduced contradict decisively every theory based on the destruction of chlorophyll in the reducing process, showing—

1. Destruction of chlorophyll colouring matter in the living cell in light is an oxidation process independent of the presence of carbonic acid.

2. Chlorophyll colouring matter is not destroyed in light when in an atmosphere of carbonic acid and hydrogen in which assimilation is possible.

3. The destruction of chlorophyll colouring matter is a pathological process, and the colouring matter once destroyed is never regenerated.

But it may be asked, Is the colouring matter a necessary condition for assimilation? Another theory, which regards chlorophyll colouring matter as a necessary condition for the decomposition of carbonic acid and water, assumes that it serves as a medium of transfer for the light. It absorbs rays of light which are then passed on to and act upon the protoplasm of the cell, whilst the colouring matter itself remains unchanged. Such an hypothesis would be admissible only if it could be otherwise proved that the colouring matter takes part in the destruction of carbonic acid. But this by no means follows from our experience of gas interchange in plants, and our knowledge of assimilation gives no support to such a theory, for the rays so strongly absorbed by the chlorophyll colouring matter are of no effect in assimilation.

That green tissues alone exhale oxygen in light may, at first sight, appear weighty evidence in favour of the colouring matter taking a direct part in the reduction process, and it might find a very simple explanation in the absorbed rays being the source of energy. But when the change in amount of respiration in light is borne in mind, and also that the gas interchange in green tissues is always the expression of the difference between assimilation and respiration, such an explanation is not satisfactory. The exhalation of oxygen by green tissues alone merely proves that in them respiration is less than assimilation, not that the green colour is an agent in the process.

Now, as under certain conditions of low light-intensity assimilation can proceed without any oxygen being exhaled, it is necessary to consider all conditions under which gas interchange is taking place before measuring the amount of assimilation by the oxygen exhaled, or considering that the latter is always an index of the extent of the former. The old notion that assimilation only commences when there is a certain degree of brightness of illumination, because under some conditions of low light-intensity no oxygen is exhaled, is incorrect, as has been shown, and assimilation actually goes on at all, even the lowest intensities, but in the lower ones it is concealed by respiration. So that the exhalation of oxygen is only recognisable when respiration is less than assimilation.

It has been hitherto supposed that a plant only begins to assimilate when it becomes green; it is first green, and then assimilates. But this idea has resulted again from the misconception that oxygen must be exhaled if there is assimilation. All that the facts warrant is, that respiration is less than assimilation only when the tissue is green, and consequently the exhalation of oxygen only commences with the appearance of green colour in the plant.

All direct observations fail to confirm the theory that the source of energy for the reduction process lies in the colouring matter.

Although the difficulties of accurate photometric determination of the absorption spectra do not permit of complete proof, yet tolerably conclusive evidence against such a view is afforded by the facts that the rays absorbed in the colouring matter, as indicated in the absorption bands of the spectrum, which must be of some value to the plant, play no preponderating part in producing the light-effect upon the plant; that the maximum of decomposition of carbonic acid does not correspond with the maximum of absorption in the chlorophyll spectrum; that leaves which are not active show the same chlorophyll spectrum as those which are active; and that artificial chlorophyll solutions decompose no carbonic acid. The source of energy is to be sought for only in the light-absorption in the other cell-contents themselves, in which intense light brings about such marked decompositions.

The sharing of the colouring matter in assimilation has been ere now questioned, though the grounds upon which this has been done have been in part incorrect. Meyer and Mulder's view that the colouring matter, instead of promoting assimilation, is formed in the process, "green tissues give out oxygen not because they are green, but because they become green," has been repeatedly controverted, for the transformation of the starch content of chlorophyll-corpuscles into wax, by which Mulder accounted for the liberation of oxygen, does not take place; and, moreover, in the formation of chlorophyll in the plant, oxygen is set free. In later times, too, Gerland has shown, in a discussion as to the relative energy of colours in assimilation, that the conformity of absorption spectra of leaves with those in chlorophyll solutions, and the decolorisation of the latter in oxygen, are not easily reconciled with the theory that colouring matter directly shares in assimilation.

It would appear, then, that the increase of respiration in light is retarded by the colouring matter, and that in this way the reduction of carbonic acid and water is favoured, and an accumulation of carbon takes place in the plant, but the colouring matter takes no direct and immediate part in the process.

The question then arises, How does this theory of the function of chlorophyll affect the result of researches on assimilation? As the oxidation and reduction processes in green tissues do not rise and fall similarly in changing light-intensities and colours, it is necessary in all questions concerning assimilation to take into consideration the amount of respiration, and the extent to which it is influenced by light.

And firstly, as regards an optimum intensity of light for the decomposition of carbonic acid. This cannot be determined simply by the amount of oxygen given off in light, for this in all intensities is only the excess of oxygen exhaled over what is inhaled. Both processes, that of exhalation and that of inhalation of oxygen, are differently affected by light-intensity and colour, and if they are not distinguished from one another in a research, the determination of the amount of oxygen exhaled fixes only approximately the relation between respiration and assimilation. It is possible in this way to determine only the intensities in which one or other process predominates, but not the amount of increase or decrease of decomposition of carbonic acid. The amount of oxygen exhaled, as has already been pointed out, is not an exact measure of the decomposition of carbonic acid, for an increase in brightness of illumination may bring an increase in decomposition of carbonic acid with an apparent decrease in the amount of oxygen given off, and in this lies the explanation of the smaller amount of gas evolution in direct sunlight than in bright diffuse daylight.

If now the exact carbon gain be sought instead of the amount of decomposition of carbonic acid in light, the oxygen exhalation again only gives an approximate result so long as the quantitative relation of the carbonic acid expired to the oxygen inhaled in varying intensities is unknown. The question is still further complicated by the unequal possession by the plants of chlorophyll, which must exercise an equally varying influence upon respiration and assimilation.

Secondly, as to the relative energy of the different rays of the spectrum in assimilation. This cannot be determined by the amount of gas given off in the different colours, because the absorption in the chlorophyll colouring matter, according to the screen theory here set forth, must modify the result. All accurate experimenters, from Daubeny and Draper to Sachs and Pfeffer, agree in showing that the greatest activity for evolution of oxygen by green tissues resides in the rays of middle refraction in the spectrum. Objections urged against this statement, and these come mainly from physiologists, who adopt a purely physical theory of assimilation, are essentially theoretical, based upon the idea that the colouring matter is the seat of light activity. Thus, Lommel considered that light action must be dependent on the degree of completeness of absorption of the rays and on their energy as measured by their heat-effect or mechanical intensity, and concluded that the chief activity must lie in the absorption bands of the chlorophyll colouring matter, that is, in the red, because the blue, on account of their small mechanical intensity, could have no effect. Experiment does not, however, confirm this idea; and it were nearer the truth had the seat of activity been looked for in the cell-contents outside the chlorophyll colouring matter. Those physiologists who hold that yellow and green rays are more effective in decomposing carbonic acid than blue and red, rightly enough express the observed facts; but there remains for explanation the function of the rays so markedly absorbed in the colouring matter.

The experiments here recorded are not conclusive regarding the effects of colour in the reduction process. Green and yellow are naturally more active than blue, because the latter is absorbed to such an extent by the chlorophyll colouring matter that it is unable to produce an effect, just as in photography the silver salts behind an interposed green glass screen are much less sensitive to blue than to yellow and green light.

At the present time, then, notwithstanding many accurate researches already made, the dependence of the decomposition of carbonic acid upon the wave lengths of the light rays needs elucidation. There is no doubt that, for green plants, yellow and green rays are far more active for the evolution of oxygen than blue, yet this is no clue to the dependence of assimilation on colour. This process might equally well be stronger in the blue, for researches say nothing certain on this point. Yet *a priori* it appears more probable that blue rays have no effect, as the absorption in the chlorophyll colouring matter would be a more significant adaptation for the accumulation of carbon in the plant if the absorption of the blue rays only enfeebled respiration without directly affecting assimilation.

Another outcome of the absorption in the chlorophyll colouring matter is, that the maximum activity in the spectrum for assimilation cannot be the same for all plants and for all brightnesses, but being dependent on the depth of colour of the plant and on the total intensity of illumination, its position must change with both conditions. Herein may be found an explanation of the varying determinations which have been given of the course of the assimilation curve in the spectrum.

Thirdly, the constancy in volume maintained in an atmosphere in which green plants are growing has been looked to as affording a clue to the chemical origin of the carbon compounds produced in assimilation. The primary assimilation products, it has therefrom been assumed, are directly derived from the carbonic acid and water in the reducing process, the carbon of the former combining with the elements of water to form a carbo-hydrate whilst the oxygen is given off. And as anatomical evidence in support of this, the existence of starch in the chlorophyll-corpuscles, as well as the fancied physiological importance and distribution of glucose, have been quoted. The, at present, commonly received theory of assimilation then, which considers starch and sugar as the primary products of the process, as opposed to the older one of Liebig that they are organic acids, is founded upon such considerations of gas interchange supported by anatomical facts.

But although assimilation theories are based upon this assumption (it may be noted in passing how completely the nitrogenous constituents of the chlorophyll-corpuscles are shut out from any influence in the process, and there is, indeed, at present no reason for supposing that they have any), it is not a necessary consequence. Any such conclusions drawn from the constancy of the gas volume in gas interchange would hold if green organs only assimilated and did not respire in light. But with respiration taking place the conditions must be different, because oxygen is thereby inhaled; and although this oxygen enters into combinations, one of the products of which is carbonic acid, yet the volume of the gases in this interchange are not equal. More oxygen is inhaled than carbonic acid exhaled. Germinating seeds rich in starch cannot, as has been pointed out, be simply or fairly compared with green organs of adult plants in respect of their respiration, but in germinating oily seeds more oxygen is evidently inhaled than carbonic acid exhaled; and in green organs this inhalation of oxygen increases considerably in light. Respiration, then, in green organs exposed to light in a limited atmosphere necessitates a diminution in the gas volume thereof.

If, now, the gas volume around an assimilating and respiring plant remains constant, the immediate product of the reducing process must be a substance poorer in oxygen than a carbo-hydrate, and poorer by that amount of oxygen used up in the respiratory process. This conclusion is inevitable if the carbon compounds are directly formed from the carbonic acid and water.

But, it might be supposed that the constancy of gas-volume observed under certain conditions only occurs if there is a definite amount of respiration, only if the primary reduction product combining with oxygen is transformed almost entirely to a carbo-hydrate, which then persists as a stable reserve substance in the chlorophyll-corpuscles resisting further oxidation in light. The amount of respiration in a green tissue would in that case influence not only the observed gas interchange, but also determine the character of the formed compounds deposited within the chlorophyll-corpuscles. The function of these corpuscles is a double one, they assimilate and they respire; and one is naturally led, on this account, to the hypothesis dealt with in the next chapter, that it is the accumulation of colouring matter which brings about the formation of different construction products in the chlorophyll-corpuscles, that is to say, through respiration in the chlorophyll-corpuscle a primary rich-in-carbon but poor-in-oxygen direct product of the reducing process passes into a more highly oxidised compound, the extent of oxidation being influenced by the amount of respiration in the corpuscle consequent upon the varying brightness of light reaching it, which in turn depends on the depth of colour in the tissues.

Chlorophyll colouring matter by its absorption of so-called chemical rays is the constant regulator of respiration and assimilation, whilst its absorption in the red may perhaps increase the heat effect of these rays on the plant.

Under the heading,

The Formation of Hypochlorin in Young Seedling Plants, and its Relation to Assimilation.

Pringsheim states shortly the conclusions to which his investigation lead him as to the true function of chorophyll.

From the point of view of the double function of chlorophyll-corpuscles already enunciated, the formative substances found in them must be the result of the combined action of assimilation and respiration. Of the enclosed bodies which are to be used up in metastasis, the chief are starch, fat, perhaps sugar, tannin, and hypochlorin. All of them, it is here maintained, cannot be immediate products of the reducing process; probably hypochlorin is the primary assimilation product. As every assimilation theory must consider the origin and construction of all bodies enclosed in the chlorophyll-corpuscles, a word with regard to the connection of all these substances with chlorophyll function may be said.

Controversy about the physiological value of these bodies has hitherto been confined to the question of the primary assimilation product. Starch, having been for long the only highly carbonised content of chlorophyll-corpuscles known, was considered as such, and its wide distribution, and, as Sachs has clearly shown, its dependence upon light and carbonic acid, supported this view. But starch, as is now known, is not the only, nor yet universal, but merely one of the most abundant products of assimilation. The like may be said of fat and sugar, each of which has been regarded as the first outcome of the reducing process, although the latter has never been proved to exist in chlorophyll-corpuscles, and also of tannin as it occurs in *Mesocarpus*, and indeed of all the ternary, rich-in-carbon, compounds hitherto known in the plant body. The origin of each and all of these, not one of which is universally present in chlorophyll-corpuscles, is doubtless to be ultimately traced to the reduction in light of carbonic acid, but the only substance which is a constant and essential product of assimilation in the corpuscles is hypochlorin. The idea that the primary product of assimilation may vary in different plants, and that these substances may thus all be direct products under different conditions, is improbable, and of no explanatory value No fact positively forbids such a notion, but the similarity in structure and composition of the chlorophyll-corpuscles, and the great agreement in gas interchange amongst green tissues, indicates an identity in all of the assimilation process. Whatever theory be adopted, there remains to be explained how it is that in one plant starch or fat, or it may be both these substances, in another tannin, or perhaps sugar, and in all hypochlorin, are formed and deposited inside the chlorophyll-corpuscles.

The theory here advanced is based upon the absorption of oxygen by the chlorophyll-corpuscles, and upon the chemical nature of their included bodies. These all agree chemically in this, that they are non-nitrogenous, and they are visible products of assimilation, derivates, differing from one another in oxygen content, of the carbonic acid and water decomposed in the process, the extent of their oxygenation being determined, on the hypothesis of a single primary assimilation product, by the amount of respiration in the corpuscles as governed by the intensity and colour of light. From the side of chemistry this view is not contradicted, but its admissibility depends on anatomical and physiological considerations.

The primary reduction product, of which, by oxidation, the ternary compounds in the chlorophyll-corpuscles are in the widest sense derivates, is to be sought for in the drops exuded from the corpuscles after treatment with dilute acid or moist warmth, as these contain all the constituents of the corpuscle sensitive to light, and with strong affinity for oxygen. All the nitrogenous compounds and stable ternary assimilation products—starch, fat, tannin, &c.—remain intact within the corpuscles. In the exuded mass, hypochlorin, which is the only very sensitive substance besides the colouring matter itself, is present as is known. Its universal occurrence has already been referred to. Wherever chlorophyll occurs it is to be found; so constant, indeed, is this, that in epidermal cells and hairs of phanerogams, or the cells of phanerogamic parasites, in which chlorophyll-corpuscles are exceedingly sparsely distributed, their assimilatory activity may be readily proved by the demonstration of hypochlorin through treatment with acid or other suitable reagent. It is found along with and without the other constituents above mentioned. They may be derived from it; it cannot arise from them. Its sporadic occurrence in the chlorophyll-corpuscles of one and the same cell indicates its employment in assimilation.

The accumulation of deposits of formative material, especially starch, in the chlorophyll-corpuscles, increases with age; the hypochlorin, on the other hand, decreases in the green tissue as they grow older. Indeed, the richer they are in these deposits, the poorer are they in hypochlorin. All this points strongly to the genesis of these bodies out of hypochlorin, and equally so does the constant relation of hypochlorin in *Spirogyra* and other *Confervæ* to the amylum bodies where a casual connection can hardly be denied.

Hypochlorin, then, is not only universally present as a product of the chlorophyll corpuscles, but has also a very definite time and place relation to the formation of the substances deposited therein. It is the primary product of the reduction process, and is the basis of all the ternary compounds in the corpuscles.

Further experimental proof of this is found in the formation of hypochlorin in young seedling plants under the influence of light. Seedlings of angiosperms grown entirely in the dark are not green, and have no hypochlorin. The duration of culture in darkness matters not. Hypochlorin cannot be formed in this instance out of the reserve materials in the plant, and therefore, even if seedlings grow in darkness until all the reserve material is used up, no hypochlorin is formed. Light is necessary for its production, and that, too, of a greater intensity than is necessary for development of green colour in the seedling. Both the hypochlorin and the chlorophyll colouring matter only arise if the seedling when still developing is placed in light, and the hypochlorin appears later than the chlorophyll colouring matter, and after a long exposure to the light.

Seedlings of such plants as peas, hemp, cucumber, flax, &c., which, after being grown for eight days in the dark, are still capable of becoming green and of developing, if exposed in a temperature of 20° to 23° C. (in July and August), to a bright diffuse daylight, become plainly green in two to three hours, and in six to ten hours are very deep green, but only after some nineteen or twenty hours of exposure are traces of hypochlorin found. Hypochlorin in seedlings of angiosperms is thus only formed under the influence of light, and as a consequence of assimilation, and only after prolonged exposure, and when the plant has become very deep green. This very significant fact may be explained by the relation of the colouring matter to respiration. The formation of hypochlorin in the plant begins with the commencement of illumination. How, then, is evidence of this effect of light not apparent in the first twenty hours? Because, apparently, the hypochlorin is consumed in light until there is a sufficient accumulation of colouring matter for its protection, and it is also possible that the hypochlorin first formed may be converted into colouring matter, and may thus be the mother substance of the chlorophyll colouring matter, an hypothesis which, as will presently be pointed out, may explain the development of green colour in the dark within the tissues of gymnospermous embryos.

The relation of hypochlorin formation to assimilation and respiration may be further elucidated by placing the seedlings grown in the dark not in bright full daylight, but in conditions of half darkness (a darkened room). Here they become quite green, but do not live long, and disintegrate almost as rapidly as those growing in complete darkness. Such facts have led to the supposition which has been already refuted in this paper, that a plant becomes green in light of a lower intensity than is requisite for assimilation. The explanation really is that, in the relations of assimilation to respiration, this low intensity is unfavourable for assimilation, and the products of this process are, without any permanent gain to the plant, again used up. If seedlings grown in darkened rooms are brought into bright light, which is favourable to development of green colour, but not to evolution of free oxygen, then no hypochlorin is to be found in them. Such plants grown in half-dark conditions (whether they have been in half darkness throughout, or were at first in complete darkness) show no trace of hypochlorin, even if the plant is as well formed and as deeply green as a seedling which has for some days grown in full daylight and contains abundance of hypochlorin. It depends on the regulation of the brightness whether or no after a time, say eight to fourteen days, hypochlorin is found in plants grown under half-dark conditions; for as soon as assimilation is greater than respiration, then hypochlorin accumulates and increases in amount with the increasing brightness. Beautiful green seedlings destitute of hypochlorin may be grown under a glass shade covered with grey paper in the half-dark illumination on the side farthest from the light of a deep room. Its absence from these is a proof that it is used up in respiration so long as that process in light is in excess of assimilation. Hypochlorin formation, therefore, is fully proved to depend upon light. Its dependence upon the presence of carbonic acid is difficult of experimental proof, because, though seedlings may be cultivated in an atmosphere deprived of carbonic acid, it is impossible by absorptive agents to keep it free of the gas; as in presence of oxygen, which is here necessary for the development of the green colour in the tissues, the time that must elapse before the hypochlorin formation can be detected is sufficient for carbonic acid to accumulate within the tissues, and to so great an extent as to give rise to hypochlorin.

Of very striking import is the fact that hypochlorin, like chlorophyll colouring matter, is formed in gymnosperms without the action of light. Colourless embryos of *Pinus picea*, *montana*, *maritima*, *Larix*, have no trace of hypochlorin. Sachs showed that from the seeds of such plants germinating in darkness, the embryos, though kept quite dark, become green. This is quite unexplained. In the first stages of germination, when the seedling is already green, no hypochlorin is formed ; but in later stages, though still in darkness, it appears in the tissues. Thus, hypochlorin appears in gymnosperms grown in darkness, and, as is the case in angiosperms after the chlorophyll colouring matter, in most cases appearing in four to five weeks' old seedlings, which have become green long before. There is no doubt, however, that light favours hypochlorin formation.

This condition in gymnosperms does not disallow the hypothesis that hypochlorin is formed in assimilation. Although formed in the embryo without access of light, yet in adult gymnosperms as in angiosperms it is the result of light-action. It resembles chlorophyll in this respect. Because chlorophyll occurs in embryos of gymnosperms grown in the dark, one does not suppose that light has no influence in its production in other plants, and the like must be held regarding hypochlorin. Possibly in seedling gymnosperms the hypochlorin may arise by metastasis without direct assimilation. A substance—perhaps a volatile oil—may descend from the mother-plant into the seeds, and out of it the hypochlorin in the seedling may be formed. Whatever be the first assimilation product, it is possible that it may be regenerated by metastasis from its own products, and for all proximate constituents of the plant the same process of regeneration is possible. But in respect of its origin, hypochlorin appears more strongly bound up with assimilation than these other proximate constituents of the plant body ; for, of all the products in the chlorophyll apparatus, hypochlorin is the only one besides the chlorophyll colouring matter itself, which, in angiosperms, cannot develop without light.

Complete anatomical proof that hypochlorin is the primary assimilation product is not yet possible, our knowledge of it is too recent, and it is only by artificial imitation of the assimilation process that all doubt can be set at rest. Yet the close relation of hypochlorin with the function of the chlorophyll-corpuscle—with its assimilation and respiration—has been fully and with certainty established through the foregoing account of its origin, its constant occurrence in chlorophyll-corpuscles, and its behaviour in light and oxygen. With no body in the cell does the hypochlorin exhibit such close relationships of function as with chlorophyll colouring matter. So much so, indeed, as to almost lead to the belief that it is an artificial product of the chlorophyll colouring matter developed by the reagents used. This, however, is not the case. The constant association of hypochlorin and colouring matter, and the difficulty of separating them, would suggest, as has been already hinted, a genetic connection between them. Nothing positive about this is as yet known. Hypochlorin exists always and only in chlorophyll-corpuscles, because it is a product of these and of the function of their colouring matter, as its formation in light depends on the presence of the colouring matter. Their analogous circumstances of origin are very striking, especially their formation in the dark in gymnosperms, seeing that both are otherwise dependent on light. Possibly a common origin may be assumed for both in gymnosperms. If a connection between them were established, and the chlorophyll colouring matter was developed from the hypochlorin, it would then have to be considered an assimilation product. This is by no means inconceivable. The grounds upon which one denies the possibility of chlorophyll colouring matter arising in consequence of assimilation are no argument against it. That chlorophyll colouring matter is a preliminary condition of assimilation has been already refuted and its true function proved. The development of the green colour of gymnosperms in darkness, and the formation of chlorophyll in an atmosphere free of carbonic acid, are as little opposed to it as to the view that hypochlorin is a product of assimilation. That development of green colour precedes assimilation has been shown to be founded on a misinterpretation of appearances. Taking all these facts together, one can hardly shake off the impression that the development of green colouring matter is one of the immediate effects of assimilation. The exact time of development of green colour coincides very nearly with that of the first evolution of oxygen from the tissues, yet after the facts brought forward assimilation must always precede the evident evolution of oxygen. Where light falls on a plant hypochlorin and chlorophyll arise together. According to the theory of the function of chlorophyll now advanced, the green colour of plants is a natural adaptation to the needs of assimilation, and the origin of a protecting screen of colouring matter from hypochlorin, the accumulation of which in light is one of the advantageous results of assimilation, would appear to satisfy these needs in a simple and appropriate manner.

On Tillering. By A. STEPHEN WILSON, Esq., North Kinmundy, Aberdeenshire. (Photographs Exhibited).

(Read 9th February 1882.)

By the word "tillering," as applied to a cereal grass, is meant the producing of more stalks than one from a single seed. The plumule of the embryo grows into the first or primary stalk, and all the secondary stalks arise either directly from the primary stalk or from secondary stalks thus directly produced. All the secondary stalks are buds growing out of stalks, and not out of roots. Indeed, it cannot be properly said that the primary stalk itself grows from the roots; this stalk and the roots grow simultaneously, and have a biological interdependence, but the roots no more produce the stalk than a man's legs produce his head.

All the tillers or secondary stalks are thus of the nature of branches, the buds or beginnings of which arise from the two or three lowermost nodes of the primary or secondaries. No such buds are thrown out upon the internodes. The secondary stalks or tillers, which are really branches, throw out roots from their bases and lower nodes, but no stalk whatever arises directly from any root. In some plants a stalk may arise directly from a root, or a root may arise directly from a stalk, but in the grasses no stalk ever arises from off a root.

But this note is not intended to be an exposition of the principle of tillering, but merely an introduction to the photographs now exhibited of barley and oat plants.

These plants were grown in the garden at North Kinmundy, along with some others not quite so prolific, in order to test the limits of tillering. Previous experiments had shown that the main conditions necessary to ensure tillering is shallow planting. When a seed is put down 2 or 3 inches, the plumule is drawn out and exhausted before reaching the surface where the tillering arises. When a seed is merely covered with earth it goes into tillering at once. The first set of seeds were torn up by the sparrows, so that a part of the tillering season was lost. The second set were protected until safe. The best barley plant produced about 140 stalks, 130 of which showed the ear out of the sheath. The second had 121 ears; others had fewer, diminishing down to about fifty. The oat plant submitted stood through the winter, and produced about 10,000 returns.

Now, as the tillering process in the barleys was going on during the whole season, some of the ears were not ripe when the plants had to be pulled. But, notwithstanding this, there can be no doubt that, in order to reap the full advantage of seed corn, it should be sown or deposited as near the surface as possible. This would be true of autumn sowing as well as spring sowing, were the former not affected by frost; but a severe winter renders deeper seeding advisable for other reasons than those directly connected with the development of the seed.

On Fixing Blowing Sands by means of Planted Grasses.

By James Coutts Crawford, F.G.S.

(Read 13th April 1882.)

"They manage these things better in France." If a thorough plan for fixing sands is required, we must probably go to France for an example. There large areas in the Landes and elsewhere have been reclaimed by the thorough process of enclosing the sand with brushwood, in squares of thirty yards (I think) each way, and planting the spaces thickly with *Pinus maritima.* Thus an article of some value is raised, the timber of these pines being sawn up for the manufacture of wine cases, and the resin which the trees yield used for covering the corks of the wine bottles.

This mode of reclaiming sandy tracts, however, must necessarily be very expensive, involving a great deal of labour; and where the climate is severe, and the locality exposed to strong winds, as in many parts of Great Britain, might probably not be successful; and it may not be amiss that I should describe certain successful operations undertaken by me in New Zealand, by which I succeeded in fixing several hundred acres of sand situated in a very unfavourable position for the purpose.

I will state what was done:—About the year 1859 I imported £5 worth of seed of *Ammophila arundinacea,* or common bent grass, and *Elymus arenarius*, or sea lyme grass, from Messrs Lawson of Edinburgh.

I employed a careful man to sow this seed over a large area of land, burying it sufficiently with a spade. The locality was one very much exposed to both north-west and south-east winds, lying partly between Lyall and Evans Bays, at Wellington, and altogether open to Lyall Bay and the southerly winds.

The climate of New Zealand, although sufficiently rainy, is much more elastic and buoyant than that of Great Britain; the ground dries much more rapidly after rain, and therefore there is more facility for the wind causing the sand to drift.

For several years after sowing the seeds I observed no signs of the required plants, but at last I found about half a dozen bunches of them in a small and sheltered glen. I found that upon pulling up one of these bunches I could divide the roots into a number of plants, perhaps from fifty to two hundred. These I planted out, and in the following year had a number of additional plants upon which to operate, and the planting has since gone on steadily increasing until several hundred acres are now secure from risk.

The sand once fixed by the bent, clovers, and other grasses take root, and a fair pasture is established.

These operations took me a long time. They have already gone on for over twenty years, and they are still in progress; but I had to educate myself up to the system, and find out by experience the best plan of operations, and therefore there was much loss of time.

All the manuals on the subject recommend different plans of sowing the sand-fixing grasses. Now I found that sowing was practically of little or no use at all. The seeds germinated, but were almost invariably blown out, and entirely disappeared in the course of a few months. It is advisable to sow a patch in a sheltered place to form a nursery for plants, but it is of little use to sow on open sand.

I next found that it was of little use to plant shallow. The plants were either blown out or were gradually turned over, so that eventually the leaves were buried and the roots were in the air.

At length I found that if the spade was put down as far as the foot could press it, and the plants then put in, that they almost invariably succeeded, and this system I have continued with great success. The plants should be put in pretty close, say from one to three feet apart. I found that Maories were much better than white men for this work; they were not so impatient. The white man likes to get over a large quantity of ground without reference to the quality of the work; the Maroi is less impatient and more careful.

It is advisable to cut off the tops of the plants when planting, and leave only a small part exposed above ground, as exposed leaves are apt to twist round each other, and perhaps destroy the growing shoot.

In New Zealand I would plant during all the cool and moist part of the year, say from March till October. In Great Britain I should think planting could go on all through the autumn, winter, and spring, except when freezing or the land covered with snow.

It is certainly desirable, although not indispensable, that the land which is planted should be enclosed, so as to keep off stock while growing,

My original stock of *Elymus* entirely disappeared. I afterwards introduced from Christchurch both *Elymus arenarius* and *E. giganteus.* The latter is, I think, very valuable for sand-fixing, as it takes a very firm hold on the ground, and therefore is difficult to pull up, and it throws out a great amount of foliage.

The principles which I advocate may be summarised as follows:—

1. Plant instead of sowing.
2. Plant deeply.

If a large area of land is to be operated upon, a regular staff of men should be employed under the direction of an intelligent head man, who ought to give the matter of the proper places in which to commence planting his attentive consideration. The prevailing winds should be studied, and the planting should always begin on the windward side. By and by, when the plants give much seed, many of them will lodge in hollows which are afterwards covered up by blowing sand, and in this way seeding may be said to answer.

From time to time, and from year to year, the plan of operation may have to be modified, and the old plantings watched and filled up as required. All this requires a careful man to look after matters.

I am under the impression that although my plants threw up seed stalks yearly, very few of the seeds ripened until the plants attained a considerable age. Now an enormous quantity of seed is annually produced, which helps by vegetating to fill up gaps.

It may be as well to recapitulate the plants used, viz.:—*Ammophila arundinacea*, or common bent (*Marram*, English; *Oyât*, French), *Elymus arenarius*, *Elymus giganteus*.

The reclamation of sandy tracts must under any circumstances be an expensive operation, and possibly not repaid by a direct return, but it may frequently be desirable or even absolutely necessary to incur this outlay, as adjoining land is always in danger of being overwhelmed while the sand remains in an exposed state.

Note by Editor.—In the *Transactions and Proceedings of the New Zealand Institute*, 1881, vol. xiv. p. 89, is a paper by W. T. L. Travers, F.L.S., on the Sand Dunes of the West Coast of the District of Wellington, which refers to the successful cultivation by Mr Coutts Crawford at Miramar Peninsula, and gives the following List of Plants found upon the Sand Dunes of New Zealand:—

Sandbinding Plants.

Of Primary Value.

Coprosma acerosa, A. Cunn.
Convolvulus soldanella, Linn.
Pimelea arenaria, A. Cunn.
Leptocarpus simplex, A. Rich.
Carex pumila, Thunb.
Hierochloe redolens, Labill.
Spinifex hirsutus, Labill.
Arundo conspicua, Forst.
Desmoschœnus spiralis.
Scedonorus littoralis, Palisot.
Gahnia arenaria, Hook. fil.

Of Secondary Value.

Hymenanthera crassifolia, Hook. fil.
Plagianthus divaricatus, Forst.
Haloragis alata, Jacq.
Tetragonia expansa, Murray.
Aciphylla squarrosa, Forst.
Coprosma Baueriana, Endl.
Cyathodes acerosa, Br.
Chenopodium glaucum, Linn. var. *ambiguum.*

Atriplex cincea, Poiret.
Atriplex Billardieri.
Salicornia indica, Willd.
Muhlenbeckia adpressa, Lab.
Muhlenbeckia complexa, Meisn.
Phormium tenax, Forst.
Phormium Colensoi, Hook. fil.
Juncus maritimus, Lam.
Cyperus ustulatus, A. Rich.
Scirpus maritimus, Linn.
Carex virgata, Sol.
Zoysia pungens, Willd.
Dichelachne stipoides, Hook. fil.
Agrostis pilosa, A. Rich.
Glyceria stricta.
Festuca scoparia.

[This enumeration may be useful to those engaged in the reclamation of Sand Dunes in various countries.—ED.]

On Lichens (1) *from Newfoundland, collected by Mr A. Gray, with a List of the Species ;* (2) *from New Zealand ;* (3) *from the South of Scotland.* By JAMES STIRTON, M.D., F.L.S., &c.

(Read 9th March 1882.)

The following lichens, which I have the pleasure of laying before the Society, were collected at Brigus, Newfoundland, during a two months' trip in the summer of 1878, by Mr Archibald Gray, Edinburgh. Mr Gray informs me that the lichens which he saw in that country were splendidly developed—the natural features of the country being well adapted for their growth. Some specimens (*Umbilicaria*) were gathered on bare rocks on the higher grounds near Brigus, at an altitude of about 250 feet; *Nephroma arcticum*, tolerably common in Newfoundland, was got about 100 feet above the sea near the cliffs at South Head of Brigus ; some—as the *Cladoniæ*—in the rocky woods, to a distance of ten miles inland ; others (*Usnea*, &c.) on the trunks of fir trees, and (*Lecidea*) on rocks by the sea. None were gathered at a greater elevation than 400 feet. Mr Gray has also mentioned that icebergs are frequently stranded by the Polar current during winter, along the rough rocky coast of Conception Bay, near where the specimens were collected. The remnant of an iceberg was seen by him aground in the bay as far on in the season as the end of June, while crossing from Portugal Cove to Brigus. Thus the presence of Arctic forms near the sea-level so far south may be accounted for.

1. This small collection of lichens, gathered within two

very restricted areas, whilst it can give only a very meagre and imperfect representation of the lichen flora of Newfoundland, possesses considerable interest in another direction.

While the main features of the collection are distinctly of the North American type, there are several curious tracings of other types, as the Norwegian, British, and, in one instance, of what may be called the Mediterranean type.

Again, as the two habitats are at or near the sea-level, and the bulk of the species, as might have been expected, is composed of plants commonly found in this zone, there is a curious intrusion of individuals of other altitudinal zones (especially European)—an intrusion to this extent at least, that it cannot fairly be accounted for from the geographical situation of the island as to latitude, and I am not sure that the influence of known ocean currents upon plant spread and growth will do much towards an elucidation in this respect.

For instance, *Stereocaulon tomentosum*, whose habitat is mainly subalpine in Europe, is here, as well as in North America generally, on the littoral zone.

2. *Cladonia sylvatica*, var. *alpestris*, is another example of the same kind, of a lichen found in the more northern parts of Norway and Scotland.

3. *Alectoria cincinnata* is only found in Scotland at high levels, and, so far as my experience goes, only near the summits of mountains of considerable elevation, and in Norway near the White Sea, &c.

4. *Nephroma arcticum* is only found in the northern parts of Norway and in Arctic North America, or it may be near the summits of the higher mountains further south, as the White Mountains; while here it is found in abundance at the sea-level.

Several instances of a similar nature might be mentioned, as *Umbilicaria arctica*, whose range corresponds closely to that of *N. arcticum*; but I desist from following out the vein, and I shall merely mention one other instance of an opposite character, viz., *Rocella*.

Generally speaking, the range of species of this genus is, for Europe, the Mediterranean; the most northern limit being the south coast of England, and it is difficult to explain the intrusion of any of the species on this coast of Newfoundland. I have little hesitation in referring the small and imperfect specimen in the collection to this genus, as the general appearance, texture, and chemical reactions are all in accordance with this decision.

The *Cladoniæ* of the *rangiferina* group are beautifully represented in the collection, and I am beginning to recognise at sight a third form in which the reactions of the thallus are K— C—. Apart from these negative reactions, there is a general, almost distinctive *facies*, but how to describe it in words I know not. I notice, however, that the axillæ are more widely gaping than in *Cl. rangiferina* or *sylvatica*, and the stems present a faint yellowish appearance towards their summits, while their surface is more flocculent, or, as it were, farinose. I grant that although it is possible when one has specimens before him, so well developed as those from Newfoundland, to be influenced by such characteristics, more especially when these are constant, yet it may not be so easy to discriminate less marked states. Meanwhile, I have thought it right to give expression to these views by constituting a new sub-species, under the name *Cladonia subsylvatica*.

The following is a list of the species and varieties, amounting to 39:—

Sphærophoron coralloides, *Pers.*

Sphærophoron divergens, subsq. nov.

Simile *Sp. coralloidi* sed plerumque humilius et medulla K flavente.

This reaction is well marked, and has also been got in several specimens from various parts of Scotland, and doubtless the same is true of plants from other localities. The negative reaction is absolute in *Sp. coralloides;* and as there are no intermediate states, I am of opinion that a specific place is due to the present plant. The blue reaction by iodine on the medulla is common to both.

Sphærophoron fragile, *Pers.*

Cladonia gracilis var. hybrida, *Hoffm.*, v. *Fr. Lich. Scand.*, p. 82.

Cladonia crispata, *Ach.*, and *forma* gracilior, *Strn.*

Cladonia rangiferina, *L.*, and var. scabrosa, *Leight.*

Cladonia sylvatica, *L.*, and var. alpestris *L.* and *Schær.*

Cladonia subsylvatica, *Strn.*
Cladonia lacunosa, *Del.*
Cladonia bellidiflora, *Schær.*
Stereocaulon tomentosum, *Fr.*
Stereocaulon Depreaultii, *Del.*
Roccella Grayi, sp. nov.

Thallus albidus vel pallido-albidus, opacus, vel nonnihil pulverulentus, fruticosus, erectus vel interdum decumbens (alt. speciminis circ. 1 poll.), compressus aut hinc inde teretiusculus, versus basin divaricato-ramosus, sursum fasciculato-ramulosus, et apicibus fere fasciculato-fibrillosus vel pectinatus et interdum fasciculato-setosus. Thallus extus, K flavens C intense erythrinosus, et C seorsum erythrinosus; medulla I sordide caerulescens. Apothecia ignota.

The external layer of the stem is densely corneous, and thick with a slender irregular medullary centre composed of loose fibres, external to which, and even intermingling with them, are seen greenish gonidia.

This lichen offers certain analogies to the genus *Siphula*, but as the reactions are those of *Rocella* as well as the dense corneous external layer, I have no alternative but to rank it under the latter genus.

Usnea longissima, *Ach.*
Alectoria jubata var. chalybeiformis, *Ach.*
Alectoria cincinnata, *Fr.*
Alectoria subsarmentosa.

Similis *Al. sarmentosæ, Ach.*, sed medulla K— C— et I pallide cærulescens; Thallus K— C flavens.

The main stems are flattened at the axills as in several species of *Chlorea* as constituted by Nylander, but their structure is entirely that of *Alectoria*. The specimens in hand are well developed, nearly a foot in length and densely matted, especially at the attenuated almost capillary apices. The reactions of the other species, viz., *Al. cincinnata* are well developed and unfailing—medulla K—C pallide erythrinosa.

Cetraria aculeata, *Fr.*
Platysma lacunosum, *Ach.*
Nephroma arcticum, *Fr.*
Peltigera aphthosa, *Hffm.*
Peltigera spuria, *Ach.*

Peltigera polydactyla, *Hffm.*
Stictina scrobiculata, *Scop.*
Parmelia saxatilis, *L.*
Parmelia physodes, *L.*
Physcia parietina, *L.*
Physcia stellaris, *L.*
Umbilicaria dictyiza, *Nyl.*
Umbilicaria Dillenii, *Tuck.*
Umbilicaria arctica, *Ach.*
Umbilicaria Mühlenbergii, *Tuck.* var. thallo superne lævi vel vix lacunoso.
Umbilicaria polyphylla, *Schrad.* var. anthracina, *Ach.*
Lecanora tartarea, *L.*
Lecanora subtartarea, *Nyl.*
Lecidea geographica var. atro-virens, *L.*

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2. I avail myself of the present opportunity to give descriptions of two rather curious and anomalous lichens from opposite poles of the earth's surface, viz., one from the south of Scotland, the other from New Zealand.

Thysanophoron Pinkertoni, gen. nov.

Thallus pallidus vel pallide lutescens podetiis validis lævibus, dendritico- et divaricato-ramosis, ramis supra confertis et fibrillis elongatis, confertissimis aut profunde digitato-divisis aut elongato-pinnatifidis munitis; cephalodia sat frequentia, pallida, plerumque parva et gonimia scytonemoidea continentia. Apothecia ignota. Thallus (alt. 1–2 — pollicaris) extus K— ; I— ; medulla K— ; I cærulescens dein violascens.

The only specimen in my possession is from Dr R. Pinkerton of Glasgow, who gathered it in New Zealand, but he cannot recall the exact situation, very probably in the neighbourhood of Wellington. There are grounds for suspecting that this lichen is given by Professor Babington under the name *Stereocaulon ramulosum* (Ach.), var. This lichen presents characteristics which link it on the one hand to *Sphærophoron*, and on the other of *Stereocaulon*. Its chemical reactions are exactly those of *Sph. coralloides*, to which it otherwise approaches in its general habit and mode of branching, while the presence of cephalodia containing gonimia exactly scytonemoid warrants association with *Stereocaulon.* Under these circumstances, it has been deemed advisable to rank it under a new subgenus *Thysanophoron.*

Professor Th. M. Fries of Upsala, Sweden, to whom a specimen was submitted, has pronounced in favour of association with *Sphærophoron.* He alleges that the presence of cephalodia is no barrier to such association, and he quotes Nylander as having occasionally detected cephalodia on specimens of *Sphærophoron.*

The system of cephalodia in the present instance is, however, far too thickly and constantly disposed over the plant to warrant the assumption of the individuals being merely accidentally located. I have examined numerous specimens of *Sphærophoron*, not only of this country, but from various parts of the world, and have not detected cephalodia on any, accordingly they must be very rare, and very probably accidental. On the other hand, the general aspect of undoubted species of *Stereocaulon* from different parts of the world is by no means so characteristic of the genus as authors would lead us to infer. I possess specimens of a *Stereocaulon* from the Himalayas, gathered by Mr J. Thomson of Glasgow, in which the general disposition and branching of the fibrillæ are such as to give *prima facie* the impression of *Sphærophoron.* And generally the more tropical *Stereocaula* have the usual flattish phyllocladia of colder northern climates converted into simple or composite cylindrical fibrillæ; in other words, their general aspect approaches more or less that of species of the genus *Sphærophoron.* On the whole, then, I am still inclined (in the absence of fructification) to separate the lichen under consideration from both *Stereocaulon* and *Sphærophoron.*

3. The other lichen is due to the Rev. George M'Conachie of Rerrick, near Kirkcudbright, and is from the ruins of Dundrennan Abbey, so sadly associated with the hapless Mary Queen of Scotland.

In general appearance it approaches closely the rather anomalous *Lecidea canescens* (Dickson), but the internal structure and colour of the thallus are almost those of *Pyxine coccifera* (Fée), as well as the constitution of the apothecia and spores. The almost entire absence of the so-called hypothallus, which is said by several writers to be distinctive of the genus *Pyxine*, would seem at first sight to forbid association in this direction, but an examination of a considerable number of specimens of *Pyxine* from tropical and sub-tropical countries scarcely warrants the presence of a hypothallus as a generic character.* The fact that no species of the genus *Pyxine* is European can scarcely be said to form an obstacle to association of the present lichen with it, and the rather that our knowledge of the distribution and range of lichens is still very defective.

In the absence of other authentic specimens, either British or European, I hesitate to classify this plant under *Pyxine* although I confess to a bias in this direction. Accordingly I shall, meanwhile at least, rank it alongside *Lecidea canescens* under the name *Lecidea erubescens.* Another curious analogy between this lichen and *Pyxine coccifera* is to be found in the identity of the chemical reactions as detailed below.

Lecidea.

Thallus pallidus vel pallide glaucescens, adpressus, anguste radiato-laciniatus, laciniis contiguis et hinc inde pallide lutescenti-sorediosis, intus rubescens, subtus erythrinosus vel coccineus. Hypothallus nigricans passim visibilis, eradiculosus. Apothecia sessilia nigra plana marginata; sporæ (4–8) næ fuscæ, ellipsoideæ vel fusiformi-ellipsoideæ, 2–loculares, vix septatæ, interdum fere polari-biloculares, raro simplices, ·013 – ·02 × ·006 – ·008 mm.; paraphyses graciles irregulares nigro-clavatæ; hypothecium fuscum vel fusco-nigrum. Iodo gel. hym. cærulescens dein sordida. Medulla præsertim infra, K sordide purpurascens.

Since writing the above Dr Pinkerton has died, at the early age of 32. He did much in the interests of his profession while serving under the Turkish flag during the late Turco-Russian war, and gave abundant promise of more. There are good grounds for believing that the exposure and irregular mode of living had much to do in determining the fatal result. While he kept himself well

* The majority of specimens of *Pyxine* growing on bark show traces of this structure, while in one specimen from India on stones scarcely any can be detected, and radicles are consequently absent.

up in surgery, his favourite branch of study, he often diverged during his travels to natural history pursuits, and made collections of plants, &c., which would have done credit to one with more pretensions to a knowledge of the subject than he professed to have.

On the Germination of Streptocarpus caulescens. By Professor Dickson. (Plate XIV.)

(Read 11th May 1882.)

My observations on this plant have been made on specimens raised in the Botanic Garden, from seeds recently sent home by Mr John Buchanan, from Blantyre, Central Africa.

It is already known that in the germination of such species as *Streptocarpus Rexii* and *S. polyanthus*, from South Africa, the two cotyledons are at first very small and of equal size, but that while one of these remains stationary in development, and finally disappears, the other continues to grow, forming an elongated sessile leaf of considerable size, lying flat along the surface of the ground. In these species the enlarged cotyledon persists throughout the life of the plant, and is the only leaf-organ performing proper leaf-functions, the other leaves being developed merely as bracts in connection with the inflorescence. A similar development, it can hardly be doubted, occurs in *Acanthonema strigosum* (described by Sir J. D. Hooker in the *Botanical Magazine*, vol. xxxviii. tab. 5339), a plant belonging to the same natural order (*Gesneraceæ*), and also a native of South Africa. It is noteworthy that in yet another South African plant, though of very different affinities, —the celebrated *Welwitschia*,—we have also an instance of leaves, either the cotyledons, or, as would appear from Mr Bower's researches, the two first leaves of the plumule, becoming much enlarged, persisting throughout the lifetime of the plant, and performing exclusively, in absence of any other foliage-leaves, the ordinary leaf-function, just like the enlarged cotyledon of *Streptocarpus polyanthus*. In the Blantyre *Streptocarpus* the plant germinates at first with two minute cotyledons of equal size and opposite to each other, *i.e.*, at the same level. A little later, however, one of these is observed to become larger, the other remaining stationary. The larger cotyledon goes on growing, develops a distinct petiole, and ultimately forms a leaf differing in no essential respect from the foliage-leaves succeeding it on the stem of this caulescent species. A further peculiarity is that the cotyledons thus unequally developed, though at first opposite each other, become, as growth proceeds, separated by an internode, the larger cotyledon being carried up nearly half an inch higher than the smaller one—a very remarkable phenomenon in a dicotyledonous plant. The larger cotyledon, moreover, is evidently of no greater persistence than the foliage-leaves which succeed it, and which, as already said, it closely resembles; and in this it differs remarkably from the other species mentioned, where the large cotyledon is persistent. As regards the subsequent development of an internode between the unequally developed cotyledons, the late Professor Dickie (*Journal Linn. Soc. Bot.*, 1867, p. 126) notes that in *Streptocarpus Rexii* and *S. primuloides* "the two cotyledons are at first opposite and equal in size. After some time, however, they become alternate, the space between the two varying somewhat in different seedlings. At a more advanced stage, the upper cotyledon thus separated from its fellow begins to enlarge, the other retaining its original size and afterwards decaying." It is interesting to note that in *Streptocarpus caulescens*, also, it is the upper of the two separated cotyledons which becomes enlarged. In the axils of both of the cotyledons buds are developed; in that of the larger cotyledon, in the first place, a primary axillary bud, and then a little later an accessory one placed vertically below the primary bud, between it and the base of the cotyledon. It might be a question for evolutionists whether to regard the condition of *S. caulescens* as a step towards the highly differentiated one of *S. polyanthus*, or as a step towards reversion to a more normal development; a speculation, perhaps, scarcely worth entering upon.

Explanation of Plate XIV.

Seedling Plant of *Streptocarpus caulescens.*

x = Cotyledon which remains stationary in development.

y = Cotyledon which has gone on to development as a leaf essentially similar in character to the ordinary foliage-leaves, and has become elevated above its fellow by formation of an internode.

z = Main axis.

x axb = Axillary bud of smaller cotyledon.

y axb = Axillary bud of larger cotyledon.

y acb = Accessory bud developed between the last and the base of the cotyledon.

On the Æstivation of the Floral Envelopes in Helianthemum vulgare. By Professor Dickson.

(Read 13th July 1882.)

It has long been known that the three large sepals and the petals in this plant are convolute in the opposite directions. It does not, however, appear to have been previously noticed that the contortion or convolution of each of these floral envelopes is alternately to right and to left in the flowers along the false axis of the scorpioid cyme. This fact is of considerable interest in connection with the theory of the scorpioid arrangement as the result of heterodromy of the leaf-spirals in the successive axes of which this cyme is made up; a theory of the truth of which still more conclusive evidence was afforded by the late Professor Hofmeister, who showed that in the flowers of *Boraginaceæ*, such as *Echium* and *Cerinthe*, the calycine segments of the successive flowers on the cyme form an alternately right- and left-handed quincuncial arrangement.

On a Monstrosity in the Flower of Iris Pseudacorus. By Professor Dickson.

(Read 13th July 1882.)

In a specimen gathered recently at an excursion to Longniddry the outer perianth segments were normal; but of the inner ones only two were normal, whilst the third one was nearly completely metamorphosed into a stamen with distinctly formed filament and anther containing pollen, the extremity of the anther ending in a petaloid expansion. And in each of the three unopened flowers of the same inflorescence there was, in like manner, a fourth stamen of somewhat smaller size than the three normal ones, and similarly taking the place of a segment of the inner perianth. Examples of an advance in metamorphosis such as this are of rare occurrence, although cases of retrograde metamorphosis, such as conversion of stamens into petals, are very common.

Report on the Vegetation in the Garden of the Royal Botanic Institution, Glasgow, from January till November 1882. By Robert Bullen, Curator. Communicated by the President.

January.

During the month the thermometer has been at the freezing-point on four occasions, and below it only twice, the lowest temperatures registered being during the nights of 8th and 28th, when 31° and 26° are recorded; the highest temperature being at noon on the 9th, with a little sun.

Vegetation unusually forward, buds of many hardy shrubs expanding rapidly. Some of the hardier Loniceras have young growths two to three inches in length. A large plant of *Cydonia japonica*, nailed against the east wall of the Curator's house, is very beautiful, being in leaf and bloom. Rhubarb (var. *Victoria*) in the open border is from four to six inches high. Hellebores, Polyanthus, Crocus, Snowdrops in bloom. Day-lilies (*Hemerocallis*) have leaves six inches long, and many other herbaceous plants are growing fast. I have never previously known grass make such rapid growth at this time of the year.

February.

During the month the thermometer has been below the freezing-point on six occasions, the lowest reading being on the 15th; the highest being 60°, on the 12th.

Petasites vulgaris was in full bloom the first week in the month; *Daphne Mezereum*, *Sisyrinchium*, and *Scilla italica* and *siberica* by the middle of the month. *Ribes sanguinea* was noticed in bloom on the 26th on the banks of the River Kelvin. *Pulmonaria officinalis* and *Hepatica* *triloba* were in bloom at the end of the month. The balsam Poplar, also some *Loniceras*, are in full leaf.

March.

During the month the thermometer was at or below the freezing-point on four occasions, the lowest reading being during the night of the 21st, falling to 28°. Cold winds, with occasional hailstorms were, however, more the cause of the low temperature than actual frost.

April.

The thermometer was at the freezing-point on four occasions, and below only twice, on the 9th and 15th.

During the earlier part of the month vegetation made little progress, owing to the cold winds which prevailed. The leaves of the more tender herbaceous plants, as also those of several deciduous trees and shrubs, were slightly injured by the frost on the night of the 15th inst. As frost has not been experienced since that date, no ill effects are observable, the leafage of most trees being at least three weeks in advance of the last two seasons.

May.

No frost has been recorded during the month. The lowest temperatures being on the following dates:—1st, 33°; 2nd, 35°; 9th, 34°; 14th, 34°. The highest on the 17th, 18th, 19th, and 20th, when the average was 69°.

The weather generally has been unfavourable to the growth of the more tender of what are commonly called hardy plants.

Common trees and plants of a perennial nature have generally continued to grow with considerable vigour. The cold winds which prevailed during the early part of the month were succeeded by twelve parching days, and comparatively cold nights, retarding late-leafing trees, as well as annuals.

A total of twenty-three dry days were recorded for the month.

June.

The lowest night temperatures are recorded about the middle of the month, 37° being the minimum; the highest maximum day temperature being 73° in the shade on the 29th.

The dry weather of the preceding month was continued during the first eight days of this month. Its effects on garden annuals, bedding out-plants in general, and the hardy violas, and pansies in particular, were serious, the latter dying off by hundreds, while the former wore a starved appearance.

During the latter fortnight, however, a sudden change has taken place; encouraged by frequent rains and sunny days, plants of all kinds have grown rapidly. Out of a large collection of spring-sown hardy annuals, the following are the only kinds in bloom at the end of June:—

Malcolmia maritima.	Nemophila insignis.
Silene pendula.	Gilia tricolor.
Gypsophila elegans.	achilleæfolia.
Limnanthes Douglasii.	Bartonia aurea.
Oxalis rosea.	Collinsia bicolor.
Lupinus affinis.	candidissima.
Lasthenia californica.	Linaria bipartita.
Nemophila atomaria.	Platystemon californicum.

July.

The highest temperature recorded during the month was 73° and 71° on the 1st and 2nd respectively. On the following day the temperature fell suddenly to 61°, the day being dull and showery, unsettled weather having prevailed generally throughout the month. The lowest temperature was 41° on the night of the 26th.

Vegetation continued to make steady progress during the early part of the month. Hardy annuals have grown and bloomed freely. Hollies which had suffered severely from the western gales during the winter have been greatly benefited by the wet weather; most trees and shrubs have made vigorous growth, the genial growing weather has had a marvellous effect on many plants. Some plants of *Kalmia latifolia*, Lilac Charles X., and hybrid rhododendrons, potted and treated for forcing in the usual way last autumn, have remained dormant until now, and after being planted out again for some weeks have bloomed during the month, though weakly.

August.

The highest day temperature was 75° on the 11th, the lowest 60° on the 1st. The highest night temperatures 54° on the 15th and 16th, thunder and lightning being frequent both nights. The lowest night temperature was 41° on the 6th.

Bright sunny weather prevailed for eleven consecutive days during the early part of the month. Since then the weather has been changeable.

Tender plants, which had made comparatively little growth last month, have experienced a sudden and beneficial change during the first fortnight of this month, which may be said to have constituted the summer of the season.

September.

The lowest night temperature recorded during the month was 32° on the 11th, and 31° on the 29th, or 1° of frost. The highest day temperature (in the shade) varied from 52° to 65°.

Although several wet and dull days are recorded during the month, several fine and dry days have succeeded each other at intervals. Seeds of many plants have ripened fairly well, and in most cases will be harvested earlier than is usual in this part of the country. Cereal crops of all kinds are a good average, but in some districts late.

October.

The following are the lowest night temperatures registered during the month, *i.e.*, 30° on the 24th, 27° on the 25th, 28° on the 26th, 32° on the 27th, and 27° on the 28th.

Garden operations have been carried on with difficulty, owing to the unsettled state of the weather, rain having been frequent and heavy. Nevertheless the genial temperature which prevailed during the first three weeks prolonged the season of autumn flowering herbaceous plants. The storms of wind and heavy rains have cleared the deciduous trees of their leaves somewhat prematurely. The young wood of most trees is filled with watery sap, denoting imperfect maturation.

November.

The thermometer has been at or below 32° on seventeen mornings during the month. Considering the wet weather which prevailed during the first week of the month, the day temperature ruled high, the mean for the first ten days being 49°. Since then the fall has been gradual, the lowest being 33° on the 12th. Rain fell less or more on 13 days.

Out-door vegetation is entirely dormant.

On Dysoxylon Schiffneri (Section *Cleisocalyx*), *a new Tree from East Australia.* By Baron Ferd. von Mueller, Ph.D., M.D., F.R.S., K.C.M.G.,

(Read 9th Februrary 1882.)

Leaves and their stalks almost glabrous; leaflets verging from an oval to a somewhat lanceolar form, opposite or nearly so, thin-chartaceous in texture; racemous bunches of flowers arising from the stem, short; stalklets nearly or fully as long as the flowers, silky; calyx large, before expansion of the corolla almost egg-shaped, then perfectly entire and closed, without any ruptures or sutural lines, subsequently torn to about the middle into two undivided or once more slightly cleft lobes; petals four, free, elongated-oblong, about one-third longer than the calyx, and likewise outside silky; staminal column broadly tubular, seven or oftener eight-toothed, the teeth semilanceolar, about three times shorter than the tube; anthers seven or oftener eight, sessile between the teeth at the summit of the tube, their connective often minutely pointed; disk cup-shaped, free, slightly crenulated, as well as the staminal tube glabrous; style filiform, its lower portion and the ovary densely downy; stigma depressed-hemispherical; ovary four-celled, with two superposed ovules in each cell; fruit globular, glabrescent, brown outside; pericarp rather thin, not unless very tardily valvular; seeds without any arillus.

In the Mount Bellenden-Ker Ranges; Karsten.

A tree attaining a height of 80 feet. Bark greyish-brown, smooth. Wood yellowish. Leaflets on very short stalklets, in few pairs, so far as the very scanty material admits of judging, 2–5 inches long, somewhat inequilateral, very minutely dotted. Racemes two or more together, 2–4 inches long, fragrant. Petals nearly half an inch long, pure white, upwards slightly imbricated, downwards valvular. Fruit not seen quite ripe, then not fully an inch long, nor showing any indication of valvular structure, four-celled. Seeds ripening solitary in each cell, turgid, almost longitudinally adnate; testa thin, dark-brown, loose. Albumen none. Cotyledons planoconvex, collateral. Radicle very short, terminal, almost concealed between the minute lobes of the cotyledons.

I have left this remarkable Meliaceous tree in the genus *Dysoxylon*, as constituted at present, although the structure of the calyx is so exceptional in the genus, that under the sectional name here adopted, or perhaps under that of *Epicharis*, this species with its nearest allies might be raised to generic distinction, especially as the fruit does not seem to slit into any valvular divisions, in which anomaly, however, *D. Klanderi* coincides (vide *Fragm. Phytogr. Austr.*, ix. 134), thus showing an approach to *Sandoricum*. The genus *Dysoxylon*, by admitting into it *Hartigshea* with arillate seeds, and *Didymocheton* with sepals overlapping at their margins, has become too artificial, while in *Hartigshea spectabilis* the anthers are inserted below the merely crenulated summit of the staminal tube, a characteristic on which otherwise much stress has been laid by Casimir de Candolle. The remarkable location of the inflorescence is not without example in the genus, it bursting also in several other species away from the leaves out of the stem or main branches.

This new species is nearest allied to *D. caulostachyum* from New Guinea, with which and the other species placed by Miquel in the section *Epicharis* it accords in the peculiar structure of the calyx; but the leaflets are not coriaceous, the pedicles longer, the calyces twice as long, thus reaching much higher up to the corolla, and the teeth of the column are neither rounded nor retuse-truncate; the fruits are likely also different.

This noble and singular tree is dedicated to Dr. Rudolph Schiffner of Vienna, who for many years has been the president of the great and highly scientific Pharmaceutical Society of Austria.

Report on Temperatures and Open-Air Vegetation at the Royal Botanic Garden, Edinburgh, from November 1881 *till July* 1882. *Compiled from Notes read at Meetings of the Society.* By the late JOHN SADLER, F.R.Ph.S., Curator.

The forest trees and shrubs flowered remarkably well during the early summer of 1881, and most of them produced fruit. The garden suffered very little from the great storm of October 1881.

In *November* 1881 the thermometer was seven times at or below 32°. On two occasions it stood at 25°. The dates of these low temperatures were the 1st, 2nd, 4th, 8th, 18th, and 26th.

Upwards of thirty species and varieties of plants were in full flower in the rock garden; Christmas roses blooming for two or three weeks.

In *December* the thermometer was at or below the freezing-point on sixteen occasions. The greatest frost was on the 22nd and 23rd, when 26° and 23° were respectively registered. These were relatively high readings, when compared with the same month, as well as that of November 1880.

In *January* 1882 the thermometer fell below the freezing-point on six occasions, as compared with twenty-seven occasions in January 1881. On the 4th and on the 29th, 28° and 26° were respectively registered.

In the rock garden fifty-two species and varieties of plants had flowered, including fourteen species of Hellebore, as well as mignonette, besides crocuses, pansies, and roses.

In *February* the thermometer was at or below the freezing-point on eight occasions, as against twenty in 1881. The lowest readings for the month were—1st, 32°; 2nd, 29°; 3rd, 30°; 7th, 28°; 9th, 29°; 16th, 29°; 19th, 30°; 28th, 32°. The three highest morning readings (9 A.M.) were on the 8th and 9th (48° and 51° respectively).

Forty-seven species and varieties of plants came into flower in the rock garden, amongst them were *Galanthus plicatus*, *G. Elwesii*, *Crocus biflorus*, *C. etruscus*, *C. imperati*, *Leucojum vernum*, *Bulbocodium vernum*, &c. There also flowered *Helleborus colchicus*, white and blue Hepaticas, the Botanic Garden purple variety of the common primrose, as well as yews, and certain species of Alnus, hazel, &c.

In *March* the thermometer was at or below the freezing-point on seven different occasions. The dates were as follows:—1st, 32°; 7th, 30°; 21st, 31°; 22nd, 30°; 23rd, 29°; 25th, 32°; and 26th, 32°.

Vegetation was six weeks in advance on the 9th inst. of what it was at the same period in 1881 in the rock garden; and specimens of the following plants in flower were exhibited at the March meeting of the Botanical Society.

Sisyrinchium grandiflorum (white and purple).
Iris reticulata.
Helleborus fœtidus.
" angustifolius.
" guttatus.
" orientalis.
" purpurascens minor.
" viridis.
" olympicus albus.
" colchicus.
Hepatica angulosa.
Daphne Mezereum.
Draba aizoon.
" aizoides.
Dentaria enneaphylla.
Aubrictia purpurea.
" grandiflora.
" cœlestis.
" Hendersoni.
Viola species, yellow variety.
Lithospermum prostratum.
Andromeda calyculata latifolia.
" media.
Omphalodes verna.
Arabis procurrens.
" albida.
Thlaspi prostrata.
Symplocarpus fœtidus.
Anemone coronaria.
" fulgens.
Primula denticulata.
" dark variety.
" intermedia.
Saxifraga crassifolia.
" rubra.
" media.
Primula marginata.
" vulgaris.
" " (single white).

Primula vulgaris (double white).
„ „ rubra.
Corydalis cava.
„ bulbosa rubra.
Polygala Chamæbuxus.
Erica herbacea.
„ carnea alba.
Mandragora vernalis.
Iberis petræa.
Dondia epipactis.
Soldanella montana.
Vinca minor.
Saxifraga oppositifolia.
„ alba.
„ aretioides.
Erythronium dens canis.
„ grandiflorum.
Cyclamen Coum vernum.
Corbularia sp. (Maw).
Ornithogalum sp. (Maw).
Gagea lutea.
Scilla sibirica.
„ præcox.
„ bifolia.
„ „ taurica.
„ „ rubra.
„ „ alba.
Puschkinia scilloides.
Bulbocodium vernum.

In *April* the thermometer was at or below the freezing-point on six occasions; it had been on twenty-one during the same month last year. The lowest temperatures were on the following dates:—8th, 32°; 10th, 27°; 12th, 29°; 13th, 31°; 16th, 26°; 27th, 28°. The frosts of this month, owing to the advanced condition of vegetation, did much injury to fruit trees and bushes in flower, as well as to tender shoots in many parts of the country.

During this month 231 species and varieties of plants came into flower in the rock garden, as compared with 52 in April last year.

In the early part of *May*, though the thermometer did not fall to the freezing-point, yet the night temperatures were very low, as shown by the following readings:—1st, 34°; 2nd, 39°; 3rd, 35°; 6th, 34°; 7th, 36°; 8th, 33°; 9th, 34°; 10th, 35°. On the 4th, 5th, and 11th the thermometer registered 43°.

On the 11th of the month 346 species and varieties were in flower on the rock garden, as compared with 158 at the same date last year.

June 1882.—The lowest readings of the thermometer during the month were on the 1st, 41°; 2nd, 41°; 11th, 37°; 12th, 38°; 16th, 35°; 17th, 35°.

Since the last month 173 species and varieties of plants came into flower in the rock garden, making a total of 666 for the season, as compared with 484 at the corresponding date last year (1881). Amongst them were the following:—

Aster graminifolius.
Anthericum liliago.
Cathcartia villosa.
Campanula thyrsoidea.
Cypripedium spectabile.
Dianthus alpinus.
„ suavis.
Eriogonum aureum.
Gentiana lutea.
Gorteria acaulis.
Gillenia trifoliata.
Kalmia angustifolia.
Lilium Chaixii.
„ colchicum.
Linnæa borealis.
Lonicera tomentella.
Milla longipes.
Orchis foliosa.
„ maculata superba.
Papaver alpina.
Primula capitata.
Spiræa aruncus.
Stenactis speciosa.
Wulfenia Amherstiana.

July.—The lowest readings of the thermometer during the month were registered on the mornings of the 5th, 44°; 9th, 45°; 11th, 44°; 12th, 45°; 25th, 46°; 26th, 45°. Since last month 135 species and varieties of plants came into flower in the rock garden, making a total of 801 compared with 561 at the corresponding period of last year. The following were amongst those which came into flower during the month:—

Alstrœmeria aurea.
Baptisia australis.
Cassinia fulvida.
Convolvulus lineatus.
Delphinium velutinum.
Dianthus cruentus.
Erica ramulosa.
Gaillardia grandiflora.
Gentiana septemfida.
Hypericum empetrifolium.
Lilium pardalinum.
Mœhringia muscosa.
Potentilla formosa.
Senecio pulcher.
Lilium auratum.
„ dalmaticum.
Mulgedium alpinum.
Olearia Haastii.

Note on Table of Flowering of Plants in the Royal Botanic Garden, Edinburgh, from 1850 *to* 1882. By John Sadler, Curator. (With Table).

(Exhibited 13th July 1882.)

The annexed table shows the dates of the flowering of forty plants during three decades and two years. The observations were begun by the late James Macnab, and continued by his successor.

50 till May 1882.

70.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.
r. 8	Mar. 22	Mar. 13	Apr. 21	Mar. 16	Mar. 29	Apr. 5	Apr. 12	Apr. 12	Apr. 28	Apr. 20	May 11	May 1
..	..	..	..	..	Feb. 10	Mar. 5	Mar. 18	Mar. 1	Apr. 7	Mar. 3	Mar. 20	Jan. 24
..		..	Mar. 17	..	Feb. 15	Feb. 24	Feb. 17	Feb. 13	Apr. 9	Mar. 4	Mar. 12	Feb. 16
..	.	Feb. 17	Mar. 2	Feb. 2	Feb. 6	Feb. 16	Feb. 16	Mar. 1	Apr. 7	Mar. 1	Mar. 5	Feb. 2
..	..		.	..	Mar. 23	Mar. 28	Mar. 28	Mar. 16	Apr. 15	Mar. 16	Apr. 1	Feb. 26
). 18	Feb. 16	..	Jan. 14	.	Jan. 15	Jan. 14	Jan. 1	Feb. 10	Mar. 5	Feb. 11	Mar. 1	Feb. 3
r. 1	Feb. 16	Jan. 30	Feb. 14	Jan. 14	Jan. 23	Feb. 4	Jan. 20	Feb. 6	Mar. 6	Feb. 12	Mar. 8	Feb. 2
r. 3	Feb. 17	Feb. 4	Feb. 17	Jan. 26	Feb. 10	Feb. 9	Jan. 28	Feb. 17	Mar. 7	Feb. 20	Mar. 12	Feb. 9
r. 27	Feb. 25	Feb. 10	Mar. 15	..	Feb. 4	Feb. 13	Jan. 26	Feb. 22	Apr. 7	Feb. 28	Mar. 2	Dec. 28
.	..	..	Jan. 15	..	Feb. 5	Feb. 20	Feb. 11	Feb. 9	Mar. 6	Feb. 2	Feb. 28	Dec. 26
..	..	Mar. 4	Mar. 18	Feb. 2	Mar. 8	Mar. 12	Mar. 11	Feb. 19	Apr. 7	Feb. 15	Feb. 26	Feb. 1
). 20	Feb. 13	..	Jan. 15	Jan. 14	Jan. 30	Feb. 1	Jan. 26	Feb. 2	Feb. 27	Feb. 8	Mar. 4	Feb. 1
r. 2	Mar. 24	Mar. 1	Mar. 22	Mar. 1	Mar. 21	Mar. 28	Mar. 23	Mar. 10	Apr. 8	Mar. 11	Mar. 29	Feb. 20
..	..	Mar. 30	Apr. 22	Mar. 22	Apr. 18	Apr. 6	Apr. 14	Apr. 6	Apr. 26	Apr. 12	May 6	Apr. 10
). 2	Feb. 13	..	Jan. 9	Jan. 10	Jan. 18	Jan. 16	Jan. 15	Feb. 4	Feb. 22	Feb. 7	Mar. 2	Jan. 24
r. 4	Feb. 15	..	Feb. 10	Jan. 15	Feb. 3	Feb. 6	Jan. 29	Feb. 7	Mar. 1	Feb. 8	Mar. 1	Feb. 1
..	..	..	..	..	Feb. 2	Feb. 17	Mar. 17	Mar. 2	Apr. 6	Killed		
..	..	..	..	..	Mar. 19	Mar. 13	Mar. 10	Mar. 8	Mar. 30	Mar. 10	Mar. 28	Feb. 21
r. 2	Feb. 15	..	Feb. 9	Jan. 10	Jan. 21	Feb 2	Jan. 18	Feb. 8	Mar. 3	Feb. 9	Mar. 4	Feb. 1
r. 3	Mar 24	..	..	..	F b. 28	Mar. 12	Mar. 17	Mar. 15	Apr. 7	Mar. 15	Apr. 2	Feb. 24
..	Mar. 27	Mar. 18	Apr 1	Mar. 14	Apr. 1	Apr. 3	Apr. 8	Mar. 18	Mar. 25	Mar. 19	Apr. 20	Mar. 4
r. 24	Feb. 28	Mar. 1	Mar. 14	Feb. 20	Mar. 13	Mar. 15	Mar. 12	Mar. 7	Apr. 1	Mar. 9	Mar. 18	Feb. 2
). 19	Feb. 20	Feb. 20	Feb. 25	Feb. 9	Mar. 11	Feb. 10	Feb. 16	Feb. 15	Mar. 6	Feb. 20	Feb. 25	Jan. 26
.	Mar. 20	Feb. 24	Mar. 25									
r. 3	Mar. 18	Mar. 4	Mar. 15	Feb. 1	Mar. 23	Mar. 23	Mar. 27	.	Apr. 1	Mar. 8	Mar. 20	Feb. 4
..	·Feb. 27	Feb. 3	Feb. 19	Jan. 4	Feb. 4	Feb. 2	Jan. 25	Feb. 8	Mar. 6	Feb. 5	Mar. 6	Dec. 27
..	..	Feb. 12	Mar. 18	Jan. 16	Mar. 13	Feb. 23	Feb. 23	Mar. 4	Mar. 30	Mar. 5	Mar. 15	Feb. 26
r. 6	Mar. 21	Mar. 3	Mar. 24	..	Mar. 30	Mar. 30	Mar. 25	.	Apr. 8	Mar. 17	Mar. 24	Feb. 3
r. 25	Mar. 18	Feb. 22	Mar. 9	Feb. 2	..	Feb 14	Feb. 24	Feb. 28	Apr. 29	Mar. 6	Mar. 9	Feb. 8
r. 27	Feb. 28	..	Mar. 28	Mar. 2	Mar. 17	Mar. 15	Mar. 8	Mar. 4	Apr. 1	Mar. 7	Mar 20	Feb. 15
..	..	Feb. 16	Mar 3	Jan. 24	Jan. 23	Feb. 6	Feb. 16	Feb. 22	Mar. 6	Feb. 25	Mar. 10	Jan. 28
r. 28	Feb. 26	Feb. 24	Mar. 7	Jan. 30	Mar. 10	Feb. 14	Feb. 20	Feb. 18	Mar. 10	Feb. 26	Mar. 12	Feb. 3
..	..	..	..	..	..	..	Mar. 4	Mar. 4	Apr. 1	Mar. 10	Mar. 21	Feb. 8
..	..	Jan. 31	Feb. 16	..	Mar. 8	Feb. 15	Feb. 20	Feb. 19	Apr. 9	Feb. 24	Mar. 18	Feb. 20
..	..	Feb. 18	Feb. 28	..	Mar. 6	Feb. 13	Feb. 17	Feb. 10	Apr. 6	Feb. 24	Mar. 8	Jan. 26
..	..	..	..	..	Mar. 31	Mar. 15	Apr. 5	Mar. 16	Mar. 30	Mar. 16	Mar. 24	Feb. 23
r. 18	Feb. 28	Feb. 16	Mar. 24	Feb. 3	Mar. 30	Mar. 25	Mar. 27	Mar. 11	Apr. 5	Mar. 11	Mar. 14	Feb. 9
..	..	..	..	..	Feb. 15	Feb. 21	Mar. 8	Feb. 15	Mar. 6	Feb. 10	Mar. 8	Feb. 3
..	..	..	..	..	Jan. 18	Jan. 12	Jan. 3	Feb. 9	Mar. 5	Feb. 12	Mar. 4	Feb. 2
..	..	..	..	..	Mar. 6	Feb. 26	Mar. 18	Feb. 28	Apr. 26	Mar. 8	Mar. 9	Feb. 2

Table of the Flowering of Plants at the Royal Botanic Garden, Edinburgh, from February 1850 till May 1882.

No.	Plant	1850	1851.	1852.	1853.	1854	1855.	1856.	1857.	1858.	1859.	1860.
1	Adonis vernalis	Mar. 16	Feb. 18	Mar. 6	Apr. 6	Mar. 28	Apr. 19	.	.		..	.
2	Arabis albida		.			.	.	.			.	
3	Aubrietia grandiflora		.		..	..	..	..			.	.
4	Bulbocodium vernum		.	.	..	..						.
5	Corydalis solida	.	.	.	..	..	.	.		.	.	..
6	Corylus Avellana	Feb. 16	Jan. 16	Jan. 25	Mar. 9	Mar. 10	Mar. 21	Feb. 15	Feb. 16	Jan. 14		
7	Crocus Susianus	Feb. 16	Jan. 26	Feb. 3	Mar. 8	Feb. 14	Mar. 5	Feb. 18	Feb. 15	Jan. 15		
8	Crocus vernus	Feb. 26	Feb. 3	Feb. 18	Mar. 18	Feb. 4	Mar. 6	Feb. 24	Feb. 19	Jan. 18	.	.
9	Daphne Mezereum	Feb. 22	Jan. 28	Jan. 31	Feb. 1	Feb. 18	Apr. 6				.	
10	Dondia Epipactis							.				
11	Draba aizoides					.						
12	Eranthis hyemalis	Feb. 14	Jan. 15	Jan. 31	Feb. 1	Jan. 26	Mar. 2	Feb. 14	Feb. 9	Jan. 16		
13	Erythronium Dens-canis	Mar. 11	Mar. 1	Mar. 12	Mar. 19	Mar. 10	Apr. 11	..		..	.	.
14	Fritillaria imperialis				.	..		..		..	..	
15	Galanthus nivalis	Feb. 11	Jan. 17	Jan. 28	Jan. 24	Jan. 24	Mar. 2	Feb. 14	Feb. 8	Jan. 4	.	.
16	Galanthus plicatus	Feb. 14	Jan. 28	Feb. 3		..		.			.	..
17	Iberis gibraltarica			.		..		.				.
18	Iris reticulata										.	.
19	Leucojum vernum	Feb. 18	Jan. 20	Feb. 21	Mar. 21	Feb. 15	Mar. 3	Mar. 1	Feb. 24	Feb. 10	.	
20	Mandragora officinalis						..			.		
21	Narcissus Pseudo-Narcissus	Mar. 24	Mar. 27	Mar. 28	Apr. 6	Mar. 25	Apr. 20					
22	Narcissus pumilus	Mar. 4	Mar. 5	Mar. 11	Mar. 21	Mar. 10	Apr. 2	Mar. 16	Mar. 15	Mar. 12		
23	Nordmannia cordifolia	Feb. 28	Feb. 20	Mar. 10	Mar. 24	Mar. 1	Apr. 9	Mar. 9	Feb. 27	Mar. 6	.	
24	Omphalodes verna	Mar. 22	Mar. 10	Apr. 2	Apr. 12	Mar. 26	Apr. 23				.	
25	Orobus vernus	Feb. 23	Feb. 17	Mar. 31	Apr. 8	Mar. 16	Apr. 16	Apr. 10	Apr. 20	Mar. 11		
26	Rhododendron atrovirens		Jan. 2	Jan. 14	Feb. 1	Feb. 18	Apr. 9	Feb. 16	Feb. 6	Jan. 5		
27	Rhododendron Nobleanum					.	..	..			.	
28	Ribes sanguineum	Mar. 11	Mar. 5	Mar. 21	Apr. 4	Mar. 14	Apr. 19	Mar. 26	Mar. 26	Mar. 23	Mar. 28	Mar. 18
29	Scilla bifolia	Mar. 13	Mar. 6	Mar. 20	Mar. 27	Mar. 15	Apr. 10	Mar. 20	Mar. 24	Mar. 16		
30	Scilla bifolia alba	Mar. 14	Mar. 4	Mar. 21	Mar. 27	Mar. 13	Apr. 5	..				
31	Scilla præcox			.				..				.
32	Scilla sibirica	Apr. 6	Mar. 26	Apr. 1	Apr. 10	Mar. 30	Apr. 21	Apr. 7	Apr. 14	Mar. 20		..
33	Scilla taurica					.	..	.	.			
34	Sisyrinchium grandiflorum						.	..				
35	Sisyrinchium grandiflorum album						.	.	.		..	
36	Symphytum caucasicum							..				
37	Symplocarpus fœtidus	Feb. 18	Feb. 4	Feb. 20	Mar. 16	Mar. 3	Mar. 20	Feb. 26	Feb. 28	Feb. 9		..
38	Tussilago alba	..	.		..			.			.	..
39	Tussilago fragrans	..			.						.	.
40	Tussilago nivea	..									.	..

No.	Plant	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868	1869	1870.	1871.
1	Adonis vernalis	..		Apr. 7	Apr. 14	..		Apr. 4	Mar. 26	Mar. 18	Apr. 8	Mar. 22
2	Arabis albida			.		.		..	.		.	.
3	Aubrietia grandiflora			.	.	..						
4	Bulbocodium vernum											
5	Corydalis solida		..	..	.							
6	Corylus Avellana	Feb. 10	Jan. 18	Jan. 16		Feb. 18				Jan. 14	Feb. 18	Feb. 16
7	Crocus Susianus	Jan. 28	Jan. 28	Feb. 9		Feb. 8		Feb. 11	Jan. 28	Jan. 22	Mar. 1	Feb. 16
8	Crocus vernus	Feb. 12	Feb. 22	Feb. 10		Feb. 24	Jan. 22	Feb. 16	Feb. 4	Jan. 30	Mar. 3	Feb. 17
9	Daphne Mezereum		.	Feb. 16	Mar. 27			.		Jan. 29	Mar. 27	Feb. 25
10	Dondia Epipactis				.		.	..				.
11	Draba aizoides							..	.			..
12	Eranthis hyemalis	[illegible]	Jan. 16	Feb. 3		Feb. 5	Jan. 30	Feb. 2	Feb. 1	Jan. 16	Feb. 20	Feb. 13
13	Erythronium Dens-canis	Mar. 14	Mar. 15	Mar. 4	Mar. 22		Mar. 19	Mar. 25	..	Mar. 6	Apr. 2	Mar. 24
14	Fritillaria imperialis										.	
15	Galanthus nivalis	Jan. 31	Jan. 29	Jan. 26		Feb. 2	Jan. 14	Jan. 31	Jan. 25	Jan. 9	Feb. 2	Feb. 13
16	Galanthus plicatus	Feb. 4	Feb. 1	Feb. 7	Feb. 2	Feb. 23	Feb. 1	Feb. 5	Feb. 6	Jan. 26	Mar. 4	Feb. 15
17	Iberis gibraltarica						.	.				
18	Iris reticulata				..		.					.
19	Leucojum vernum	Feb. 1	Feb. 1	Feb. 2	Feb. 4	Feb. 26	Jan. 24	Feb. 5	Feb. 13	Jan. 17	Mar. 2	Feb. 15
20	Mandragora officinalis		.		..		Mar. 18	Apr. 9	Mar. 18	Mar. 2	Apr. 3	Mar. 24
21	Narcissus Pseudo-Narcissus		.	Mar. 28	Apr. 2			Apr. 5	Mar. 26	Mar. 27	..	Mar. 27
22	Narcissus pumilus	Mar. 6	Feb. 27	Mar. 8	Mar. 21		Mar. 14	Mar. 4	.	Feb. 18	Mar. 24	Feb. 28
23	Nordmannia cordifolia	Feb. 19	Feb. 15	Feb. 12	Jan. 26		Feb. 7	..		Jan. 21	Feb. 19	Feb. 20
24	Omphalodes verna	Feb. 6		Feb. 2			Mar. 14	Feb. 22	.	Feb. 10		Mar. 20
25	Orobus vernus	Mar. 4	.	Feb. 25	.		Feb. 6	Feb. 15	..	Jan. 25	Apr. 3	Mar. 18
26	Rhododendron atrovirens	Jan. 28	Jan. 26	Jan. 27				Feb. 16	Feb. 1			Feb. 27
27	Rhododendron Nobleanum		.		.			.	.			.
28	Ribes sanguineum	Mar. 7	Mar. 10	Mar. 2	Apr. 12	Apr. 8	Apr. 9	Apr. 3	Mar. 9	Mar. 1	Apr. 6	Mar. 21
29	Scilla bifolia	Mar. 7	Feb. 20	Feb. 28	Mar. 18		Jan. 30	Feb. 16		Feb. 3	Mar. 25	Mar. 18
30	Scilla bifolia alba	Mar. 9	Mar. 10	Mar. 4	Mar. 26	Mar. 28	Mar. 21	Mar. 22	..	Feb. 21	Mar. 27	Feb. 28
31	Scilla præcox	.	.	.			.	..	..	..	.	.
32	Scilla sibirica	Mar. 8	Mar. 17	Mar. 10	Mar. 25	.	Feb. 8	Feb. 23	Feb. 8	Mar. 2	Mar. 28	Feb. 26
33	Scilla taurica		.	.	.	.	..	..				
34	Sisyrinchium grandiflorum		..				..	..		.	.	.
35	Sisyrinchium grandiflorum album	.	..	.			..	..		.	.	..
36	Symphytum caucasicum	.	..			.	..	..		..		
37	Symplocarpus fœtidus	Feb. 9	Feb. 26	Feb. 15	Mar. 14	.	Feb. 8	Feb. 18		Feb. 11	Mar. 18	Feb. 28
38	Tussilago alba		..	..	.	.	..	..	..	..	..	..
39	Tussilago fragrans		..	.	..	.	.	..	..	..	..	..
40	Tussilago nivea				..		..	.	..	.	..	..

No.	Plant	1872.	1873	1874.	1875	1876	1877	1878.	1879.	1880.	1881.	1882
1	Adonis vernalis	Mar. 13	Apr. 21	Mar. 16	Mar. 29	Apr. 5	Apr. 12	Apr. 12	Apr. 28	Apr. 20	May 11	May 1
2	Arabis albida			.	Feb. 10	Mar. 5	Mar. 18	Mar. 1	Apr. 7	Mar. 3	Mar. 20	Jan. 24
3	Aubrietia grandiflora	..	Mar. 17	..	Feb. 15	Feb. 24	Feb. 17	Feb. 13	Apr. 9	Mar. 4	Mar. 12	Feb. 16
4	Bulbocodium vernum	Feb. 17	Mar. 2	Feb. 2	Feb. 6	Feb. 16	Feb. 16	Mar. 1	Apr. 7	Mar. 1	Mar. 5	Feb. 2
5	Corydalis solida				Mar. 23	Mar. 28	Mar. 28	Mar. 16	Apr. 15	Mar. 16	Apr. 1	Feb. 26
6	Corylus Avellana		Jan. 14		Jan. 15	Jan. 14	Jan. 1	Feb. 10	Mar. 5	Feb. 11	Mar. 1	Feb. 5
7	Crocus Susianus	Jan. 30	Feb. 14	Jan. 14	Jan. 23	Feb. 4	Jan. 20	Feb. 6	Mar. 6	Feb. 12	Mar. 8	Feb. 2
8	Crocus vernus	Feb. 4	Feb. 17	Jan. 26	Feb. 10	Feb. 9	Jan. 28	Feb. 17	Mar. 7	Feb. 20	Mar. 12	Feb. 9
9	Daphne Mezereum	Feb. 10	Mar. 15	..	Feb. 4	Feb. 13	Jan. 26	Feb. 22	Apr. 7	Feb. 28	Mar. 2	Dec. 28
10	Dondia Epipactis		Jan. 15	..	Feb. 5	Feb. 20	Feb. 11	Feb. 9	Mar. 6	Feb. 2	Feb. 28	Dec. 26
11	Draba aizoides	Mar. 4	Mar. 18	Feb. 2	Mar. 8	Mar. 12	Mar. 11	Feb. 19	Apr. 7	Feb. 15	Feb. 26	Feb. 1
12	Eranthis hyemalis		Jan. 15	Jan. 14	Jan. 30	Feb. 1	Jan. 26	Feb. 2	Feb. 27	Feb. 8	Mar. 4	Feb. 1
13	Erythronium Dens-canis	Mar. 1	Mar. 22	Mar. 1	Mar. 21	Mar. 28	Mar. 23	Mar. 10	Apr. 8	Mar. 11	Mar. 29	Feb. 20
14	Fritillaria imperialis	Mar. 30	Apr. 22	Mar. 22	Apr. 18	Apr. 6	Apr. 14	Apr. 6	Apr. 26	Apr. 12	May 6	Apr. 10
15	Galanthus nivalis	.	Jan. 9	Jan. 10	Jan. 18	Jan. 16	Jan. 15	Feb. 4	Feb. 22	Feb. 7	Mar. 2	Jan. 24
16	Galanthus plicatus		Feb. 10	Jan. 15	Feb. 3	Feb. 6	Jan. 29	Feb. 7	Mar. 1	Feb. 8	Mar. 1	Feb. 1
17	Iberis gibraltarica		.	..	Feb. 2	Feb. 17	Mar. 17	Mar. 2	Apr. 6	Killed		
18	Iris reticulata				Mar. 19	Mar. 13	Mar. 10	Mar. 8	Mar. 30	Mar. 10	Mar. 28	Feb. 21
19	Leucojum vernum		Feb. 9	Jan. 10	Jan. 21	Feb. 2	Jan. 18	Feb. 8	Mar. 3	Feb. 9	Mar. 4	Feb. 1
20	Mandragora officinalis				Feb. 28	Mar. 12	Mar. 17	Mar. 15	Apr. 7	Mar. 15	Apr. 2	Feb. 24
21	Narcissus Pseudo-Narcissus	Mar. 18	Apr. 1	Mar. 14	Apr. 1	Apr. 3	Apr. 8	Mar. 18	Mar. 25	Mar. 19	Apr. 20	Mar. 4
22	Narcissus pumilus	Mar. 1	Mar. 14	Feb. 20	Mar. 13	Mar. 15	Mar. 12	Mar. 7	Apr. 1	Mar. 9	Mar. 18	Feb. 2
23	Nordmannia cordifolia	Feb. 20	Feb. 25	Feb. 9	Mar. 11	Feb. 10	Feb. 16	Feb. 15	Mar. 6	Feb. 20	Feb. 25	Jan. 26
24	Omphalodes verna	Feb. 24	Mar. 25									
25	Orobus vernus	Mar. 4	Mar. 15	Feb. 1	Mar. 23	Mar. 23	Mar. 27		Apr. 1	Mar. 8	Mar. 20	Feb. 4
26	Rhododendron atrovirens	Feb. 1	Feb. 19	Jan. 4	Feb. 4	Feb. 2	Jan. 25	Feb. 8	Mar. 6	Feb. 5	Mar. 6	Dec. 27
27	Rhododendron Nobleanum	Feb. 12	Mar. 18	Jan. 16	Mar. 13	Feb. 23	Feb. 23	Mar. 4	Mar. 30	Mar. 5	Mar. 15	Feb. 26
28	Ribes sanguineum	Mar. 3	Mar. 24	..	Mar. 30	Mar. 30	Mar. 25		Apr. 8	Mar. 17	Mar. 24	Feb. 3
29	Scilla bifolia	Feb. 22	Mar. 9	Feb. 2		Feb. 14	Feb. 24	Feb. 28	Apr. 29	Mar. 6	Mar. 9	Feb. 8
30	Scilla bifolia alba		Mar. 28	Mar. 2	Mar. 17	Mar. 15	Mar. 8	Mar. 4	Apr. 1	Mar. 7	Mar. 20	Feb. 15
31	Scilla præcox	Feb. 16	Mar. 3	Jan. 24	Jan. 23	Feb. 6	Feb. 16	Feb. 22	Mar. 6	Feb. 25	Mar. 10	Jan. 28
32	Scilla sibirica	Feb. 24	Mar. 7	Jan. 30	Mar. 10	Feb. 14	Feb. 20	Feb. 18	Mar. 10	Feb. 26	Mar. 12	Feb. 3
33	Scilla taurica		.	.			Mar. 4	Mar. 1	Apr. 1	Mar. 10	Mar. 21	Feb. 8
34	Sisyrinchium grandiflorum	Jan. 31	Feb. 16	.	Mar. 8	Feb. 15	Feb. 20	Feb. 19	Apr. 9	Feb. 24	Mar. 18	Feb. 20
35	Sisyrinchium grandiflorum album	Feb. 18	Feb. 28	.	Mar. 6	Feb. 13	Feb. 17	Feb. 10	Apr. 6	Feb. 24	Mar. 8	Jan. 26
36	Symphytum caucasicum	.	.	..	Mar. 31	Mar. 15	Apr. 5	Mar. 16	Mar. 30	Mar. 16	Mar. 24	Feb. 23
37	Symplocarpus fœtidus	Feb. 16	Mar. 24	Feb. 8	Mar. 30	Mar. 25	Mar. 27	Mar. 11	Apr. 5	Mar. 11	Mar. 14	Feb. 9
38	Tussilago alba	.	.	..	Feb. 15	Feb. 21	Mar. 8	Feb. 15	Mar. 6	Feb. 10	Mar. 8	Feb. 3
39	Tussilago fragrans	.		..	Jan. 18	Jan. 12	Jan. 3	Feb. 9	Mar. 5	Feb. 12	Mar. 4	Feb. 2
40	Tussilago nivea	.		.	Mar. 6	Feb. 26	Mar. 18	Feb. 28	Apr. 26	Mar. 8	Mar. 9	Feb. 2

Notes on Memorial Trees Planted in the Royal Botanic Garden, Edinburgh. By JOHN SADLER, Curator.

(Read 13th July 1882.)

The following are some notes as to the measurements of a few of the memorial trees in the Royal Botanic Garden, Edinburgh, at the planting of which I was present. The old yew, the beautiful weeping birch, and other trees brought from the old garden in Leith Walk in 1824, were no doubt planted by gentlemen who then took an interest in the new garden.

1. *Quercus conferta*, Kit. (*Q. pannonica*, Hort.) The Hungarian Oak. Planted by the late Sir William Gibson-Craig, Bart., of Riccarton, on the 4th November 1865, in commemoration of the amalgamation of the Experimental Garden (the Royal Caledonian Horticultural Society's Garden) with the Royal Botanic Garden. The tree is very vigorous, and has made wonderful growth since 1865. Dr Masters states (*Bot. Soc. Trans. Edin.*, vol. xii. p. 437) that the measurements of the tree in 1875 were as follows:—

Height 20 ft.
Spread of branches 36 ft.
Circumference of stem 28 in.

On 20th September 1881 I carefully measured the plant, and found it as follows:—

Height, ...		29 ft. 6 in.
Circumference of stem at	1 ft. from base,	33·40 ,,
,, ,,	2 ft. from base,	31·60 ,,
,, ,,	3 ft. from base,	31·20 ,,

This tree was one of those which the late Sir Robert Christison, Bart., periodically measured.

2. *Cedrus Deodara*, Loudon (*C. Indica*, De Cand.) Indian Cedar. Introduced into Britain in 1831 by the Hon. W. Leslie Melville; planted by H.R.H. the Prince of Wales on 8th August 1859. Having been present on the occasion, I think that the plant was then, as far as I can remember, between 8 and 9 ft. high. When measured on 20th September 1881 it was as follows:—

Circumference of stem at 1 ft. from ground 45·30 in.
" " at 3 ft. from ground 37·90 "
" " at 5 ft. from ground 34·80 "

It is not a handsome tree, having evidently been raised from a cutting. It is growing at the west of the garden near the "View of Edinburgh."

3. *Abies Albertiana*, Murray. *A. Bridgesii*, Kellog, Prince Albert's Fir, or the Californian Hemlock Spruce. Planted by H.R.H. Prince Alfred, now Duke of Edinburgh, on 5th June 1863. The tree, which stands in the wood on the west side of the garden, measured, on 20th September 1881,—

Height, ... $24\frac{1}{4}$ ft.
Circumference of stem at 1 ft. from base, 15·80 in.
" " 3 ft. from base, 14·30 "
" " 5 ft. from base, 10·50 "

This tree was introduced into Britain in 1851 by the Oregon Association of Edinburgh, through John Jeffrey, their collector, and named in honour of the late lamented Prince Consort, who was Patron of the Association.

4. *Sequoia* (*Wellingtonia*) *gigantea*, Lindl. Mammoth tree of California. Planted by the late Sir Robert Christison, Bart., in July 1861. It stands in front of the main entrance gate. On 20th September 1881, it measured,—

Height, ... $24\frac{1}{2}$ ft.
Stem (circumference) at 1 ft. from ground, 61·50 in.
" " 3 ft. from ground, 47·50 "
" " 5 ft. from ground, 41·50 "

At the time the tree was planted it was between 6 and 7 feet high.

5. *Thuja gigantea* (*T. Lobbii*). Gigantic Arbor-vitæ. Planted by H.R.H. Prince William of Hesse, on 24th October 1863. Height of tree on 20th September 1881, $12\frac{3}{4}$ ft.; circumference at 1 foot from ground 11·90 in. It is growing in the wood on the west side of the garden.

6. *Retinospora obtusa*. Japanese "Tree of the Sun." Planted by the Countess of Rosslyn, on 2nd June 1879. Height of tree on 20th September 1881, 7 ft. 10 in.; circumference at 1 ft. from ground 7 in. The plant is re-

markably healthy, and is growing on the terrace in front of the range of the conservatories.

7. *Libocedrus decurrens*, Torrey. Decurrent Arbor-vitæ. Planted by the Earl of Rosslyn, 21st May 1880. Height on 20th September 1881, 10 ft. 3 in.; circumference at 6 ft. from base, 14 in. The Earl planted it while he held the office of Lord High Commissioner for the Kirk of Scotland. Introduced into Britain from Oregon in 1853, by Jeffrey.

8. *Betula alba*, var. *pendula*, White Weeping Birch. Planted by their Royal Highnesses the Duke and Duchess of Edinburgh, on 26th August 1881. Height of tree when planted, 8 ft. 1 in.; girth at 1 ft. from base, 3·95 in.; at 2 ft., 2·65 in. This promises to become a handsome tree.

9. *Quercus Cerris*, var. *variegata*. Variegated Turkey Oak. Planted by Dr Lyon Playfair, M.P., on 10th February 1869. On 20th September 1881 the height of the tree was 12 ft.; the circumference at one ft. from base, 21·90 in.; at 2 ft., 20·90 in.; and at 3 ft., 21 in.

10. *Quercus conferta* (*Q. pannonica*). Hungarian Oak. Planted by Dr Masters, editor of the *Gardeners' Chronicle*, on 13th July 1875. Height on 20th September 1881, 17 ft.; circumference of stem at 1 ft. from ground, 18·30 in.; at 2 ft., 16·80; at 3 ft., 16·50; and at 4 ft., 14·80 in. It is healthy, and making vigorous growth.

11 *Abies Douglasii*, var. *Pattoniana*. Planted by Emeritus Professor Balfour, April 1880. Height of tree on 20th September 1881, 10 ft. 10 in.; girth of stem at 1 ft. from ground, 8·70 in.; at 2 ft., 7·70 in.; and at 3 ft., 6·70 in. The plant is growing on the terrace near the west end of the front range of hot-houses.

12. *Pinus Jeffreyii*, Balf. Jeffrey's Pine. Planted by Isaac Anderson-Henry, Esq., of Hay Lodge, on the 11th May 1868. Height of tree on 20th September 1881, 19 ft. 9 in.; circumference of stem at 1 ft. from base, 26·80 in.; at 2 ft., 24·40; at 4 ft., 18·40; and at 5 ft., 18·50 in. Native of California, from whence it was introduced by John Jeffrey in 1852.

Extracts from Correspondence as to the Effects of the Winter of 1881–1882 in different parts of Scotland.

1. In the North of Scotland.

From Mr J. Forrest, *Haddo House Gardens, Aberdeenshire.*

Haddo House is distant from the sea 16 miles, with an elevation of 189 feet above its level.

The winter of 1881–82 has been mild and open.

Owing to the mildness of the winter months, shrubs and other plants suffered little or no injury from frost; but several plants, especially Roses, which had made considerable growth during the months of February and March, were very much destroyed by the cold winds and severe frosts in April. These frosts also did great damage to fruit trees and bushes. The blossom of Plums, Pears, and Cherries was, in most cases, nearly all destroyed, and Gooseberries and other small fruits were also very much injured. Rhododendrons and Bay Laurels, which were so much cut up by the severe frosts of 1880–81, have made strong healthy growths. Hollies, which were also very much cut up by these frosts, have not done so well; and several plants which broke out pretty freely last season have died off this spring. All hardy border plants withstood the winter well, and have flowered luxuriantly. East Lothian stocks in dry sheltered situations lived through the winter, and flowered beautifully in May and June.

Although the winter was mild it cannot be said that this has been an early season, as the cold weather in April kept things back very much. Plants have done better, however, than for the last two or three seasons.

From Mr Thomas M'Donald, *Balfour Castle Gardens, Kirkwall, Orkney.*

The winter of 1881–82 was very favourable for vegetation, and shrubs and flowers were earlier in bloom this season than in several of the past ones. Snowdrops, Hepaticas, Crocuses, and Violets were in flower in the last week of January. The spring was unusually fine, and vegetation did not receive any check from frost. Auriculas, Polyanthuses, Mahonias, and Hypericums were in flower early in April. Bedding out was commenced on the 20th of May. *Cotoneaster microphylla, Fuchsia globosa, F. Riccartonii*, and *Escallonia macrantha* were unusually fine, the growth of the latter being from 2 to 3 feet in length. Laburnum, Mountain Ash, and Hawthorn were in full bloom by the end of May. White-fruited Elder was in flower on the 20th of July.

Lowest Temperatures.			*Rainfall.*		
October	15th,	34°	October	3rd,	·50 in.
November	19th,	34°	November	2nd,	·10 ,,
December	9th,	29°	December	4th,	·60 ,,
January	5th,	30°	January	2nd,	·40 ,,
February	16th,	29°	February	3rd,	·50 ,,
March	7th,	29°	March	5th,	·60 ,,
April	16th,	29°	April,	2nd,	·00 ,,

From Mr Angus Macdonald, *The Gardens, Balmacaan, Glen Urquhart, Inverness-shire.*

Last winter was the most favourable for open-air vegetation which I have seen in Glen Urquhart for over thirty years. Some herbaceous border plants bloomed in January. Scarlet Rhododendrons were in full bloom in February. We were visited, however, by frosts in May and June, which told very much on fruit blossoms and tender plants.

From Mr. D. Melville, *The Gardens, Dunrobin Castle, Sutherlandshire.*

The winter of 1881–82 was exceptionally mild and favourable. We had a few days' frost between the 10th and 23rd of December, with an occasional thaw between. There was just sufficient ice to fill ice-houses and stores and afford a few days' curling. Fresh winds set in on the 24th. Little more frost was experienced during the winter, with the exception of the nights of the 15th and 16th February.

The lowest reading during the winter was 23° on the 16th February. The thermometer stood at 32° or below it on 37 occasions during the winter, compared with 107 in 1880–81.

The prevailing winds during the winter were westerly up to the end of February. During March and April east winds were most prevalent.

I observed little or no damage to plants caused by frost during the winter. Our only losses were standard Roses, of which a good few succumbed. I think the unripe wood, and drying east winds in spring, had more to do with this than frost.

The following plants, among others, stood the winter unprotected : — *Phormium tenax*, *Veronica Andersonii*, *Eulalia japonica*, *Aralia Sieboldii*, *Escallonia macrantha*, *Arundo conspicua*, *Salisburia adiantifolia*, *Garrya elliptica*, Tritonias, Aucubas, Japanese Acers, and Sweet Bay.

We are close to the sea here, and well sheltered from the north winds, which accounts for the comparative mildness of the climate.

2. In the Middle of Scotland.

From Mr John Robb, *Drummond Castle Gardens, Perthshire.*

August 10, 1882.

Last winter passed away almost free of frost. I have no casualties to report, with the exception of a few dwarf H. P. Roses, which got a little singed on April 16, which was the severest night we had; but they soon got all right again.

From Mr William S. Bisset, *Moncreiffe Gardens, Perthshire.*

August 9, 1882.

The winter of 1881–82 compared very favourably with the two previous ones in this district. The only frost to speak of prevailed between the 15th and 23rd of December. The months of January and February were extremely mild, more especially between the 16th and 23rd of January. On the 4th of January I pulled flowers of Hepaticas and *Pyrus japonica;* on the 16th, Snowdrops, *Rhododendron Nobleanum*, *Ribes sanguineum*, Hellebore, and Aconite; and on February 6th, a twig of Thorn, in full leaf, from a hedge near the Bridge of Earn. On January 6th we had a most violent storm of wind, which proved more disastrous than any that has occurred during the last thirty years. Trees were uprooted which had withstood the blasts of hundreds of years, while in plantations of from fifty to sixty years' growth acres were entirely levelled with the ground. From the 20th March to the middle of April cold east winds and frosty nights prevailed, which to a certain extent damaged the blossom of fruit trees; although, in my opinion, the deficiency in the fruit crop results more from the unripened condition of the young wood, owing to the previous bad summer and autumn.

From Mr John Fortune, *The Gardens, Blairadam, Kinross-shire.*

August 1, 1882.

The winter of 1881–82 will long be remembered, owing to the disastrous gales of wind which swept across the country. A great deal of damage was done here to old trees, hundreds of which were levelled with the ground. Three separate gales occurred during the winter, viz., on the 14th October from N., on the 22nd November from S.W., and on 6th January from W.S.W. In the last-mentioned gale the biggest and oldest *Cedrus Deodara* was ruined by a large Silver Fir falling on the top of it. The first flower appeared on the Gooseberry this season on 25th March, while last season it appeared on the 3rd of May; and this is the greatest difference in time of flowering which I have observed in any plant this season. Snowdrops were fully five weeks earlier this spring than last. They began to flower on the 7th of February, while last spring it was the 11th of March before they appeared. Other things were in like proportion. On the 1st of May this season forest trees—such as Beech, Plane, and Lime—were as far into leaf as they were about the 11th or 12th of the same month last year.

From Mr George Johnston, *The Gardens, Glamis, Forfarshire.*

May 30, 1882.

The Gardens are about twelve miles distant from the sea, with an elevation of 125 feet above its level. The soil and subsoil are light and free, and vegetation is early; but, owing to the Dean (a slow sluggish stream) passing through the grounds, early vegetation is often destroyed by frost, which also appears early in autumn,—in some seasons as early as the beginning of September. The past winter was the mildest which has been experienced during the seventeen years I have been here. The lowest temperatures occurred on the 18th November and 23rd December. The lowest temperatures in January were on the 4th and 29th. February was very mild, the lowest temperatures being on the 9th and 25th. On the 16th of February flowers of seventeen different plants were gathered from the open border.

Report on the East Coast of Arran, Buteshire.

From the Rev. David Landsborough, *Kilmarnock.*

The east coast of the island of Arran is peculiarly sheltered. The Goatfell range of mountains on the north-east runs for a distance of 5 miles north and south parallel to the coast, ascending to the height of nearly 3000 feet (2866). This not merely shelters from the west, but, as nautical men are well aware, as much from the east, the high mountains lifting up the wind, so that places at their foot are almost unaffected by winds blowing from the front. At Lamlash there are mountains, half the height of the Goatfell range, behind, and the Holy Isle, 1030 feet in height, is in front. These circumstances, along with the position of Arran, on the west coast of Scotland, render certain spots in it very mild and sheltered.

The soil is also, in general, light; though at Cromla, one of the places mentioned, it is a stiff clay; this is thoroughly drained. During severe frost the minimum temperature of the three places principally mentioned (Captain Brown's, Lamlash; Brodick Castle High Garden; and Cromla Garden, Corrie) is about 10° higher than at the Observatory, Glasgow. At Brodick Castle Low Garden the thermometer falls about 2° lower than at the High Garden. It may also be noticed that although the rainfall of Arran is high, there are few foggy days, as the mountains draw up the mist, and less rises from salt-water than from fresh. The localities selected are all in closest proximity to the sea, and almost on sea-level, excepting the Brodick Castle High Garden, which is elevated about 100 feet above it. *Platanus orientalis* is rare in the west of Scotland. One tree, twenty years of age, grows in the Kay Park, Kilmarnock, and it has lately been planted in avenues at Greenock. It grows vigorously in the Brodick Castle avenue. An example, twenty years old, of what is apparently *Platanus occidentalis* grows at Auchendrane (Miss Cathcart's), near Ayr. *Quercus suber*, in Brodick Castle Park (2 feet 1½ inches in circumference at 4 feet from the ground), is uninjured. *Buddlea globosa*, at Whitehouse, Lamlash, is in perfect health. *Eucalyptus globulus* (blue gum), at Captain Brown's, Lamlash, 18 inches in circumference at 5 feet from the ground, and the one at the hotel at Corrie, were almost stripped of their leaves by the severe frosts of 1880–81, but are now quite recovered. *Eucalyptus amygdalina* (peppermint tree of Tasmania), at Cromla, Corrie, 8½ inches in circumference at 5 feet from the ground, did not suffer nearly so much as *E. globulus* in the winter of 1880–81. It and the one in the Brodick Wood are in perfect health. *Eucalyptus coriacea* (white gum), at Captain Brown's, Lamlash, was planted in 1880, and had not even a leaf injured by the severe frost of the following winter. This is a beautiful tree, and so hardy that it would thrive at many places in the west of Scotland. *Eucalyptus Stuartiana* and *E. polyanthema*, planted a year ago at Brodick Castle Low Gardens, were last winter uninjured. *Eucalyptus rostrata* (red gum) was cut down to the ground. *Eucalyptus calophylla*, *E. diversicolor*, *E. hæmastoma*, *E. marginata*, and *E. melliodora* were killed. *Acacia melanoxylon* (the black wood of Australia) is hardy at Brodick and Corrie. It is one of the most valuable timber trees of Australia. *Acacia decurrens* grows beautifully in Captain Brown's garden, Lamlash. A handsome plant of *Casuarina equisetifolia* (the swamp oak of Australia), a strange tree, having exactly the appearance of a tree puddock pipe (*Equisetum*), described as "the most singularly picturesque tree of Australia," and furnishes one of its best timbers, said even to equal the

English oak in its qualities, was kindly given me this spring by Mrs Dunlop of Annanhill, near Kilmarnock. I gave it to Mr Crawfurd, gardener, Brodick Castle, by whom it was carefully planted in the High Garden. When planted it was 8½ feet in height. It is now in bloom, and has grown about 2½ feet. *Araucaria Cunninghamii* (Moreton Bay pine) has grown for twenty years in Brodick Castle High Garden. It was much browned by the late severe winters, but is again in good health. *Araucaria excelsa* (Norfolk Island pine) is at present growing at Lamlash. It was planted this summer by Mr Orr Ewing, M.P. *Desfontainea spinosa* grows in the utmost perfection. At Cromla, Corrie, it blooms abundantly during most of the summer and autumn, and also in the earlier part of a mild winter. It is 7 feet 3 inches in height, and no severity of weather has ever affected it. *Fuchsia microphylla* is quite hardy, and is in general in bloom till the New Year. *Camellia japonica* and *C. reticulata* are hardy and occasionally bloom. *Escallonia rubra albiflora* on the wall at Brodick Castle is 9½ feet in height. The following plants are also hardy :—*Photinia serrulata, Elæagnus reflexa variegata, Prunus sinensis flore pleno, Myrtus communis* (a standard 10 feet in height, flowers profusely every year), *Eurya latifolia, Berberis Darwinii, Coccoloba vespertilionis, Rhododendron ciliatum, Azalea amœna, Euonymus latifolia aurea*, &c. *Daphne papyracea, Pittosporum Ralfsii*, and *Genista linifolia* were this summer planted at Lamlash. Three species of *Cordyline* have been tried at Cromla, viz., *C. indivisa, C. australis*, and *C. Veitchii*, all of which were uninjured by the late severe winters, and all of them are most luxuriant. When they attain their full height (10 feet), and have sent forth their handsome spikes of blue and white flowers, they will become even more striking. The tree ferns which grow at Cromla, Corrie, have quite recovered from the effects of the late winters. *Dicksonia antarctica*, planted fifteen years ago, when not larger than a bladder fern (*Cystopteris fragilis*), has now a stem 20 inches in height and 26 inches in girth ; while its fronds, which are abundantly covered with spores, are 6 feet 3½ inches in length and 2 feet 7 inches in breadth. An excellent plant of *Dicksonia squarrosa*, which was kindly given me three years ago by Mr Gray, gardener, Newfield, Ayrshire, is also quite recovered, but has not yet produced spores. A handsome plant of *Lomaria gibba*, kindly given me by Mr Lockhart, gardener, The Craig, Ayrshire, was planted this year at Cromla. *Todea superba* and *Todea hymenophylloides* both grow very well. I received specimens this summer of *Pteris scaberula* from the gardener at Culzean Castle, which have taken root. Specimens of *Trichomanes radicans* (the Killarney fern) were found in 1863 by Mr Combe under the shelter of a rock between Corrie and Sannox. One of these specimens was given to Miss Brown of Lanfine, Ayrshire. It was placed by her under glass, and grew admirably. This summer Miss Brown most kindly gave me a plant of it to be restored to its native Arran. It also has taken root. *Schizostylis coccinea* grows in great perfection, and flowers abundantly at Strathwhillan, Brodick, where also the Banksian Rose occasionally blooms, and Marshal Niel and Celine Forestier bloom abundantly. The Cloth of Gold Rose grows well, but has not bloomed.

From Mr John Smith, *The Gardens, Ballikinrain Castle, Stirlingshire.*

July 1882.

Frost set in here on the 15th of October, and during the month we had altogether four frosty nights. In November we had no frost, but rain fell on 26 days, giving a fall of 8¼ inches for the month. In May there was no frost. Vegetables withstood the mild winter well. Shrubs, Roses, and herbaceous plants have done exceedingly well. Owing to the wet autumn, fruit in this district is very scarce.

Our thermometer is 4 feet above the ground. The rainfall for 1881 was 51·75 inches. There were 192 days on which rain fell. Our distance from the sea is 20 miles, with an elevation of 265 feet above its level. Exposure northern.

From Mr P. W. Fairgrieve, *The Gardens, Dunkeld, Perthshire.*

July 26, 1882.

Last winter was very open, and allowed a great deal of work to be done. Notwithstanding the unfavourable conditions under which fruit buds were matured last year, our crop looked very well up to the 15th of April. On that night we had 16° of frost, which completely ruined our Apricot crop and all other wall fruits, with the exception of Plums. Although Apples, Standard Plums, &c., were not in blossom then, the effects of that night, and the cold nights which followed completely destroyed them.

3. In the South of Scotland.

From Mr Malcolm Dunn, *The Palace Gardens, Dalkeith, Mid-Lothian.*

Sept. 1, 1882.

The winter of 1881–82 was a remarkable contrast to that of the previous season. While the winter of 1880–81 was of extraordinary length and severity, the past winter has been exceptionally mild—

in fact, we could scarcely say we had any winter, in the usual acceptance of the term. This was fortunate for vegetation, which, owing to the previous wet, cold, and sunless summer and autumn, was in a very unmatured state, and in the worst possible condition to withstand the rigours of a severe winter.

The first nip of frost came immediately after the great storm of the 14th of October, up to which date deciduous trees had retained the foliage in an unusually green state. The gale had thus a better hold of the trees, and the ground being soft from the previous heavy rains, they were comparatively easy to upset, and many thousands of them fell before the hurricane in its course over the country In this district the gale lasted scarcely half an hour, but during that time it did great damage to forest trees, somewhere about 300 having been destroyed in Dalkeith Park, and vast numbers of others broken and injured. On the morning of the 15th, 30° Fahr. were registered, followed by 26° on the 16th, 29° on the 17th, and 31° on the 18th. This killed off all tender plants,—such as Dahlias, Tropæolums, French Beans, and the like,—but had little apparent effect on the leaves of most deciduous trees, which remained green till the end of the month, when 28° on the 29th, 28° on the 30th, and 26° on the 31st killed them, and brought them off. The rich colours and brilliant tints which the foliage of many trees assume in the autumn were almost wholly absent, the leaves generally remaining green or greenish-brown till frost nipped them. The rainfall for the month amounted to 1·50 inches.

On the 1st November the thermometer registered 28°, and also 28° on the 2nd, with open, mild weather till the 18th, when 25° were registered. Mild weather again prevailed till the 26th, when the thermometer stood at 30°; at 30° on the 29th, and 31° on the 30th—making a total for the month of 20° of frost, registered on 6 days. Rainfall of the month, 2 inches.

The month of December began mild, no frost being registered till the 4th, when the thermometer stood at 27°, and on the 6th at 30°. From the 9th to the 24th occurred the longest spell of frost during the winter, the ice on still water being about 2 inches thick on the 23rd, but it was soon melted by the thaw which set in on the 24th, and continued to the end of the year. The frost registered during this period was as follows:—On the 9th the thermometer stood at 28°; on the 10th at 22°—the severest night's frost of the winter; 11th, 28°; 13th, 26°; 14th, 28°; 15th, 26°; 16th, 23°; 18th, 30°; 19th, 31°; 20th, 26°; 21st, 28°; 22nd, 23°; 23rd, 23°; and 24th, 29°. Total frost during the month, 84°, on 16 days. Rainfall, 1·10 inches.

January proved extremely mild, frost being registered on only two days, and the mean temperature of the month reached the high average of 42°, the highest day temperature being 54° on the 15th, and the lowest at night 30° on the 4th and 6th. Vegetation began to be active, and winter crops—such as Cabbage, Spinach, Leeks, Onions, and the like—made unusual progress. Throughout the month many plants were in flower; early Rhododendrons, *Erica herbacea*, and *Chimonanthus fragrans* being particularly fine. In the course of the month, 4° of frost were registered on two days. Rainfall, 1·40 inches.

Slight frost prevailed from the 1st to the 9th of February, and again on the 15th and 16th, the severest being on the 2nd, when the thermometer stood at 27°, and the month closed with 29° on the 28th. In all 30° of frost were registered on 10 days. Vegetation made steady progress, but not so rapidly as in the previous month. Numerous spring flowers were in bloom, which after the 16th were scarcely ever affected by frost. Rainfall, 1·70 inches.

During March the thermometer stood at 30° on the 6th, 28° on the 7th, 28° on the 21st, 29° on the 22nd, and 31° on the 23rd—in all 12° of frost on 5 days. Spring flowers were in abundance, and vegetation made great progress for the season of the year. Rainfall, 2 inches.

April began with a cold easterly wind, which checked vegetation, but there was no frost till the 8th, when the thermometer registered 27°, with 28° on the 9th, 28° on the 10th, 31° on the 11th, 27° on the 12th, 28° on the 15th, and 26° on the 16th, after which we had no more frost for the season. In all 29° of frost were registered on 7 days. Rainfall, 1·80 inches.

Comparing this with the previous winter, it will be seen that we have had 53 frosty days, with 205 degrees of frost, against 148 frosty days, and 1300° of frost in the winter of 1880–81. As shown by the rainfall—11·50 inches in seven months—the winter was dry as well as mild, and plants gradually ripened their growth and buds throughout the winter, so that they started in spring with much more vigour than could have been expected from their unripe condition in the autumn. The chill easterly winds in April checked their growth, and brought myriads of insects, which did much injury to plants till about the middle of May, when warm genial weather setting in, vegetation made a great rush for a month or so. Heavy rains and cold winds began in the middle of June and lasted till the end of July, destroying much of the fine promise in the spring of an abundant growth during the season.

All through the winter of 1881–82 many plants were to be seen in flower. *Rhododendron dauricum*, *R. Nobleanum*, and *R. caucasicum album* were in flower from November onwards, and after the nip of frost in the middle of February, which blackened a few of their flowers, they, and many other varieties of early Rhododendrons, burst out into splendid flower, and continued so for months. It is seldom the early Rhododendrons are seen in such perfection of flower in Scotland, but the grand display they make in a genial season like the past is more than worth the trouble of waiting a few years to see it. Hardy spring flowers of every kind were early and fine, as well as being unusually abundant. Snowdrops, Crocus, Narcissus, and other bulbous-rooted plants flowered profusely. Many plants of doubtful hardiness came through the winter in the open air unscathed—such as Camellias, Oranges, *Eucalyptus globulus, Clianthus puniceus*, &c. Small fruit of all kinds was very abundant during the summer; but Apples, Pears, Plums, and Cherries, although they flowered moderately well, produced crops much below the average. In most instances the flowers were weakly, and "set" badly; and insects and cold caused much of the fruit which did set to drop off prematurely. Vegetables have proved by far the most satisfactory crops of the season.

From Mr John Garrett, *Whittinghame Gardens, Haddingtonshire.*

Sept. 4, 1882.

We do not as a rule suffer much here from frost. Last winter the lowest readings of our thermometer were on the 10th and 23rd December. A good many of our shrubs nevertheless show an injured condition, these being chiefly common Bay Laurels, Laurustinus, Sweet Bays, *Garrya elliptica*, and *Aucuba japonica*. Red Cedar, *Cupressus macrocarpa*, *Picea Cephalonica*, *P. nobilis*, *P. Nordmanniana*, and *Eucalyptus viminalis* show more or less injury. Some Hollies and a good many Thorns have died, but this I attribute to the injured condition in which they were left by the previous winter. Indeed, in our case it would not be too much to say that the whole damage has been caused by the winter of 1880–81. Our crop of hardy fruits is almost *nil* this season. Gooseberries and Strawberries were both an abundant crop, and Raspberries moderate.

From Mr Andrew Turnbull, *The Gardens, Bothwell Castle, Lanarkshire.*

Aug. 5, 1882.

The winter of 1881–82 was perhaps the mildest we have had since that of 1845–46, during which the thermometer never fell lower than 25°, with the exception of the 19th and 20th of March, when it fell to 20° and 19° respectively. As a consequence of this, the whole of the fruit crop in the locality was destroyed; even Gooseberries did not escape. The following are the lowest readings of the thermometer during last winter:—October 16th, 23°; 30th, 20°; December 11th, 16°; 22nd, 20°; January 29th, 23°; February 7th, 28°; April 16th, 22°; 27th, 23°. On the 22nd of November we had a hurricane which did considerable damage in the west; but we in a great measure escaped the one which did so much damage in the east about a week earlier. On the 16th of June the thermometer fell to 31°, and previous to this we had cold easterly winds, by which the fruit crop (which at an early period looked very promising) was greatly damaged, and in some cases quite destroyed. Some of the more tender trees, especially Peaches, were nearly killed. Forest trees are much healthier than they were last season. Oak, which is the prevailing timber tree here, has almost escaped the ravages of the oak caterpillar this season. Last year they were almost wholly stripped of their leaves by it, and that after one of the severest winters of modern times. All the spring flowering plants were early in bloom, but were a fortnight at least later than in 1846.

Our distance from the sea is 32 miles, with a height of 146 feet above its level. The exposure is W.S.W.

From Mr JOHN SHANNON, *The Gardens, Jardine Hall, Dumfriesshire.*

Aug. 8, 1882.

The winter of 1881–82 was very mild. There has been no damage done here so far as I can see, with the exception of a good deal of fruit blossom which was frosted in April. As a result of this, we have a very poor crop of fruit, with the exception of Strawberries, Gooseberries, and Raspberries, which are an average. All other out-door fruits are a complete failure.

The following are the lowest temperatures from November 18th to April 16th, taken from thermometer 3 feet above the ground :—

November	December	January	February	March	April
18 = 24°	4 = 30°	3 = 31°	1 = 27°	6 = 30°	1 = 32°
23 = 30	6 = 29	4 = 28	2 = 27	9 = 31	7 = 32
25 = 28	9 = 28	7 = 32	6 = 32	11 = 31	8 = 31
29 = 29	10 = 23	8 = 32	7 = 32	12 = 28	9 = 23
	11 = 23	9 = 29	9 = 26	21 = 31	10 = 25
	13 = 24	18 = 32	15 = 25	22 = 28	11 = 35
	14 = 29	21 = 31	16 = 26	23 = 28	15 = 21
	15 = 24	26 = 30	18 = 25	25 = 31	16 = 25
	16 = 19	29 = 27	19 = 31	26 = 31	
	17 = 31			27 = 32	
	20 = 25			31 = 31	
	22 = 21				
	23 = 16				
	24 = 25				
	31 = 28				

From David Murray, *Culzean Gardens, Maybole, Ayrshire.*

Aug. 24, 1882.

The lowest temperature during the winter of 1881–82 was on the 11th December. We had no hardy plants injured. All our wild flowers were much in advance of their usual time of flowering. There was not a week during the winter in which we could not pluck Daisies from the lawn. A vase of Geraniums which had not been emptied in the autumn had some full-blown trusses on the plants in the middle of January, and the scarlet flowers looked as bright as in summer.

From Charles Stuart, Esq., M.D., *Chirnside, Berwickshire.*

The contrast between the weather of the last three years and the present one is so remarkable that it is certainly worth a careful comparison. One of the latest springs ever remembered was that of 1879. The trees did not fully expand their leaves till the middle of June. The cold winds of April and May of 1880 retarded vegetation and caused that spring to be later than it promised. The spring of 1881 may be said not to have begun till May, when, after the bleakest March and April on record, the country under forcing weather became suddenly green, more like what is seen on the Continent than in Scotland. The summer from June was a cold one, the crops making slow progress; a wet harvest rendering the grain unsaleable. The great gale of 14th October seemed to exert some peculiar influence in settling the elements, although it has been remarked that after three years of bad weather a change for the better is sometimes seen, and this has certainly been the case in the present season. On October the 29th Cheviot was covered with snow, and for two days afterwards a sharp frost prevailed, which cut down the more tender plants for the season. November was ushered in with snow showers, and frost was felt for another day, when the weather gradually settled. By the 7th of that month we had very fresh weather, with temperatures in the shade above 50°. November 11th and 12th, 55° in shade; 14th 56°. On the 22nd there was an alarming gale from the west and occasional rain blasts, but in the main seasonable weather. The highest temperatures in December occurred on the 2nd = 50°·4, and same on 3rd; lowest on 15th, max. 32°·4, min. 21°. Wind generally W.S.W. Rainfall, 1·57.

January 1882 was a wonderful month in point of weather, the sun shining out frequently from morning till night, the wind being generally south-west, and the rainfall only amounted to 1 inch. The highest temperature occurred on the 4th = 50° max., 25°·5 min. On the 5th, 52°; on the 12th, 50°; 24th, 51°; 27th 50°. The lowest temperatures were observed on the 26th = 37°·2, min. 25°·4. On the 18th the barometer stood for several days at 30·8, higher than it had been seen for forty years. On the 17th I heard the spring notes of the thrush; and on the 19th the song of both blackbirds and thrushes, and also the cooing of the wood-pigeons. I observed towards the third week of the month twenty-eight plants in flower in the rock garden, including winter Aconites, Snowdrops, *Hepatica angulosa* and other species, *Dondia epipactis*, Primroses, *Saxifraga oppositifolia*, *S. oppositifolia* var. *pyrenaica*, various Hellebores, sweet-scented *Tussilago*, &c. In the fields the common Groundsel, Coltsfoot (*Tussilago*), *Veronica Buxbaumii*, white and purple Nettle, *Leontodon*, and common Furze were all in bright flower during the course of the month. About the Retreat, near Abbey St Bathans, on the Whitadder, the common yellow Primrose was gathered at Christmas, and in the deans about Cockburnspath all through January the Primroses were quite plentiful. Partridges paired from the 15th of January. In thirty-five years' residence in Berwickshire I have never seen the common Primrose in flower in January before, and only on one occasion in bud during the same period.

February was ushered in with colder weather; on the 4th the temperature being 48° max., 28°·6 min.; 6th, 49° max., 26° min.; 7th, 42°·26 max., 26°·8 min.; and there was a slight fall of snow on the 28th. By the 9th mild weather again set in, and continued till the 21st, when the thermometer registered 56° max., 40°·3 min. Rainfall, 1·95 inches. Wind veered from S.E. to S.W. and due west. The garden flowers in bloom were those already mentioned, with the addition of *Sisyrinchium grandiflorum* and *S. grandiflorum album*, *Anemone blanda*, *Primula Cashmeriana*, *P. denticulata*, *P. denticulata alba*, *P. denticulata* var. *purpurea*, *P. pulcherrima*, *P. rosea*. The Crocuses were at their best on the 21st; and on the same day *Vanessa urticæ*, the nettle butterfly, was disporting itself in the sun. The catkins on the Willows were fully expanded in sheltered nooks, and *Viola odorata* was in flower by the end of the month on the river bank. Gooseberry bushes and Thorns were budding out, the appearance of the country being quite green, a very marked contrast to the previous season, when on the 5th of March the high road was blocked with snowdrifts, several of them 12 feet deep.

April was a very cold month, especially the early part of it.

The temperatures were never extremely low, but cold, parching winds on the 1st, 5th, 8th, 15th, 21st, 23rd, and 26th retarded vegetation, and night frosts nipped many of the tender plants prematurely advanced in growth by the fine previous weather. The highest temperature during the month was on the 19th, 58°; lowest on the 12th, 44°, min. 28°. That night did great damage, vegetation being so advanced. The wind blew N.E. to N.W. on the dates previously mentioned, and the rainfall was 4·63 inches. With no remarkable summer temperature to record, the weather as a whole seemed suitable for the advance of the cereals and green crops, which are excellent over the Merse,—indeed, finer crops have never been seen. July had three warm days, 1st, 2nd, and 5th, with temperature 71°, 74°, and 76°. August 10th was our warmest day of the season, temperature 81° ; 11th, 79° ; and 12th, 71°. Since that time we have had much unsettled weather, the crops being secured in a very different state than was the case last year, the quality of the grain being excellent. The forest trees still bear traces of the low temperature to which they were exposed in 1879, 1880, and 1881, especially the Oaks in low situations. When not killed outright, 20 feet and more of the top seems entirely destroyed, giving a shabby appearance to the rest of the tree. Laburnums, Hollies, and Ashes have suffered most. The great gale of 14th October 1881 has uprooted many of our finest trees,—a beautiful avenue of aged Oaks, forming a most picturesque glade, at Whitehall being completely wrecked. The Spruces and Silver Firs have, however, with the present fine season, lost much of their blasted appearance, which was so evident on their weather side for several years past, and we may now hope that there may be a succession of more genial seasons.

PROCEEDINGS

OF THE

BOTANICAL SOCIETY.

SESSION XLVI.

Thursday, 10th November 1881.—Mr ALEXANDER BUCHAN, M.A., F.R.S.E., Vice-President, in the unavoidable absence of the President, occupied the Chair.

The following Candidates were elected Resident Fellows:—

Dr HALLIDAY CROOM, 25 Charlotte Square.
Mr WILLIAM ADAMS, Royal Bank.

The following Communications were read:—

I. *A Paper embodying the Results of Meteorological Observations on the Weather of last Summer.* By Mr BUCHAN, Vice-President.

II. *Obituary Notices of Messrs William Gorrie, Hewett C. Watson, ex-Provost Russel of Falkirk, and other deceased Members of the Society.* By Mr ANDREW TAYLOR.

III. *Obituary Notice of the late Thomas Sprot, W.S.* By Mr ISAAC ANDERSON-HENRY.

IV. *Exhibition of Potato Monstrosities.* By Dr PATERSON, Bridge of Allan.

V. *Report on the State of Plants in the Royal Botanic Gardens.* By Mr JOHN SADLER, Curator.

VI. *Note regarding* Strophanthus hispidus, *Dc., along with Specimens received at the Royal Botanic Garden.* By Mr John Buchanan, Associate, Blantyre, Shiré Highlands, East Africa.

June 28, 1881.

I went myself specially to the Shiré, with a view of getting all that Professor Fraser requires. The woody climber is not in flower at this season, and it was almost by chance that I got leaves

The *Strophanthus* grows on the Shiré River, and extends north beyond the Murchison Cataracts. I am told that it is plentiful, but I have only seen two plants, both on the lower Shiré. The stem is of immense length, and on the ground many great folds of it are lying in various directions. In ascending, the stem coils itself round other trees, and ascends to the top. The leaves sent are taken from a young rod of this year's growth, part of which I send. The stem, on being cut, gives out a milky juice of a gummy nature, and exceedingly bitter. I am not yet able to say whether it is in sufficient quantity to supply a demand for its use as a medicine.

I think the *Strophanthus* will flower about January, but I cannot say definitely, as I have not seen it. The follicles, I believe, will be ripe generally in July and August. I have not heard of *Strophanthus* being used as a medicine amongst the natives. They have too great a dread of it to use it in this way. It is well known as an arrow poison, and is used more than any other, and is the most deadly poison they have.

The method of preparing the *Strophanthus* poison is as follows :—A man takes a follicle and puts seeds with the wool attached into a pot. He then takes a small piece of bamboo, which has the thin splits inserted crosswise in the end. This he revolves speedily by rubbing it between his hands. The seed is put in motion, and falls to the bottom of the pot; the wool rises and comes out at the top, and is carried away by the least breath of wind. The seeds are then put into a small mortar and pounded into a paste, which is then ready for use.

It is common to mix the milky juice of a *Euphorbia* with it to make it stick on the arrow, and they also use the sap of a tree, specimens of which I sent last year, for the same purpose. The tree is known by the name of *Tenza*, and is so named in my last collection. An animal struck by an arrow thus poisoned is said to live only a few seconds. This poison is used in the native wars with deadly effect. (Vide *Proc. Roy. Soc. Ed.*, 1869–70, p. 99; also Oliver in *Hook Ic. t.*, 1098).

VII. *On an Ivy Tree blown down in the Gale of Friday,* 14*th January* 1868, *which grew on the south side of Whitehill Mansion House.* Communicated in a Letter by R. B. Wardlaw Ramsay, Esq., Whitehill, Hawthornden, to Professor Balfour. Plate XII. reproduced from a photograph.

The tree encircled a massive stone and lime pillar, depicted on an old plan of 1758, as the former gateway of the garden. The stem above the surface of the ground attained a height of 14 feet. As the stone pillar was only about 7 feet high, the trunk grew clear of it, with a small portion surrounding it.

The following measurements may be interesting :—

	In circumference.	
Stem at the root (6 inches of solid timber). .	4 feet	0 inches.
Two root stems at surface of ground, .	2 ,,	0 ,,
	1 ,,	10 ,,
,, at 6 feet up, . .	1 ,,	7 ,,
First branch of stem, . . .	1 ,,	6 ,,
Second ,, . . .	1 ,,	4 ,,
Third ,, . . .	1 ,,	2 ,,
Height of stem, ...	14 ,,	0 ,,
Extreme height over all, . . .	21 ,,	0 ,,
Spread of branches, . . .	60 ,,	0 ,,

MISCELLANEOUS COMMUNICATIONS.

Mr John Buchanan, Blantyre, East Africa, in the letter to Professor Balfour, quoted above, stated that the *Coffea arabica* plant sent out by him three years previously was now yielding a magnificent crop of berries; and also, that the sugar-cane grows well at Zomba, many of the canes being 2 and 3 inches in diameter and 12 feet high. Coffee promises to be the more successful crop.

Mr John Campbell, Ledaig, Argyleshire, sent specimens of flowering plants from his open garden, collected on November 9. These included strawberries in flower and fruit,—*Agapanthus umbellatus*, *Escallonia macrantha*, *Aster argophyllus*, *Cytisus hybridus*, *Andromeda media*, *Helleborus niger*, *Pyrus japonica* (white and scarlet varieties), *Anemone hepatica*, &c.

Thursday, 8th December 1881.—Professor BAYLEY BALFOUR, President, in the Chair.

The following Candidate, having been recommended by the Council, was balloted for and duly elected as a Foreign and Corresponding Member:—

G. C. W. BOHNENSIEG, Custos bibliothecæ Societatis Teylerianæ; and author of *Repertorium annuum Literaturæ Botanicæ periodicæ*, Haarlem.

The following Office-Bearers for 1881–82 were elected:—

PRESIDENT.

Professor BAYLEY BALFOUR, Sc.D., M.B., C.M.

VICE-PRESIDENTS.

ALEXANDER BUCHAN, A.M.
HUGH CLEGHORN, M.D.
WILLIAM B. BOYD of Faldonside.
ISAAC ANDERSON HENRY.

COUNCILLORS.

Sir ROBERT CHRISTISON, Bart., M.D., D.C L.
Professor THOMAS R. FRASER, M.D.
Professor DOUGLAS MACLAGAN, M.D.
JOHN SADLER.
ROBERT GRAY.
WILLIAM CRAIG, M.D., C.M.
MALCOLM DUNN.
THOMAS ALEX. GOLDIE BALFOUR, M.D.
JAMES ROBSON SCOTT, M.D.
JAMES BUCHANAN.

Honorary Secretary—Emeritus Professor BALFOUR, M.D.
Honorary Curator—The PROFESSOR of BOTANY.
Foreign Secretary—Professor DICKSON, M.D.
Treasurer—PATRICK NEILL FRASER.
Assistant Secretary—ANDREW TAYLOR, 37 South Clerk Street.

LOCAL SECRETARIES.

Aberdeen—GEORGE DICKIE, M.A., M.D.
Berwick—PHILIP W. MACLAGAN, M.D.
Birmingham—GEORGE A. PANTON, 95 Colmore Row.
Calcutta—JOHN ANDERSON, M.D.
,, GEORGE KING, M.D., Botanic Garden.
Cambridge—CHARLES C. BABINGTON, M.A., Professor of Botany.
Dublin—W. R. M'NAB, M.D., Professor of Botany, Roy. Col. Science.
Dumfries—JAMES GILCHRIST, M.D.
Exeter—THOMAS SHAPTER, M.D.
Fife—J. T. BOSWELL, LL.D., of Balmuto, Kirkcaldy.
Georgetown, Demerara—W. H. CAMPBELL, LL.D.
Glasgow—Professor BAYLEY BALFOUR.
Greenock—DONALD M'RAILD, M.D.
Kilbarchan—Rev. G. ALISON.
London—WILLIAM CARRUTHERS, F.R.S., British Museum.
London, Brixton—JOHN ARCHIBALD, M.B., C.M.
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 College.
Ottawa, Ontario—W. R. Riddell, Prov. Normal School.
Perth—F. Buchanan White, M.D.
Saharunpore, India—J. F. Duthie, Supt. Botanic Garden.
Shrewsbury—Rev. W. A. Leighton.
Silloth—John Leitch, M.B., C.M.
Wellington, New Zealand—James Hector, M.D.
Wolverhampton—John Fraser, M.A., M.D.
Zanzibar—Sir John Kirk, M.D.

The following Communications were read:—

I. *Opening Address on the Occurrence and Formation, as well as the Chemical and Physical Characteristics of Chlorophyll.* By Professor Bayley Balfour, President.

II. *On the Progress of Vegetation at the Royal Botanic Garden during November.* By Mr John Sadler, Curator.

Mr Dunn, Dalkeith Palace, said it was remarkable that, with so much open weather, there had been so little growth of vegetation of any kind.

Mr Buchan stated that meteorological records for 118 years back showed that the temperature for last month over the British Islands had been very greatly above the November of any recorded year. This was particularly the case in the upper parts of the valleys of the Tweed and Clyde, and of the Trent and Thames, where the temperature was 6° to 7° above the average of previous Novembers. Going back on the whole 118 years, last November was the warmest November in those restricted parts, and over the rest of Great Britain it was nearly the warmest. Sir Robert Christison had a weather prognostication, that if there was sufficient frost to harden the ground in the last week of October or the first week of November, the coming winter would be mild, and so far that had turned out to be correct.

MISCELLANEOUS COMMUNICATIONS.

1. Mr John Campbell, Ledaig, Argyleshire, sent *Escallonia macrantha* and *Rhododendron Nobleanum* in bloom from his garden, the greater part of which had been washed away by the great gale of November.

2. Sir Robert Christison, Bart., exhibited twigs with fruit from a vigorous oak tree about 170 years old, and 10 feet in girth of trunk at narrowest, being one of several in an avenue in Dalswinton Park, Nithsdale, 1880; also twigs with acorns from several natural oak trees at or near Ballahulish, August 1880.

V. *On the Progress of Open-Air Vegetation at the Royal Botanic Garden.* By Mr John Sadler, Curator.

MISCELLANEOUS CONTRIBUTIONS.

1. Mr Sadler intimated receipt, at the Royal Botanic Garden, of a collection of ninety packets of seeds from Tibet, from Mr Elwes, Cirencester, Gloucester; and also of a collection of seeds from the Botanic Garden at Saharunpur, collected mainly from altitudes in the Himalaya of between 10,000 and 15,000 feet.

2. Mr Sadler also mentioned, as additions to the Garden, the erection of a new house for growing cool plants; and the formation of a marsh or bog garden. The Arboretum was making satisfactory progress.

Thursday, 9th February 1882.—Emeritus Professor Balfour in the Chair.

The following Candidates were balloted for and duly elected as Resident Fellows:—

Rev. John M'Murtrie, M.A., 14 Inverleith Row.
Francis M. Caird, M.B., 8 Torphichen Street.
Henry Beveridge, Esq., Hillside Villa, Corstorphine.

The following Communications were read:—

I. *Notice of the late Sir Robert Christison, Bart.* By the Chairman.

II. *Notice of the late Professor George S. Blackie, M.D.* By John Sibbald, M.D.

III. *Dysoxylon Schiffneri*, (Section *Cleisocalyx*), *a new Tree from East Australia.* By Baron Ferd. von Mueller, Ph.D., M.D., F.R.S., K.C.M.G.

IV. *On Tillering.* By Mr A. Stephen Wilson, North Kinmundy, Aberdeenshire. Illustrated by Photographs.

V. *On the Phenology of the Upper Ward of Lanarkshire in* 1790. By Mr Henry Buchan, S.S.C.

In a letter to the Assistant Secretary, Mr Buchan quoted from an old manuscript diary kept at Brownlee, near Carluke, the following entry, under date January 24, 1790:—"Wind west. Very mild warm day. The whole of this winter remarkably mild and fresh. Polyanthus, primrose, and auricula in bloom. A carnation has continued putting forth flowers all winter. Some beans in blossom." He also gave extracts from the diary showing, among other things, that on February 21 of the same year, the bees were carrying on work, and on March 28 the jargonelles began to blossom, while on April 4 a cherry tree on the wall began to blossom; and on May 2 cherries, plums, and pears were in blossom. But this mild winter and favourable spring of ninety-two years ago were not followed by an early harvest. September was very rainy; the fall of rain on the 19th of that month—3 inches at eight o'clock at night—being the greatest the observer had ever noted. On October 3 the harvest was general; and on the 24th the corn was mostly cut down, but on November 7 some "victual" was still out. This, however, is a district in which early harvests are hardly looked for in any season.

VI. *On Temperatures at the Royal Botanic Garden, and their Effects on Vegetation.* By Mr JOHN SADLER, Curator.

Thursday, 9th March 1882.—Professor BAYLEY BALFOUR, President, in the Chair.

The Treasurer submitted his Report on the financial affairs of the Society for the past Session, with the Auditor's Abstract and Report thereon.

An Abstract of the Accounts had been previously circulated with the Billet calling the meeting.

The state of Funds was as follows:—

Amount at close of Session 1879–80,				£246	9	2
Increase during Session 1880–81,				28	19	7
Funds belonging to the Society,				£275	8	9
Illustration Fund:—						
Balance on hand at close of Session 1879–80,	£33	14	1			
Decrease during Session 1880–81,	8	15	6			
Amount of Illustration Fund,				24	18	7
Total Funds,				£300	7	4

The following Candidates were elected Resident Fellows:—

Mr A. J. Roughead, Seed Merchant, Haddington.
Mr John A. Park, Seed Merchant, Haddington.
Mr Frank Pullar, 33 Queen Street.

The following Communications were read:—

I. *The Climate of the Carpathian Mountains in its Relation to the Hungarian Oak.* By Mr Alexander Buchan, M.A., Vice-President.

This inquiry had been instituted from its having been demonstrated that the *Quercus conferta* had been able to withstand the severe frosts of the south of Scotland during the two previous seasons to the present one. It appears to thrive abroad in districts where there is, periodically at least, 8° lower temperature than that experienced in Berwickshire a year ago. The late Sir Robert Christison, Bart., had been prosecuting this subject even when on his death-bed.

II. *On Lichens from* (1) *Newfoundland*, collected by Mr A. Gray, with a List of Species; (2) *from New Zealand*; (3) *from the South of Scotland.* By Dr James Stirton. Communicated by Mr Robert Gray.

III. *Exhibition of Animals containing Chlorophyll.* By Mr Patrick Geddes.

IV. *Botanical Notes.* By Mr John Sadler.

(*a*) Miss Anne J. Hope-Johnstone of Marchbank Wood, near Moffat, sent a basket of Trusses of *Rhododendron Nobleanum.*

(*b*) Mr Daniel Shiels, interested in the newspaper report of Mr Stephen Wilson's paper on "Tillering," read at the February meeting, sent to the Museum a plant of common Barley grown in a garden in Duncan Street, Newington, in 1880. There are more than 60 stalks and 50 spikes, averaging 25 grains in each head, making 1250 in all. The plant was grown from a single grain under an apple tree. The stalks are over 3 feet high.

V. *On Temperatures at the Royal Botanic Garden, and their Effects on Vegetation.* By Mr John Sadler, Curator.

MISCELLANEOUS COMMUNICATIONS.

1. The following plants in flower from the cold frames in the Royal Botanic Garden were exhibited, viz., *Epigæa repens* (the American Mayflower), at present in full bloom; *Corbularia bulbocodium sulphureum; Korolkwia Sewerzvoii*, a plant closely allied to *Fritillaria; Primula cashmeriana, Soldanella montana, Saxifraga Stracheyi*, and from the open wall *Magnolia conspicua.*

Thursday, 13*th April* 1882.—Professor BAYLEY BALFOUR, President, in the Chair.

It was unanimously agreed to send a letter of condolence to Lady Thomson, Bonsyde, on the death of her husband, Sir C. Wyville Thomson, a former President of the Society.

The following Communications were read:—

I. *Obituary Notice of Professor Sir C. Wyville Thomson.* By Emeritus Professor JOHN HUTTON BALFOUR.

II. *On the Genus* Trichia *in Britain.* By the PRESIDENT.

III. *On Fixing Blowing Sands by means of Planted Grasses.* By Mr JAMES COUTTS CRAWFORD, F.G.S., late of Wellington, New Zealand.

IV. *On Temperatures at the Royal Botanic Garden, and their Effects on Vegetation.* By Mr JOHN SADLER, Curator.

V. *Miscellaneous Contributions.*

Dr Cleghorn presented to the Museum at the Royal Botanic Garden a specimen of *Cynomorium coccineum*, a plant of the *Balanophoreæ*, collected by him in the island of Gozo.

Thursday, 11*th May* 1882.—Professor BAYLEY BALFOUR, President, in the Chair.

On the motion of Professor Dickson, seconded by the President, the Society unanimously adopted a recommendation of the Council to re-establish the Society's triennial prize of £10 in connection with the University of Edinburgh, to be awarded for the best original botanical research, competitors to have attended the Botanical class within three years preceding the award.

The following Communications were read:—

I. *Obituary Notice of Charles Robert Darwin, Honorary Fellow.* By Emeritus Professor BALFOUR, Honorary Secretary.

The Honorary Secretary was requested to send a letter of condolence to Mrs Darwin.

II. *On the Germination of* Streptocarpus caulescens *lately raised in the Edinburgh Botanic Garden from seeds sent by Mr Buchanan, Blantyre, Central Africa.* By Professor DICKSON.

III. *Report on the Vegetation in the Garden of the Royal Botanic Institution, Glasgow, from January to April,* 1882. By Mr ROBERT BULLEN, Curator. Communicated by the PRESIDENT.

IV. *Exhibition of Botanical Diagrams, after Koch, by the aid of the Magic Lantern and Lime Ball Light.* By the PRESIDENT.

V. *Botanical Notes.* By Mr JOHN SADLER.

VI. *On Temperatures at the Royal Botanic Garden, and their Effects on Vegetation.* By Mr JOHN SADLER, Curator.

MISCELLANEOUS COMMUNICATIONS.

1. Mr Isaac Anderson-Henry, of Hay Lodge, Trinity, placed on the table two plants in bloom, which he conceived to be wholly new to this country. The one, an Androsace, had been grown from seeds labelled *Olearia ilicifolia*, sent by Dr Curl, of Wellington, New Zealand, as collected on Mount Ruahine Heads, in the Northern Island. The plant on the table was the only seed which came up

out of the contents of the packet. In New Zealand, *Samolus* is the only known representative of the Primrose order, yet, if got on these high summits, not at all botanically explored, it may have been mingled with seeds of *Olearia*. Sir Joseph Hooker maintains that these mountain ranges will yet yield a rich harvest to the explorer. The other plant, an *Arnebia*, was raised from seeds sent by Mrs Augusta Johnstone, and picked up in elevated valleys between Murree and Rawul Pindi; they were labelled "Prophet Flower." It may be Dr Aitchison's *A. speciosa*.

Thursday, 8th June 1882.—Dr CLEGHORN, Vice-President, in the Chair.

The following communications were read:—

I. *Obituary Notice of Joseph Decaisne, Member of the Institute, Honorary Fellow.* By Mr ANDREW TAYLOR, Assistant Secretary.

II. *Report of the Meeting of the Scottish Alpine Botanical Club, at Dalwhinnie, July and August* 1881. By Mr WILLIAM B. BOYD of Faldonside.

The summer meeting of the Scottish Alpine Botanical Club was held at Dalwhinnie Hotel, on Wednesday, 27th July.

The hotel, which is chiefly frequented by anglers, is situated about a mile from Loch Ericht, where good trout fishing is to be had, and frequently large specimens of *Salmo ferox* are obtained. Thursday morning being fine, it was resolved to visit the Sow of Atholl, with the view of rediscovering *Menziesia cœrulea*, which was first found here by Professor Balfour, and had not been gathered for many years. After breakfast, we started in two carriages for the foot of the hill, which is much nearer to Dalnaspidal station than to Dalwhinnie. Having left our conveyances, we divided into parties with the view of the more readily discovering the rare plant. Some of the party had been with Professor Balfour on a previous occasion, and had gathered it, but could not now remember the place. The hill was carefully hunted for a long time with apparently no result. Many were the disappointments we met with as the leaves of *Empetrum nigrum* and *Azalea procumbens*, which both grew plentifully here, are to an unpractised eye exceedingly like it, and they were frequently mistaken for the *Menziesia.* However, at last it was got in flower: the plant was past its regular time of flowering, and those we saw were a few accidental late flowers, and but for them we might not have discovered the habitat of the plant at all. As far as we could judge, the *Menziesia cærulea* is confined to a very limited area on the hill of perhaps about 100 yards by 50, but within that area in considerable abundance. This is the only rare plant which grows on the Sow of Atholl, the other plants gathered were all of common occurrence on the Highland mountains, viz., *Silene acaulis*, *Saxifraga aizoides* and *hypnoides*, *Epilobium alsinifolium*, *Arctostaphylos Uva-ursi*, *Azalea procumbens*, *Rubus chamæmorus*, *Salix herbacea*, *Saxifraga stellaris*, *Drosera rotundifolia*, *Gnaphalium supinum*, &c. The view from the top of the Sow was very fine towards the south, the day being very clear, the whole of the Breadalbane mountains was spread out before us; the view to the west and north was interrupted by the close proximity of the hills on the other side of the Truim valley.

On Friday we started to examine the hills to the north of the Truim. After walking about three miles along the road, we struck to the left up what seemed a rather promising looking corrie; but on closer examination the only part where any plants of interest were to be found was a steep face of rock at the very head of the glen. There we saw a great profusion of *Dryas octopetala* in full bloom, the huge plants hanging over the face of the craig, and the large white flowers shown against the dark-coloured rock were most striking. A number of Salices were seen by the side of the burn, and *Aspidium Lonchitis* was gathered, but not in great quantity. *Asplenium viride* and *Polypodium alpestre* were also noticed. On our way home, in a pool by the side of the road, fine specimens of *Utricularia minor* in flower were obtained.

On Saturday, which was very wet, some of the party went out in the neighbourhood of the hotel, and to the side of Loch Ericht. In a bog near the hotel *Utricularia intermedia* was found. This is a rare plant, and one of the most interesting gathered on this excursion. Some nice tufted varieties of *Blechnum boreale* were got by the side of the loch—one especially good, and which promises to retain its peculiarity in cultivation. Close by the side of the water, and growing in large tufts of moss, was a very fine display of *Pinguicula vulgaris* in flower; they were very beautiful, and extended for nearly a mile along the side of the loch. An unusually strong variety of *Cnicus heterophyllus* was also observed near the same place. It had been part of the programme to visit Ben Aulder to gather *Polypodium flexile*, which is one of the few localities in Scotland where it is found; but as the tenant of the deer forest was abroad, and could not be communicated with, we were obliged to forego the pleasure, and reserve it for another occasion. On Monday we left Dalwhinnie for Lawers Inn, and proposed visiting Ben Lawers on the following day. In the afternoon before dinner, during a walk by the side of Loch Tay, the following plants were seen:—*Rumex alpinus*, *Parnassia palustris*, *Orchis maculata*, and *Anagallis tenella* in beautiful flower; and on returning by the road great quantities, and very luxuriant specimens, of *Habenaria chlorantha* were seen in the meadow not far from Lawers Inn.

On Tuesday, 2nd August, the ascent of Ben Lawers was made. The day was fine, and the excursion most enjoyable. We walked up the peat road to Loch na Cat, and struck the rocks to the right, where we got *Myosotis alpestris* in great beauty. We all noticed the exceedingly rich dark blue colour of some of the specimens, which, however, failed to retain it under cultivation when removed to our gardens. *Erigeron alpinus* and *Veronica saxatilis* were got on the same rocks. A little farther round we gathered some nice tufts of *Woodsia hyperborea.* I do not think the *Woodsia* will ever become extinct on Ben Lawers through the over-enthusiasm of botanists, as we saw many fine tufts quite out of reach of any one, which will remain to shed their spores and produce plants lower down. From the *Woodsia* rocks we kept up the hill, and after lunching by the side of a small stream where the water was most delightfully cool, we started for the top of Ben Lawers, and on the way the following plants were gathered:—*Carex pulla*, *Cerastium alpinum*, *Scherleria sedoides*, *Epilobium alpinum* and *alsinifolium*, *Gnaphalium supinum*, *Luzula spicata*, *Poa alpina vivipara*, *Polygonum viviparam*, *Salix reticulata* and *herbacea*, *Saxifraga aizoides*, *hypnoides*, *nivalis*, *oppositifolia*, *Sibbaldia procumbens*, *Silene acaulis*, and *Thalictrum alpinum.* We also got a nice variety of *Aspidium Lonchitis* with perfectly smooth pinnæ, and when we reached the top *Saxifraga cernua* was gathered in the crater, and also *Sagina saxatilis* and *Alsine rubella* were got near the top of the mountain. As the wind was cold on the top, and the day well advanced, we hurried down to our hotel for dinner. Lawers Inn has been much improved of late years, an addition has been made to the house, and the botanist could not, I think, find more comfortable and convenient quarters, when exploring the rocks and corries of the Breadalbane mountains.

III. *Recent Additions to the University Herbarium.* By Mr ANDREW TAYLOR.

Amongst the Donations received three deserve special mention :—

1. Fungi sent by Joseph Bancroft, M.D., from Australia.
2. A collection made by Surgeon-Major Aitchison in 1880, in the Kuram Valley, Afghanistan.
3. Dried Plants from Shiré Highlands, East Africa, from John Buchanan, Associate.

IV. A specimen of *Polemonium cæruleum*, from the garden of G. H. Potts, Esq., Fettes Mount, Lasswade, was shown.

Professor Dickson pointed out its broadly fasciated stem with thickly clustered flowers along its edge-like extremity. This form has now come up for the second season.

V. Professor Dickson exhibited a specimen of *Cheiranthus Cheiri*, var. *gynantherus*, and also a proliferous rose, where the second flower, instead of springing from the organic extremity of the floral axis, *i.e.*, the bottom of the hollowed-out receptacle, springs from its margin in the neighbourhood of the insertion of the corolla and stamens.

VI. *On a peculiarly branching Silver Fir, grown at Conishead Priory, Cumberland.* By Mr JOHN SADLER (Plate XIII.).

This silver fir (*Picea pectinata*), with large lateral branches, was photographed by Mr George Panton, who obtained the following measurements of the tree, which has since been blown down :—

Circumference of main stem at 1 foot from ground,	14 ft. 4 in.
,, ,, 3 feet ,,	13 ,, 4 ,,
,, ,, where the large arm projects from trunk, ...	12 ,, 4 ,,
Length of arm trunk to elbow, ...	19 ,, 0 ,,
Circumference of arm close to trunk, . . .	8 ,, 8 ,,
,, ,, at the middle, . .	8 ,, 0 ,,
,, ,, at the elbow, . .	8 ,, 3 ,,
Probable height of main trunk, ...	76 ,, 0 ,,
,, erect stem of arm from elbow, .	65 ,, 0 ,,

The tree was supported by a wooden prop at the elbow.

VII. The following plants in flower were exhibited from the Royal Botanic Garden:—

Aciphylla squarrosa
Delphinium nudicaule
Allium oreophilum
Orchis hircina
,, mascula alba
Dianthus alpinus
Calceolaria Kellyana
Androsace rotundifolia, var. macrocalyx
Primula floribunda
Erinus alpinus
Edraianthus caricinus
Gentiana ornata
Silene quadridentata
Lewisia rediviva
Sarmienta repens
Veronica Lyallii
Polemonium humile
Polygonum capitatum
Saxifraga propaginea
,, mutata
,, Guthrieana, variegata.
Goodyera repens

Thursday, 13th July 1882.—Professor BAYLEY BALFOUR in the Chair.

The following Candidates were elected Resident Fellows:—

WILLIAM SANDERSON, Talbot House, Ferry Road.
ALEXANDER SHEARER, Marchmont Road.

The following Communications were read:—

I. *Obituary Notice of Deputy Surgeon-General W. Jameson, C.I.E.* By Dr CLEGHORN.

II. *Exhibition of Plants from the Murree and Kashmir Hills, Punjab;* collected in 1851, and presented to the University Herbarium by Deputy Surgeon-General ANDREW FLEMING, M.D., F.R.S.E.

The plants, Dr Fleming explained, were collected on the ranges rising from the north-west of the Punjab, during the summer months, and give a very good idea of the flora of the N.W. Himalaya. The collection was probably the first ever made at Murree. One great peculiarity was the paucity of ferns, for in the 300 to 400 specimens there were only half a dozen ferns; whereas in the

Eastern Himalaya in a few weeks one could gather 150 to 200 ferns. Everybody knew the abundance of Rhododendrons in the Darjeeling district, but he only found one species on the Murree hills during the season. Several species of *Primula* and *Androsace* in the collection, specially *A. incisa*, are worthy of notice.

III. *On the Æstivation of the Floral Envelopes of* Helianthemum vulgare. By Professor DICKSON.

IV. *On a Monstrosity in the Flower of* Iris pseudacorus. By Professor DICKSON.

V. *On Pitcher-like Developments of the Leaves of Pelargonium and Cabbage.* By Dr JAMES SIDEY. Communicated by Professor DICKSON.

These consisted of two leaves of Pelargonium exhibiting development as peltate funnels or pretty deep cups, and of an example of cabbage-leaf with stalked funnels springing from the upper leaf-surface.

VI. *Report on the Vegetation in the Garden of the Royal Botanic Institution, Glasgow, for May and June.* By Mr ROBERT BULLEN, Curator. Communicated by the PRESIDENT.

VII. *On the Physical Properties of Chlorophyll, with Spectroscopic Illustrations.* By the PRESIDENT.

VIII. *Notes on Table of Flowering of Plants in the Royal Botanic Garden, Edinburgh, from* 1850 *to the present year.* By Mr JOHN SADLER, Curator.

IX. *Notes on Memorial Trees in the Royal Botanic Garden of Edinburgh.* By Mr JOHN SADLER, Curator.

MISCELLANEOUS COMMUNICATIONS.

1. The President exhibited a monstrosity of *Trifolium repens*, obtained during a class botanical excursion to Millport this summer.

2. Mrs Bain, Napier Road, Merchiston, exhibited a fine truss of *Cacalia alpina*, grown in her garden from seeds obtained near Geneva.

3. Dr Paterson, Bridge of Allan, sent a magnificent spike of *Vanda suavis*, also dried fronds of *Platycerium grande.*

4. Mr John Campbell, Ledaig, Argyleshire, sent *Orobanche rubra* grown in that locality.

5. From a communication sent by Dr W. H. Campbell, a former secretary of the Society, it appears that the Botanic Garden, George-town, Demerara, is now being irrigated, steam pumping machinery having been erected for this purpose.

6. Mr Sadler laid on the table a specimen of *Carthamus sp.*, from South Africa, 200 miles from Cape Town, in 1881, which was now being examined in the pharmaceutical laboratory of the University by M. Hay, M.D., for a bitter principle in its leaves.

ADDITIONS

TO THE

LIBRARY, HERBARIUM, AND MUSEUM,

AT THE

ROYAL BOTANIC GARDEN, EDINBURGH,

FROM 1ST OCTOBER 1881 TO 1ST OCTOBER 1882.

I.—LIBRARY.

BOOKS.

AGARDH. Florideernes Morphologi.—*From the Author.*

ALMQUIST. Monographia Arthoniarum Scandinaviæ.—*From Royal Swedish Academy of Science, Stockholm.*

CLEVE and GRUNOW. Arctischen Diatomaceen.—*From the Authors.*

HOOKER, Sir J. D. Students' Flora of the British Islands, 2nd ed., 1878. —*Purchased.*

JACKSON, BENJ. DAYDON. Guide to the Literature of Botany, being a classified selection of Botanical Works. London, 1881.—*Purchased.*

MULLER, Dr C. A. Synopsis Muscorum frondosum omnium Cognitorum. 2 vols. 8vo. Berolini, 1849-51.—*Presented by Mr Thomas Walker, Carluke.*

ROBINSON, W. Alpine Flowers for English Gardens, 3rd ed., 1879. *Purchased.*

TODARO, Prof. AUGUSTINO. Hortus Botanicus Panormitanus sive Plantæ novæ vel criticæ quæ in orto Botanico Panormitano coluntur. Descriptæ et Iconibus illustratæ auctore. Tomus Secundus, Fasciculus Secundus. Panormii, 1879.—*From the Author.*

WITTSTEIN and MUELLER. The Organic Constituents of Plants and Vegetable Substances and their Chemical Analysis. By S. G. C. Wittstein. Authorised translation from the German Original, enlarged with numerous additions by Baron F. v. Müeller, Melbourne, 1878.—*Presented by David Christison, Esq., M.D.*

ZETTERSTEDT. Musci et Hepaticæ Finmarkiæ ; Musci et Hepaticæ Gotlandiæ ; Florula Bryologica montium Hanneberg et Halleberg. —*From the Author.*

PAMPHLETS, REPRINTS FROM SCIENTIFIC PUBLICATIONS, &c.

Agardh, J. G. Till Algeers Systematik.—*From the Author.*

Balfour, I. B. Botanical Society Club Anniversary Meeting, 1881.—*Inverleith House, Edinburgh, 15th February* 1881.

Balfour, J. H. Obituary Notices of Sir Robert Christison, Bart., and Sir C. Wyville Thomson. (From the Trans. Bot. Soc. Edin. Vol. XIV. Part 3.)—*From the Author.*

——— High School, Carson and Pillans Class Club—List of Class Fellows—1815–82.

Bornet, Ed. M. M. et A. Grunow. *Mazœa* nouveau Genre d'Algue de l'Ordre—des *Cryptophycees.* (Extrait du Bulletin de la Société Botanique de France. Tom. XVIII. 1881.)—*From the Authors.*

Cohn, Prof. D. Ferd. Bericht über die Thätigkeit der Botanischen section der Schlesischen Gesellschaft in Jahre 1880.—*From Prof. Cohn, Secretary of the Section.*

Coldstream, W. Memorandum on the Artificial Propagation of Tasar Cocoons. Communicated by W. Coldstream, Esq., Deputy Commissioner, Hoshiarpur. (From the Journal of the Agricultural and Horticultural Society of India. Vol. VI. Part 4. New Series.)—*From the Author.*

De Candolle, M. Alph. Darwin consideré en point de vue des causes de son sucées et de l'importance de ses travaux.—*From the Author.*

Dickson, Prof. A. On some of the Relations of the present state of the law to Medical Science and to Public Health. An Address delivered to the Royal Medical Society of Edinburgh, November 4th, 1881.—*From the Author.*

Eichler, A. W., Prof. Neben Beldungs abrolichungen bei Fichtenzapfen. By A. W. Eichler, 1882. Ueber die Weiblichen Blüthen der *Coniferen.* By A. W. Eichler. (From the Monatsbericht der König. Akad. der Wissenschaften zu Berlin, 1881.)

——— *Ouvirandra Hildebrandtii.* (From the Monatschriften des Vereins zur Berforderung des Gartenbaues in den König. Preuss, Staaten. 1879.)

——— Ueber die Blattstelling bei *Liriodendron tulipifera.* (From the Sitzungsbericht des Botanischen Vereins der Provinz Brandenburg.)

——— Ueber einige zygomorphe Blüthen. (From the Gesellschaft Naturforschen. der Freunde, 1880.)—*From the Author.*

Gray, Asa. Contributions to North American Botany. (From Proceedings of the American Academy of Arts and Sciences. Vol. XVII., 1882.)—*From the Author.*

——— Studies of *Aster* and *Solidago* in the Older Herbaria. By Asa Gray.—*From the Author.*

Jolis, Aug. De. Note sur le *Myosotis sparsiflora* de la Flore de la Normandie. Par Aug. De Jolis, Directeur de la Société Nationale des Sciences Naturelles et Mathematiques de Cherbourg. (Extrait des Memoires de la Société Nationale des Sciences Naturelles et Mathematiques de Cherbourg. Tome XXIII. 1881.)

Joly, M. C. Du Role de la Femme dans l'Horticulture. (Extrait du Journal de la Société Nationale d'Horticulture. Tome IV., 1882.)

Lindberg, S. O. Europas och Nord Amerikas Hoitmossoi. (*Sphagna.*) By S. O. Lindberg, Helsingfors, 1882.—*From the Author.*

——— Monographia Prœcursonia Peltolepidis, Santeriæ et Cleveæ Auctores S. O. Lindberg. Helsingfors, 1882.—*From the Author.*

Morren, M.M. Ed., et Fonsny. Les Broméliacées decouvertes en 1879 pendent le voyage des Princes Auguste et Ferdinand de Saxe-Coburg, et décrites par. M. le Dr Henri W. de Fernsee. Précédé d'une Notice Biographique et d'une relation de ses Voyages par. MM. Ed. Morren et H. Fonsny. (Publié dans le Bulletin de la Fédération des Sociétés d'Horticulture de Belgique pour 1880.) Liège, 1881.—*From the Authors.*

Mueller, Baron Ferd. von. Fragmenta Phytographiæ Australiæ, &c. Vol. XI. Melbourne, 1878–81.—*From the Author.*

——— On the Development of Rural Industries. Read as first Vice-President of the Rural Section of the Social Science Congress. Melbourne, Nov. 1880.—*From the Author.*

Ormerod, E. A. A Lecture on Injurious Insects. Delivered at the Royal Agricultural College, Cirencester, 1881.—*From the Author.*

Radlkofer, Prof. Ueber die Zurückführung von Omphalocarpum zu den Sapotaceen und dessen Stellung in dieser Familie. Von L. Radlkofer. (Separat Abd. ans d. Sitzungsberichten der K. B. Akad. d. Wissensch. Bd. XII. Heft 3.)—*From the Author.*

Regel, E. Descriptiones Plantarum Novarum et minus cognitarum. Fasc. VIII. 1881.—*From the Author.*

Sadler, John. Report of Temperatures during the Winter 1880–81 at the Royal Botanic Garden, Edinburgh; the Effects of the same on Open Air Vegetation at the Garden and in other parts of Scotland, with Table of Dates of Flowering of Spring Plants. 1882. (From Trans. Bot. Soc. Edin.)—*From the Author.*

——— On a Curious Form of Kohl Rabi. (From Trans. Bot. Soc. Edin. Vol. XIV.)—*From the Author.*

Schomburgk, R. South Australia. Report on the Progress and Condition of the Botanic Garden and Government Plantations for the year 1881. Adelaide, 1882.—*From the Author.*

Scott, Alex. Remarks on the Natural History of Socotra. 1880.—*From the Author.*

Swedish Academy. Fifteen Pamphlets by Kjellman, Lagerstedt, Wittrock, Zetterstedt, Cleve, Almquist, Angström, Dusén, Lindberg, Nordstedt, Scheutz, Theorin, Zetterstedt, and Wille.—*From the Academy.*

University of Durham. College of Medicine, Newcastle-on-Tyne. Prospectus for Session 1882–83.—*From the University.*

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

BERLIN.—Botanischen. Verein fur die Provinz Brandenburg.
Verhandlungen. Nos. XXI.-III.—*From the Society.*

BERNE.—Société Helvétique des Sciences Naturelles.
Verhandlung. 1881.
Mittheilungen. 1882.—*From the Society.*

BONN.—Naturhistorischer Vereine der Preussischen, Rheinlande, und Westfalens.
Verhand. Jahrgang, XXXVIII., 2. 1881.—*From the Society.*

BOSTON.—Massachusetts Horticultural Society.
Transactions, 1881. Parts 1 and 2.—*From the Society.*

BRAUNSCHWEIG.—Vereins fur Naturwissenschaft zu v. fur Geschäftsjahr. 1880–81.—*From the Society.*

BREMEN.—Naturwissenschaftlicher Verein.
Beilage. No. 8. 1880.
Abhandl. Bd. VII. 3 Heft.—*From the Society.*

BRISTOL.—Bristol Naturalists' Society.
Proceedings. Vol. III. Part 3.—*From the Society.*

BRUSSELS.—Société Royale de Botanique de Belgique.
Bulletin XX.—*From the Society.*

CHERBOURG.—Société Nationale des Sciences de Cherbourg.
Memoirs. Tome XXIII.—*From the Society.*

COPENHAGEN.—Botaniske Forening i Kobenhavn.
Botaniske Tidsskrift (Journal de Botanique). Series III. Vol. XIII. Liv. 1.—*From the Society.*

EDINBURGH.—Botanical Society.
Transactions and Proceedings. Vol. XIV. Part 2, 1881.—*From the Society.*
Royal Society.
Transactions. Vol. XXX. Part 1. Proceedings 1880–81.—*From the Society.*
Royal Physical Society.
Proceedings. Session 1880–81.—*From the Society.*
Royal Scottish Society of Arts.
Transactions. Vol. X. Part 4.—*From the Society.*

EPPING FOREST and County of Essex Naturalists' Field Club. Vol. II. Part 6.—*From the Club.*

ERLANGEN.—Physikatisch Medicineschen Sociétät zu Erlangen. Heft. 13. 1880–81.—*From the Society.*

GIESSEN.—Oberhessische Gesellschaft.
20th and 21st Bericht.—*From the Society.*

HAARLEM.—Bevordering van Nijverheid.
Tijdschrift. Deel. V. and VI.—*From the Society.*
Musée Teyler.—Archives. Series II. Part 2.—*From the Corporation.*

HALLE.—Kais. Leop. Carol. Deutsche Akad. der Naturforscher.
Nova Acta. Band XLI. Part 1, No. 4; Part 2, Nos. 5 and 6. Band XLIII. Part 1.—*From the Society.*

LIÈGE.—La Belgique Horticole Annale de Botanique et d'Horticulture. Par Dr Edouard Morren, 1880.—*From the Editor.*

LISBON.—Academia Real das Sciencias de Lisbon.

Memorias. Nova Serie. Tom. VI. Parte I.

LONDON.—India Office—Forest Department.

Report of a Visit to the Torrent Regions of the Hautes and Basses Alpes, and also to Mount Faron, Toulon. E. M'A. Moir, Deputy-Conservator of Forests. Calcutta, 1881.

Suggestions regarding the Management of the Leased Forests ot Busahir in the Sutlej Valley. By Dr Brandis, Inspector-General of Forests with the Government of India. 1881.

Administration Reports — Bombay Presidency, including Sind. 1880–81.—*From the India Office.*

Linnean Society.

Journal. Nos. 115–121.

Transactions. 2nd Series, Botany, Vol. II. Part I.—*From the Society.*

Pharmaceutical Society.

Journal and Transactions.—*From the Society.*

Quekett Microscopical Club.

Journal. No. 48, Ser. II. No. 1.

General Index of the Journal of Q. M. C. Vol. I.–VI. 1868–1881. —*From the Club.*

LUND.—Minnesskript ulqifven af. Konigl. Fysiographiska Sällskapt. 3 Oct. 1878.

Universit. Acta. Tom. XIV., 1877–78. Tom. XV., 1878–79. Tom. XVI., 1879–80. Tom. XVII., 1880–81.

Accessions. Katalog. 1879–81.—*From the University of Lund.*

LYONS.—Société Botanique de Lyon.

Annales. 1880-81.—*From the Society.*

MANCHESTER.—The Botanical Record Club.

Phanerogamic and Cryptogamic Report for the year 1880–81.—*From the Club.*

MELBOURNE.—Royal Society of Victoria.

Transactions. Vols. XV., XVI., XVII., XVIII.—*From the Society.*

MONTREAL.—Horticultural Society.

Reports, 1st, 2nd, 4th, 5th, and 6th.—*From the Society.*

NEW YORK.—Lyceum of Natural History of New York.

Transactions. Fasc. I. Annals; Index and Contents. Vols. I. II.; 1 and 2; 3 and 4; and 5 and 6.—*From the Academy.*

American Museum of Natural History.

Bulletin. No. I.—*From the Museum.*

OTTAWA.—Geological and Natural History Survey of Canada.

Report of Progress for 1879–80. Maps to accompany.

Report of Progress, 1879-80.—*From the Director.*

PARIS.—Société Botanique de France.

Bulletin. Tom. XXVIII. Comptes Rendus, 5–6. Session Extra-ordinaire à Fontainbleau. Revue Bibliographique, B–C, E.—*From the Society.*

PERTH.—Perthshire Society of Natural Science. Proceedings, Vol. I. Part 1. 1880–81.—*From the Society.*

PETERSBURG, ST.—Hortus Imp. Bot. Petropolitanus.
Acta. Tom. VII. Fasc. II.—*From the Directors.*

SYDNEY, AUSTRALIA.—Royal Society of New South Wales.
Journal and Proceedings, 1880–81.—*From the Society.*

TORONTO.—Canadian Institute. The Canadian Journal of Science, Literature and History. New Series. Part 2, 1881.—*From the Society.*

UPSAL.—Société Royale des Sciènces. Nova Acta, Vol. XI.—*From the Society.*

WASHINGTON.—Smithsonian Institution.
Report of the Board of Regents, 1880–81.
List of Foreign Correspondents, April 1882.—*From the Institution.*
U.S. Geological and Geographical Survey of the Territories. Bulletin Vol. VI. No. 2.—*From Dr F. R. Hayden.*
First Annual Report of the United States Geological Survey.—*From the Survey Office.*

WATFORD.—Hertford Natural History Society and Field Club.
Transactions. Vol. I. Parts 5, 6, 7, 8, 9.—*From the Society.*

WELLINGTON.—New Zealand Institute.
Transactions and Proceedings. Vol. XIV. 1880.—*From the Institute.*

PERIODICALS.

The Gardeners' Chronicle. July to December 1881.
——— January to June 1882.—*Purchased.*
The Journal of Botany. November 1881.—*Purchased.*
Nature.—*From the Editor.*
Curtis's Botanical Magazine. Vols. XXXVI., XXXVII. 3rd Ser.—*Purchased.*
The Journal of Forestry.—*From the Proprietors.*

DONATIONS TO THE HERBARIUM.

BALDWIN, D. D. A complete set of Hawaiian Ferns.—*Purchased.*

BUCHANAN, JOHN, Blantyre, E. Africa. About 300 specimens of Phanerogams and other Plants from Shiré Highlands.

FLEMING, ANDREW, Deputy Surgeon-General. A collection of nearly 300 plants from the Murree and Kashmir Hills, collected in 1851.

FRASER, PATRICK NEILL. A specimen of *Langsdorfia Moritziana.*

GOODSIR, R. A. A specimen of *Banksia serrata.* Lake Victoria, Gippsland.

GROVES, HENRY, 13 Richmond Terrace, Clapham Road, London, S.W. 15 specimens of *Chara.*

HAY, Dr M. A specimen of *Carthamus.*

KEW HERBARIUM. 29 Packages of Duplicates from Robert Brown's Australian Collection.—*Presented by direction of J. J. Bennet, Esq.*

Kew Herbarium. Transit of Venus Expedition. Marine Algæ from Kerguelen's Island. Duplicate set No. 2. Mosses. Set No. 2. December 1874–75.

——— "Challenger" Expedition. Algæ, 3rd Set of Duplicates.

——— Plants collected in Afghanistan. By Surgeon-Major J. E. T. Aitchison.

M'Donell, Mrs. Upwards of 150 Indian Ferns from Darjeeling, E. India.—*Presented through Dr A. Fleming.*

Nicholson, Geo., Kew. A specimen of *Scutellaria sp.* from Virginia Water.

Ravenel, H. W. *Fungi Americani.* Cent. VII. VIII. (Per M. C. Cooke.)—*Purchased.*

Sargent, C. S. 28 specimens of plants, chiefly *Coniferæ.*

DONATIONS TO THE MUSEUM.

Wilson, A. Stephen, N. Kinmundy, Aberdeen. Photographs illustrating his paper on Tillering, in the Transactions.

Shiels, D., Edinburgh. Plant of common Barley grown in garden, Duncan Street, Newington, illustrating Tillering.

Cleghorn, Dr. A specimen of *Cynomorium coccineum* from the island of Gozo.

Botanical Society of Edinburgh.

Patron:

HER MOST GRACIOUS MAJESTY THE QUEEN.

LIST OF MEMBERS.

Corrected to April 1883.

HONORARY FELLOWS.

His Royal Highness The PRINCE of WALES, K.G., Hon. F.R.S.E.
His Royal Highness The DUKE of EDINBURGH, K.G., K.T., LL.D. Edin.
His Majesty Pedro II. EMPEROR of BRAZIL, K.G.
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LIST OF PLATES.

ERRATA.

Page 159, line 2 from foot, *for* "1857" *read* "1867."
,, 233, line 3 from top, *for* "unipulchrum" *read* "uniflorum."
,, 259, line 6 from bottom, *for* "*Weigela*" *read* "*Weigelia.*"
,, 279, footnote, *for* "vol. xii." *read* "vol. xiii."
,, lii, line 7 from top, *for* "*Gillia*" *read* "*Gilia.*"
,, lvi, line 10 from bottom, *for* "Grislinia" *read* "Griselinia,"
,, ,, ,, *for* "Penettya" *read* "Pernettya,"
,, ,, ,, *for* "Manuka" *read* "Manuku."
,, lxviii, line 9 from top, *for* "*Cytisus Hypocistus*" *read* "*Cytinus Hypocistis.*"

M^c Farlane & Erskine Lith^rs Edin

IVY TREE AT WHITEHILL. BLOWN DOWN ON 24TH JANUARY 1868.

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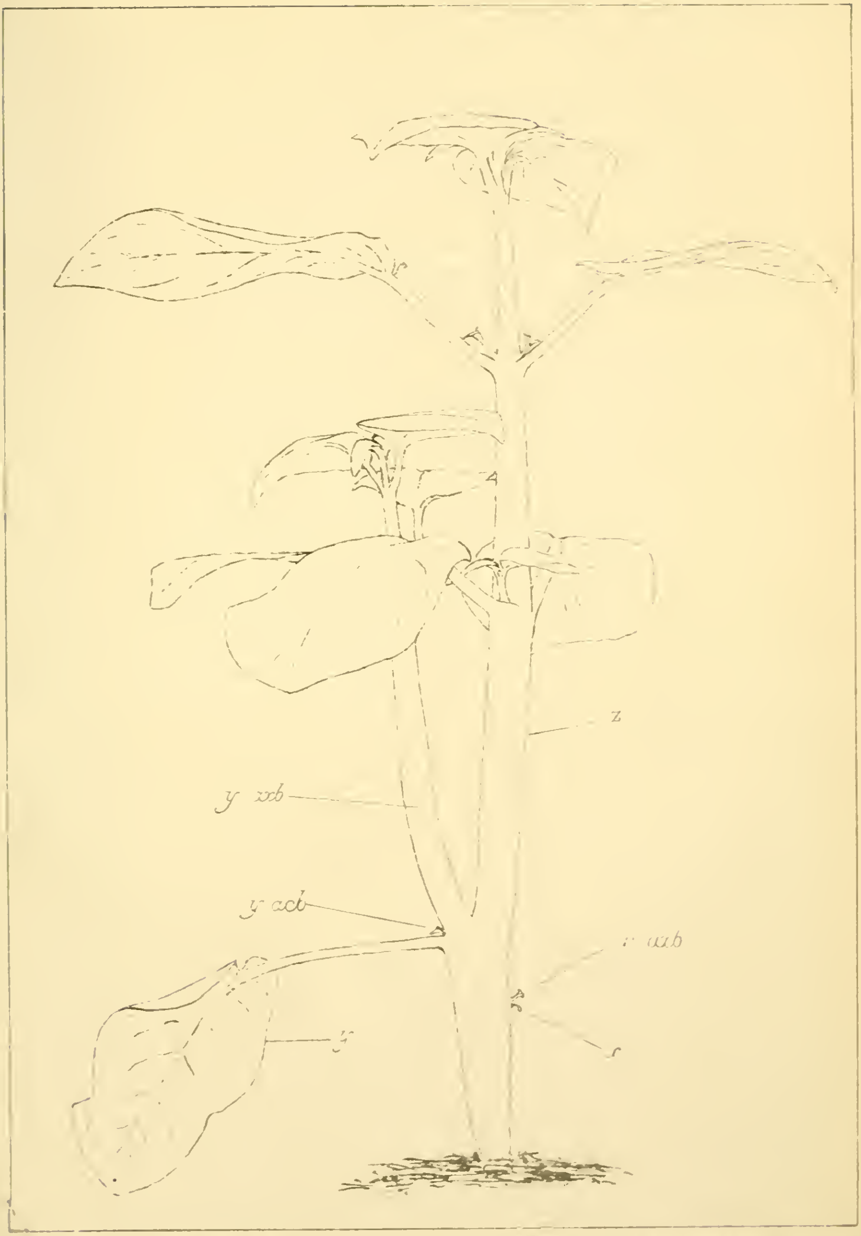

STREPTOCARPUS CAULESCENS

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