INDICES

TO THE

TRANSACTIONS

OF THE

NATURAL HISTORY SOCIETY

OF GLASGOW

VOL. VI. (New Series).

1899-1902.

With Title-Page and Table of Contents.

GLASGOW: PUBLISHED BY THE SOCIETY
AT ITS ROOMS, 207 BATH STREET.
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In December, 1903, the publication of Volume VI. of the Society's Transactions was completed by the issue of Part III. It was found impossible, however, to arrange at that time for the preparation of Indices to the Volume, such as had been supplied with the concluding Part of each of the five previous Volumes of the New Series, and have since been also furnished for Volume VII. In response to a frequently-expressed desire, Indices to Volume VI. have been prepared and are now issued, along with Title-Page and Table of Contents, for that Volume.

Glasgow, *February*, 1911.

TRANSACTIONS

OF THE

NATURAL HISTORY SOCIETY

OF GLASGOW

(INCLUDING THE PROCEEDINGS OF THE SOCIETY).

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PROCEEDINGS—*continued.*

INDICES—

ERRATA.

Page 158,	line	1,	for	"*zonica eccabunga*" read "*onica Beccabunga.*"
,, 163,	,,	23,	,,	"*spiceta*" read "*spicata.*"
,, ,,	,,	28,	,,	"*triglunus*" read "*triglumis.*"
,, 266,	,,	2,	,,	"*schweinizii*" read "*Schweinitzii.*"
,, ,,	,,	4,	,,	"*Frametes—F.*" read "*Trametes—T.*"
,, ,,	,,	13,	,,	"*melalencus*" read "*melaleucus.*"
,, ,,	,,	15,	,,	"*Meruliu*" read "*Merulius.*"
,, 271,	,,	17,	,,	"*Eutrichium*" read "*Eritrichium.*"
,, 279,	,,	27,	,,	"*Laurus*" read "*Larus.*"
,, 334,	,,	2,	,,	"*haasti*" read "*Haastii.*"
,, 335,	,,	23,	,,	"*Philadelphoris*" read "*Philadelphus.*"
,, 361,	,,	6,	,,	"*Corinilla*" read "*Coronilla.*"

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TRANSACTIONS

OF THE

Natural History Society of Glasgow.

Notes on the Marine Mollusca of Port-Stewart, North Ireland

(Especially in their relationship with the Clyde Fauna).

By Rev. G. A. Frank Knight, M.A.

[Read September 26th, 1899.]

The northern coast-line of Ireland presents a striking diversity of scenery and rock formation. As one sails round the Mull of Cantire, passes the great island of Rathlin, and skirts the mainland onward through the Skerries to Portrush, views are obtained of some of the finest examples of cliff structure in the world. The Giant's Causeway, which faces the gales of the North Atlantic, is justly celebrated for its marvellous exhibition of the form adopted by basalt in the act of cooling from a molten condition. But the picturesqueness of its columnar structure is greatly enhanced by the frowning crags which encircle and rise far above it, and the sight of the great Atlantic billows dashing themselves against the bases of these precipices is a thing to be indeed remembered. With several breaks in the basaltic formation, as, for example, at Dunluce Castle, there is a more or less continuous wall of rock from Ballycastle in the east to Port-Stewart in the west. Sandy bays are occasionally found, wedged in between the volcanic masses, and these intervals in the rampart have been seized on as sites for villages and towns. Portrush is built on a rocky promontory which is flanked by two sandy bays, while Port-Stewart, five miles further to the west, skirts a sandy enclosure, which is guarded by two rocky headlands.

But a mile beyond Port-Stewart the scenery totally changes. The precipitous crags disappear, and their place is taken by a wide stretch of beautiful firm sand, skirted by great rolling sand dunes, with bent. This is the character of the coast for several miles. The same sandy scenery is continued across the River

Bann till Castlerock promontory is reached. The cliffs here are resumed for a short distance, and then the land sinks down into a great and absolutely flat triangular piece of country, whose seaward limit is known as Magilligan Strand and Point. Thereafter comes the extensive stretch of water called Loch Foyle, and beyond is the great headland and promontory named Inishowen.

Port-Stewart, therefore, enjoys special facilities for conchological work. It has the broad beach of glistening sand, where the Atlantic sweeps in with giant strength; and it has also the rocks, with their pools and seaweeds, which afford shelter for much molluscan life. The sand dunes are in themselves extremely interesting, steep and loose in formation, and overgrown in many places with prickly plants and bent. It is not uncommon to find flint arrow-heads amongst these mounds, and the presence there also of so many of our largest marine shells, such as *Cyprina islandica,* so far removed from the sea margin, suggests the thought whether there is any connection between the two—whether our primitive forefathers who inhabited these dunes were accustomed to bring down their prey with these flint arrow-heads, and whether, when game was scarce, they were obliged to appease the gnawings of hunger by means of these large shell-fish which they gathered on the beach.

During my stay in the neighbourhood of Port-Stewart, I paid considerable attention to its marine mollusca. I was handicapped very considerably in the preparation of a complete molluscan faunal list of the locality by the fact that I had no dredging apparatus with me. The water is so pure, and the sands are so clean, that anyone dredging in deep water along that coast is certain to have a rich harvest. The abundance of shells cast up by the waves and tides on the shore is a proof of the richness of the outside waters. The following records are therefore entirely the result of shore collecting.

But if I was deprived of the means of deep-sea research by the want of a dredge, I was more than liberally assisted in shore work by the friends whose hospitality I was enjoying. They, one and all, soon became infected with the passion for discovering something new, and every day they would sally forth with unabated ardour, and with keenest rivalry, in the hope that the last tide had wafted in a mollusc which would contribute an addition to the list of species. To their perseverance and industry I am greatly indebted for any completeness which this shore list presents.

A few days' research soon revealed the fact that certain stretches of the sandy beach yielded certain shells in abundance which were comparatively scarce elsewhere. Of course there is always the difference of habitat between the rock-loving species (such as Patella, Littorina, and Purpura), and those specially addicted to sand, such as Mya, Tellina, Cardium, and Venus. But, in addition to these broad distinctions, it was curious to note how *Cypræa europæa* occurred in very large numbers near Rock House, but was very much scarcer as one proceeded west. Indeed, it might be possible roughly to space out the shore according to its predominant shells, although it must always be borne in mind that dovetailing of the groups was inevitable to a certain extent. Proceeding westward then, the order of prevailing species was something like this:—On the gravel bank near Rock House, *Cypræa europæa*, *Trochus cinerarius*, and *Pleurotoma turricula.* At the little sandy bay known as the "Ladies' Bathing Place," by far the most abundant shell was *Donax vittatus.* Beyond the last rocky point, till the River Bann is reached, the sandy beach might be spaced out into portions where the predominant types are respectively:—*Montacuta*, *Helcion pellucidum* and its var. *lævis*, *Venus*, *Solen*, *Capulus* and *Fissurella*, *Mactra*, then a small stretch of *Cypræa*, followed by a portion of the beach on both sides of the old stranded wreck on which alone *Actæon* was procured. This is but a rough division, but the absence or presence of particular shells from certain portions of the beach was so marked, that one instinctively came to associate certain strips of sand with certain corresponding molluscs.

There has not been such exhaustive conchological work carried on in Ireland as has been the case with some parts of Scotland, and notably the Clyde area. But the number of workers is increasing, and they are animated with great enthusiasm. Most of their results find publication in the pages of the *Irish Naturalist*, but there is one exhaustive treatise on "The Marine Shells of North Ireland," which stands out to this day as the most complete work on the subject. It is compiled by the Keeper of the Royal National Library in Dublin, Mr. Robert Lloyd Praeger. On my finding out the molluscan richness of the locality, I wrote to Mr. Praeger and asked for information of former research carried on in the neighbourhood, and he very kindly sent me a reprint of his work, which appeared in the *Proceedings of the Belfast Naturalists' Field Club* for 1887-88, though actually published in 1889. The pamphlet is a long one of 50 closely-printed pages, and gives a full list of all species and varieties recorded by previous workers in the North of Ireland. It summarises the Irish localities mentioned in (1) Forbes and Hanley's *British Mollusca;* (2) *The Natural History of Ireland*, by William Thompson; (3) the *Reports of the Belfast Dredging Committee*, by George C. Hyndman; (4) *Report on the Marine Zoology of Strangford Lough*, by Professor Dickie; (5) Jeffreys' *British Conchology;* (6) private lists drawn up by a number of individual workers.

Mr. Praeger's catalogue then, exhaustive as it appears, is seen to deal more with the shells of the east coast of Antrim than with those found in the north. I have, therefore, thought it advisable, whenever mention is made in his list that any species has been found on the North Antrim, or Derry coasts, to enter the same in my own list, that comparison of the two may be facilitated. Magilligan Strand, which is separated from the Port-Stewart beach by the River Bann and by the high ground near Castlerock, enjoys a reputation for yielding large varieties of species; wherever a shell is common to its sandy stretch and that about Port-Stewart, I have mentioned the fact as an interesting occurrence.

Besides Mr. Praeger's exhaustive list, there is an excellent article by Dr. Geo. W. Chaster in *The Irish Naturalist*, Vol. VI., p. 120, 1897, entitled "A Day's Dredging off Ballycastle, Co. Antrim." So large is the number of species recorded from that day's work, that I have thought it well to indicate by an asterisk any species or varieties obtained by myself at Port-Stewart, which were *not* collected at Ballycastle by Dr. Chaster's party.

There was, however, another point which occurred to me on working out the molluscan fauna of this Irish coast. It was the degree of correspondence or difference between the shells of the Antrim and Derry shores, and those of the Clyde estuary. I have, therefore, deemed it a matter of sufficient interest to institute a comparison between these respective faunas, and in every case where an Irish form is unknown to inhabit Clyde or Scottish waters, I have indicated the same by a note.

The total number of species and varieties which I obtained on the Derry and Antrim coast was 112. Of these, 14 are not found in the Clyde, or have been recorded on evidence which is not altogether satisfactory, leaving no fewer than 98 which are common to the Irish and Clyde shores.

Of the 112 species and varieties, I am happy to be able to say that eight are additions to the lists of both Mr. Praeger and Dr. Chaster. These are *Ostrea edulis*, var. *parasitica*, Turt.; *Pecten tigrinus*, var. *costata*, Jeff.; *Cardium tuberculatum*, L.; *Venus gallina*, var. *gibba*, Jeff.; *Donax vittatus*, var. *truncatus*, Marsh.; *Purpura lapillus*, var. *imbricata*, Lmk.; *Pleurotoma lævigata*, var. *minor*, Jeff.; and *Bulla hydatis*, L. *Hydrobia jenkinsi*, E. A. Smith, must probably, in the meantime, be looked on as not strictly marine.

In order to make my list as trustworthy as possible, all the shells were sent for verification to Mr. J. T. Marshall, of Torquay, who has repeated many former kindnesses in once again authenticating my records.

The only further remark I need make is, that I have followed the nomenclature of Jeffreys in his *British Conchology*, which, though now in many ways obsolete, must be our working system until the Conchological Society issue their new and revised list.

ANNOTATED LIST OF SPECIES AND VARIETIES.

Pelecypoda.

Anomia ephippium, L.—Not nearly so abundant as *A. patelliformis*, but still tolerably frequent.

**A. ephippium*, var. *squamula, L.*—Common.

**A. ephippium*, var. *aculeata, Müll.*—Moderately common.

A. patelliformis, L.—Very abundant, but valves usually much worn.

Ostrea edulis, L.—Valves very scarce.

**O. edulis*, var. *parasitica, Turt.*: with the type.—Not recorded in Praeger's list.

Pecten pusio (*L.*).—Valves in great abundance; showing also much diversity in the form and degree of variability in shape for which this species is noted. "Dead valves frequent on the Derry Coast" (Praeger).

P. varius (*L.*).—"Of general occurrence around the coasts of Donegal, Derry, Antrim, and Down." Not so frequent as the last species.

P. opercularis (*L.*).—Great numbers of half-grown and beautifully-coloured valves.

P. tigrinus, *Müll.*—A few valves. "Single valves at Portrush (Miss Richardson) and Magilligan (Praeger)."

**P. tigrinus*, var. *costata*, *Jeff.*—One large well-marked but imperfect valve. Not recorded in Praeger's list.

**Mytilus edulis*, *L.*—Frequent, but generally of small size.

M. edulis, var. *incurvata*, *Penn.*—In considerable quantities, attached to drift-wood, etc.

**M. edulis*, var. *pellucida*, *Penn.*—A few examples.

M. modiolus, *L.*—Moderately common.

M. phaseolinus (*Phil.*).—Two valves. Not admitted by Brown as sufficiently authenticated to be included among the "Mollusca of the Firth of Clyde, 1878," but well established since.

Nucula nucleus (*L.*).—A few worn valves.

Pectunculus glycymeris (*L.*).—"Thrown up in abundance at Magilligan Strand, but only single valves" (Praeger). This statement holds true also for Port-Stewart.

Arca tetragona, *Poli.*—One of the most abundant of all the shells found in the neighbourhood; valves in countless numbers strew the beach. Regarding the habitat of this species, Jeffreys (*Brit. Conch.*, Vol. II., p. 181) remarks:—"Rocky, stony, and shelly ground on all our coasts and at all depths." But from this comprehensive statement the Clyde estuary must, I fear, be excluded. I have not come across a single record of this species having been obtained in the waters to the north of a line between the Mull of Cantyre and the mouth of Loch Ryan. It has been recorded from Stornoway, 18 fathoms, by M'Andrew and Forbes; from Iona and Eigg, by Mr. Alexander Somerville; and from Oban Bay by the Rev. J. E. Somerville, having been obtained attached by a green byssus to the corners of old *Mytilus modiolus*. Mr. Frank Coulson has also taken it off Kerrera; off Loch Don, living, in 97-120 fathoms; and off Croulin Island in 15-50 fathoms. Messrs. Chaster and Heathcote, in their exhaustive report on the molluscan fauna of Oban Bay (*Journal of Conchology*, Vol. VII., p. 307) can only add to the mention of its capture by Canon Norman, "two dead and worn valves." It is not unlike the well-known Mediterranean shell *Arca Noœ*, *L.*

Montacuta ferruginosa (*Mont.*).—Valves washed up in considerable abundance along the sands.

Lucina borealis (*L.*).—Moderately common, but seldom full-grown. "Single valves are commonly thrown ashore on the Derry Coast, where also the writer has found living specimens" (Praeger).

Axinus flexuosus (*Mont.*).—A single very large valve.

Cardium echinatum, *L.*—"Single valves of large size are abundant, and complete specimens frequent, on the sandy beaches of Magilligan and Portrush". (Praeger). The young specimens of this shell, as a rule, had their spines very well developed.

**C. tuberculatum*, *L.*—Mr. Praeger omits this shell from his North of Ireland list, yet I found it in fair numbers on the broad stretch of sand near Port-Stewart. Jeffreys (*Brit. Conch.*, Vol. II., p. 273) has a remark "Leach says, 'abundantly in the Firths of Forth and Clyde, Youghal, Bantry, Cork, and Dingle Bays, Ireland,' but I fear he has confounded this species with *C. echinatum*." The only West of Scotland records I have for it are Bute (on the somewhat doubtful authority of the late Mr. Smith, of Jordanhill, as *C. rusticum*) and Lewis, as a locality given by the late Dr. Robertson, of Millport. It is quite recognisable from *C. echinatum*. I have valves from Broad Bay, Stornoway, and from Ballantrae.

**C. exiguum*, *Gm.*—Three worn valves. "Portrush, dead—Miss Richardson" (Praeger).

C. fasciatum, *Mont.*—Tolerably frequent.

**C. nodosum*, *Turt.*—Two valves.

**C. edule*, *L.*—Not by any means abundant.

Cyprina islandica (*L.*).—"Thrown up in great numbers on Magilligan Strand during northerly gales" (Praeger). Valves of young specimens were found along the tide-marks, but up amongst the sand dunes very large shells were conspicuous. Indeed, so numerous in some places were these large *Cyprinæ*, lying on the surface or half-buried in the loose sands, that one was almost inclined to ask, Have we here the remains of an ancient kjökken-mödden?

Venus exoleta, *L.*—Very scarce indeed.

V. lincta, *Pult.*—"Common, dead, thrown up on sandy beaches, from Magilligan in Co. Derry to Newcastle in Co. Down" (Praeger). This *Venus* is certainly the predominant one of its genus on the Port-Stewart sands, while *exoleta* is curiously rare.

V. ovata, *Penn.*—A few odd valves.

V. gallina, *L.*—"Found alive from low-water mark to 8 and 10 fathoms on the north and north-east sandy coasts. Thrown ashore on the sandy beach of Magilligan in quantity and of large size" (Thompson). The Port-Stewart specimens were living and beautifully marked on the exterior.

**V. gallina*, var. *gibba*, *Jeff.*—One valve. Not mentioned in Praeger's list.

Tapes virgineus (*L.*).—Very frequent.

**T. pullastra* (*Mont.*).—Curiously scarce, perhaps because so little mud (which this species loves) is mingled with the fine firm sand of the Port-Stewart beach.

**T. pullastra*, var. *perforans* (Mont.).—Four odd valves.

**Tellina balthica*, *L.*—A single perfect, though dead, specimen. I believe it is the opinion of most conchologists that this species is rapidly dying out, at least on the west coast of Scotland and England. Formerly the shell used to be abundant in many localities, where now only a few stray examples may be obtained. The survivors are nearly all of the well-known pink colour, the yellow varieties being much scarcer. Mr. Standen, of the Owens' College, Manchester, informs me that he remembers seeing whole bays of the coast of Lancashire strewn with this shell, whereas now it is by no means a frequently-met-with species.

**T. tenuis*, *Da C.*—Valves fairly abundant, but not so plentiful as the next species.

**T. fabula*, *Gron.*—"Not uncommon on extensive sandy beaches, as Magilligan" (Thompson). My experience at Port-Stewart was, that it was much more abundant than *tenuis*, a circumstance the reverse of what obtains in Clyde waters.

Psammobia ferröensis (*Chem.*).—A few odd valves. "Thrown up alive by the tide at Castlerock, Co. Derry." (Praeger).

**Donax vitattus*, *Da C.*—This is without doubt the predominant shell on the coast. Some parts of the shore, *e.g.* the little bay known as the "Ladies' Bathing Place," are literally covered with the shells of this mollusc; the shells being of all hues from the richest dark purple to the most golden yellow. The majority of the shells are perfect, though empty, the strong ligament holding the valves together. Living specimens are also frequent. Thompson states that it is "plentiful close to low-water mark at Magilligan, where it is collected by the people for food." Praeger records it from Portrush. The only Clyde localities I have for this species are:—Clyde (Smith and Landsborough—both declared doubtful by Mr. Alfred Brown, and excluded from his list of the mollusca of the firth); Ardrossan and Ayr (Coulson); Irvine (J. Smith); Kames Bay, Cumbrae, one living and one dead (Robertson); and Saltcoats (Alex. Somerville). Broad Bay, Stornoway, is the great place for this shell, or rather for its variety *turgida*, a locality where it may be seen in countless numbers.

**D. vittatus*, var. *truncatus*, *Marsh.*—I was fortunate in securing three specimens of this variety, which is an addition to Jeffrey's *British Conchology.* The shell is described and figured in the *Irish Naturalist* for January, 1895. Mr. J. T. Marshall says, that so far as he is aware, this variety is peculiar to the south and west of Ireland. The discovery of the variety in the extreme north of Ireland is, therefore, very interesting.

**Mactra solida*, *L.*—By no means frequent. "Portrush, dead" (Miss Richardson). "Dead valves are abundant at Magilligan" (Praeger).

M. solida, var. *elliptica*, *Bro.*—Moderately common.

M. subtruncata (*Da C.*).—Frequent; more coarse in appearance than those found so abundantly on our Ayrshire shores.

**M. stultorum*, *L.* — "Portrush, and abundant on the Derry coast" (Praeger). It is, indeed, abundant—finely marked living, or perfect, though dead, specimens being everywhere obtainable. The distribution of this handsome shell is somewhat peculiar. It is the typical mollusc of the north-east coast of Scotland, being very plentiful on the sandy beach near Aberdeen. Down the west coast there is a solitary record of its discovery at Oban by Mr. Alex. Somerville, who states also that, in 1888, a valve was shown him which had been picked up by Miss Kallenberg in Islay. Smith and Landsborough both record it from the Clyde, the former naming Ayr and the latter Lamlash Bay as their respective localities; but Mr. Alfred Brown, who refuses to admit the shell as a genuine Clyde mollusc, suggests that possibly they may have intended by the name not the *stultorum* of Linnæus, but the *stultorum* of Pennant, which is our *M. subtruncata*, *Da C.* This, however, can hardly be the case, as J. Smith records it as "frequent" on the Irvine and Ardeer beaches, and Coulson has taken it on the Ardrossan shore.

**M. stultorum*, var. *cinerea*, *Mont.*—Rather scarce, with the type. "Magilligan" (Thompson).

**Lutraria elliptica*, *Lmk.* — "On the Derry coast it is very abundant" (Praeger). I obtained some large valves.

Scrobicularia prismatica (*Mont.*).—"Magilligan" (Thompson). The valves of this rare and beautiful shell were tolerably abundant, and, as a rule, longer than those obtained in Clyde waters. It is generally distributed throughout the West of Scotland, but nowhere in great abundance, except (according to Alfred Brown) off Ardrishaig Pier, in 6 fathoms.

S. alba (*Wood*).—Not so plentiful as the foregoing species, and all the valves obtained were very small, and more thin and glossy than those got in, for example, Loch Goil or the Gareloch.

Solen ensis, *L.*—Very scarce at Port-Stewart.

**S. siliqua*, *L.*—Very common all along the sands, but none very large.

**S. siliqua*, var. *arcuata*, *Jeff.*—Sparingly, with the type. Not mentioned in Praeger's list.

Thracia prætenuis (*Pult.*).—"Magilligan is the only northern locality in which the species has yet been met with by Mr. Hyndman or myself. It is thrown ashore quite fresh there" (Thompson). I have about a dozen valves from the sands of Port-Stewart. Mr. Praeger says, "I have a valve found by my brother at Magilligan." It is fairly common in the Clyde.

Corbula gibba, *Olivi.*—A single valve.

**Mya arenaria*, *L.*—Common.

**M. truncata*, *L.*—Not so frequent as the last species.

Saxicava rugosa (*L.*).—Fairly plentiful, but not of large size.

Gasteropoda.

**Patella vulgata*, *L.*—In its usual prolific abundance.

Helcion pellucidum (*L.*).—Very common along the sands, and on the gravel beds between Port-Stewart and Rock House.

**H. pellucidum*, var. *lævis* (*Penn.*).—One of the most abundant shells of the neighbourhood, especially among the gravels above the rocks near Rock House.

Tectura virginea (*Müll.*).—Frequent, but much worn.

Emarginula fissura (*L.*).—Plentifully obtained. "Thrown up by the tide on sandy beaches at Castlerock and Magilligan" (Praeger).

Fissurella græca (*L.*).—"Portrush—Miss Richardson. Magilligan and Castlerock, Co. Derry, dead" (Praeger). One of the most abundant shells along this coast, and frequently of large size. It is excluded by Brown from his Clyde fauna, though its presence was vouched for by Smith at Bute; north of Holy Isle, 10-30 fathoms, by Greville and Miles; in Loch Fyne, by Barlee; and at Lamlash, by Landsborough. Since the publication of the "Mollusca of the Firth of Clyde" it has been recorded by the "Medusa" from Loch Goil, in 35-40 fathoms, and in the Dunoon basin, from 6-8 fathoms. It is difficult to conceive how such a well-marked shell could be confused with any other species. It is frequently found in Oban Bay, Tobermory, Stornoway, and elsewhere on the west coast.

Capulus hungaricus (*L.*).—"Rather worn shells are thrown ashore by the tide at Magilligan" (Praeger). Abundant on the Port-Stewart sands, though never attaining to the size of the true "Torbay bonnet."

Trochus helicinus, *Fabr.*—A single, minute specimen.

**T. magus*, *L.*—"Not uncommon on the coasts of Derry and Antrim" (Praeger). I obtained only two much-worn specimens.

T. tumidus (*Mont.*).—Only four examples obtained.

T. cinerarius, *L.*—Abundant.

**T. umbilicatus* (*Mont.*).—Rather scarce.

T. zizyphinus, *L.*—Common.

T. zizyphinus, var. *lyonsii*, *Flem.*—With the type, but scarce. The only Clyde record is my discovery of it while on the "Garland," inside Sanda Island, in 25 fathoms.

Phasianella pullus (*L.*).—Six of these beautiful little shells were got in the gravel bank near Rock House. Brown omits it from the Clyde mollusca. Smith had recorded it from Portpatrick, and Forbes had vaguely mentioned the "Clyde, 15 fathoms." Mr. Somerville has a specimen which he obtained in Arran. I have taken it between Sanda and the Mull of Cantyre in 19 fathoms.

Lacuna crassior (*Mont.*).—I was fortunate in securing five examples of this species, which is a total stranger to the Clyde. The only West of Scotland records are:—Oban Bay, where Mr. Darbishire obtained three, and Messrs. Chaster and Heathcote one specimen, but all dead; and Loch Spelve, one dead, 7-15 fathoms (Coulson).

L. divaricata (*Fabr.*).—A solitary example of this abundant shell.

L. puteolus (*Turt.*).—Only one specimen obtained. The only records from the Clyde are somewhat contradictory. Mr. Alfred Brown says that it is very scarce, and to be found at Farland Point, Cumbrae. Canon Norman records it as plentiful on the Allans, in Millport Bay! I have records for its occurrence in Loch Fyne and in the Outer Hebrides.

**Littorina obtusata* (*L.*).—Abundant everywhere.

**L. neritoides* (*L.*).—This is the species which covers the lower parts of the basaltic columns of the Giant's Causeway. The shells are there in myriads, just above high-water mark, and therefore able to abide calmly the wrath of the billows of the Atlantic. A higher wave than usual may sweep over them, but as a rule they are smitten merely by the flying spray, and thus their position on these truncated columns is apparently as secure as is "Lord Antrim's Chair." Mr. Brown admitted this species into his Clyde list under protest, and solely on the authority of Canon Norman, who affirmed that he had obtained it in abundance on the Outer Allans, at Millport. Neither Mr. Brown nor Dr. Robertson had ever this good fortune. But since the date of Brown's list it has been secured in several other places on the Clyde, and its establishment as a record is certain. In a letter which I received from Canon Norman in July last, he stated, "All I can say is that specimens taken in 1854 are still in my collection, and that the last time I was at Cumbrae, in 1888, I found it in another spot—Farland Point."

**L. rudis* (*Maton.*).—In its usual abundance.

**L. littorea* (*L.*).—Everywhere plentiful.

Rissoa parva (*Da C.*).—A solitary example of this very common species.

R. striata (*Ad.*).—A single specimen of this equally common species.

**R. cingillus* (*Mont.*).—Two specimens.

**Hydrobia ulvæ* (*Penn.*).—A few examples from the sands; not plentiful, as the mud which it loves is absent from the neighbourhood.

[**H. jenkinsi, E. A. Smith.*.—I obtained two specimens of this most interesting species, both from the tide marks on the sands of Port-Stewart. It is a moot point whether this shell should be regarded as purely a fresh-water mollusc, but until the question is definitely settled we may treat it here as at least a brackish-water species. The history of the mollusc is peculiar. In October, 1889, Mr. Edgar A. Smith, Keeper of the Molluscan Collection in the British Museum, described in the *Journal of Conchology* an apparently new species of Hydrobia, which Mr. A. J. Jenkins had collected on Plumstead Marshes. Specimens of a similar character were also forwarded him from ditches at Beeton, near North

Woolwich. As the species had features which distinguished it from all known British or foreign Hydrobiæ, Mr. Smith decided to give it the name of its discoverer, and called it *Hydrobia jenkinsi* (*Journal of Conchology*, Vol. VI., p. 142). In December, 1892, Mr. Lionel E. Adams read a paper before the Conchological Society in which he stated that he had discovered specimens of the shells at Countess Weir, halfway between Exeter and Topsham, and also at Sandwich. He suggested that the species had been introduced through the importation of timber from Russian or Finland ports. In November, 1893, Mr. A. T. Daniel reported the discovery of a flourishing colony of the shell in an inland locality, namely, in a canal near Dudley, Staffordshire. In April, 1894, Mr. Adams again reported that there had arisen a large colony near Lewes, in Sussex. In July of the same year, the *Journal of Conchology* had a note by Mr. C. H. Morris that *H. jenkinsi* had, in that locality, enormously increased in numbers. Suddenly appearing in the neighbourhood, it could now be gathered by the gallon. In November of the same year, it was observed in a canal at Short Heath Station, near Willenhall, by W. H. Overton. In December, 1897, came the first record of an Irish locality, Mr. Adams again writing that he had seen specimens gathered at the mouth of the Bann. He believed this habitat supported his theory that it was imported through timber, as he found that three firms imported Baltic timber at Coleraine, and that a considerable amount was used for the Bann mouth extension works. The Bann is a thorough tidal river below Coleraine, and there can be no doubt that *H. jenkinsi*, on this occasion at least, enjoyed the benefit of salt water. In May, 1898, Mr. A. Hann had a note in the *Journal of Conchology*, Vol. IX., p. 89, that he had discovered the species in abundance near Middlesborough, where Baltic timber is constantly brought into the Tees. In June of the same year, Mr. Adams had another note (*Ibid.*, p. 114) regarding the distribution of this species, arising out of the fact that Mr. Welch, of Belfast, had sent him some specimens found at Kenmare, in a little stream running into the tidal river at the head of the estuary. Baltic timber was imported at

Kenmare till twenty years ago. Mr. Welch also sent some which had been taken from within half-a-mile of Newry in marsh drains. Such is the history of this shell up to date. I have only to record my own capture of it on the sea-sands of Port-Stewart.]

Turritella terebra (*L.*)—Neither frequent nor large, and yet "In Loch Foyle the dead shells of this species constitute a large part of the great shell-banks for which the place has long been noted" (Praeger).

Scalaria communis, *Lmk.*—Two specimens of this handsome shell recorded from Magilligan in the Belfast Museum. Authentic records for the Clyde are somewhat scarce. Brown doubts its presence here altogether. J. Smith obtained it on the Ardeer beach.

**Ianthina rotundata*, *Leach.*—"On the north coast of Antrim and on the coast of Derry it is of frequent occurrence, and is occasionally washed in in quantity. I am informed that after October gales the strand at Bush-foot is sometimes thickly strewn with it. Portrush, occasionally — Miss Richardson" (Praeger). My fortune in regard to this beautiful oceanic visitor was limited to a single perfect specimen, which was picked up not far from the rocks near Rock House. The mollusc, as is well known, is entirely a pelagic species, buoyed up on the Atlantic billows by its float, from the under surface of which hang its clusters of egg capsules. The only recorded Scottish localities where it has been cast on our shores are Machrihanish Bay (Campbeltown Museum); Loch Ryan (on the authority of the late James Smith, of Jordanhill) and Skye (in a MS. of the late Professor Forbes). It is strange, however, that some stray specimen should not be sucked round the Mull of Cantire, and landed somewhere on our broad Ayrshire sandy beaches.

**Natica catena* (Da C.).—"Thrown up alive and of large size on Magilligan Strand" (Praeger). Good-sized examples were common on the Port-Stewart sands.

N. Alderi, *Forb.*—Frequently met with.

Velutina lævigata (*Penn.*).—Not uncommon, but frequently injured by the heavy waves. "Thrown up by the tide at Portrush and Magilligan" (Praeger).

Aporrhäis pes-pelecani, (*L.*).—Two immature specimens, without the adult "webbed-foot."

Cerithium reticulatum (Da C.).—Moderately abundant in gravel beds near Rock House.

**Purpura lapillus* (*L.*).—Very common on rocks near Rock House.

**P. lapillus*, var. *imbricata*, *Lmk.* : with the type.—Not referred to in Praeger's list; nor have I any records of its occurrence in Clyde waters. It has been taken, in 20 fathoms, off Iona by Mr. Somerville.

Buccinum undatum, *L.*—Common.

**Murex erinaceus*, *L.*—Found dead in abundance, and generally much worn. Jeffreys gives a list of British stations, and remarks—"All the specimens procured from the northern coasts were dead" (*B. C.*, vol. IV., p. 308). But Mr. Praeger has been fortunate enough to dredge it alive, in 3 fathoms, off Rockport, Belfast Lough, which, I understand, is a solitary record for its living state. Brown omits it from his Clyde list; Smith quotes Bute and Ayr as places where it has been found; Forbes mentions "the Clyde, 15 fathoms, dead"; and Mr. Somerville has taken it at Ardrossan. It is got in Oban Bay, but commonly dead and worn.

Trophon truncatus (*Ström.*).—Two examples obtained.

Fusus antiquus (*L.*)—Common.

F. gracilis (*Da C.*).—Sparingly on Port-Stewart sands. "I have not observed it on the Derry Coast" (Praeger).

**Nassa reticulata* (*L.*)—"I have dead shells from Portrush and Magilligan" (Praeger). It occurs in considerable abundance along the broad sands of Port-Stewart, but more especially on the gravel bank beside Rock House.

N. incrassata (*Ström.*).—In myriads near Rock House.

Defrancia linearis (*Mont.*).—Only one specimen.

Pleurotoma nebula (*Mont.*).—Two examples of this rather scarce mollusc.

**P. lævigata*, var. *minor*, *Jeff.*—It would seem that the two specimens which I obtained of this variety are a new record for the North Irish coast. Praeger does not mention the species at all; and Jeffreys gives Guernsey as the habitat of the type, while "the variety occurs in the Channel Isles also, and on the coasts of Dorset, Devon, and Cornwall." Alcock records it from Connemara. The type is referred to in the "Medusa" records as occurring near Minard, in Loch Fyne, in 15-20 fathoms; in the Dunoon basin, in 20 fathoms; and off Carradale, in 16-20 fathoms, There are no Scottish records for the variety.

**P. septangularis* (*Mont.*).—A single example of this rare species. Smith records it from Ayr and Bute; Canon Norman states it is rare in Lamlash Bay; Dr. Robertson took a single live specimen off Cumbrae.

P. turricula (*Mont.*).—Abundant in the gravel beds near Rock House.

Marginella lævis (*Don.*).—Hyndman had recorded this from Magilligan. I was glad to secure one example from the gravel bank near Rock House. It was not full-grown, and had its apex slightly damaged. The shell is widely, though very sparsely, distributed over the West Highlands, but the only record from the Clyde is the dubious mention of Ayr by the late James Smith.

Cypræa europæa, *Mont.*—In great abundance on the sands, but more especially on the "Cowry Beach," near Rock House.

Cylichna cylindracea (*Penn.*).—A single example washed up.

**Actæon tornatilis* (*L.*).—"Port-Stewart—Miss Richardson. Frequent on the Derry Coast, thrown up by the tide, from the Bann to Magilligan Point" (Praeger). Most of the specimens obtained of this beautiful and distinguished-looking shell were somewhat injured by the waves.

**Bulla hydatis*, *L.*—This again seems to be a new record for the North of Ireland. My specimen is a fragment, but quite recognisable. Praeger does not mention the species, and Jeffreys gives only Galway, Bantry Bay, Cork Harbour, and Dublin Bay. The only Scottish record I possess is "Deep water of Upper Loch Fyne," mentioned in the "Medusa" lists. It is possible that this may be right, but more likely it is a mistake for *Bulla utriculus*.

Notes on the Occurrence of Trichomanes radicans, Sw., in Scotland.

By William Stewart.

[Read 31st October, 1899.]

In preparing a list of the Ferns of the Clyde area for the meeting of the British Association in Glasgow, I found a note in the *Journal of Botany*, Vol. I., p. 293, by Mr. C. C. Babington of the finding of this fern in Arran, by the late Mr. George J. Combe, in 1863. In Vol. II., p. 104, Mr. Walter Galt has a reference to the discovery, in which he expresses a doubt of the plant being a native. Hennedy also, in his *Flora of Clydesdale*, regards it as being a "questionable native;" while Dr. Bryce, in *Arran and other Clyde Isles*, accepts it as a native without demur.

That it is a genuine native of Scotland is established by evidence of its having been found on Lochfyneside, as well as in Arran where it has occurred in three stations many miles apart. The collation of this evidence, and the putting on record my own testimony in connection with one of the instances, is my reason for presenting this note to the Society.

In Vol. XVII., p. 35, of the *Transactions of the Botanical Society*, there is a lengthy note by Mr. W. B. Simson claiming the discovery of the Corrie station for Mr. Robert Douglas, "the walking postman between Brodick and Corrie," who was in the habit of collecting Ferns for sale, and who had shown him a specimen of the plant under the name of *Asplenium marinum*. Mr. Simson confesses that he did not know the species, which he saw was certainly not *A. marinum*, but states that he subsequently identified it as *Trichomanes radicans*, Sw., and proceeds to describe the spoliation which ensued, in which he himself was not ashamed to take the final part. He says—"I took off my coat, rolled up my shirt sleeves, and, with my hand, scraped the slimy mud out of the bottom of the crevice and from its sides, in the hope of finding a fragment of root, or stem rather, which might have been left behind. My 'happy thought' was rewarded by finding a fragment of a frond with an inch or two of rhizome, which I took away with me, wrapped in moss, and planted on my return to Edinburgh." He concludes his note as follows:—"What I have stated will prove that the Fern was actually found at the time and in the place I have described, *though I am not at all surprised that it has never been found there since.*" The absence of surprise, after such a confession, is not remarkable.

The Rev. David Landsborough has a note in the same volume of the Botanical Society's *Transactions*, p. 39, in which he records the finding of *Trichomanes radicans* on Lochfyneside, about the same time, by two Paisley botanists. He says—"Mr. James Cooke, proprietor of the *Paisley and Renfrewshire Gazette*, writes—'It was found by Mr. Young and myself conjointly, in a cave on Lochfyneside, some two or three miles above Ardlamont Point, in 1863, so far as I remember. We did not know what it was, but on bringing it home Mr. Hendry identified it, and it was brought by him to the next meeting of the Philosophical Society—a very small society in those days—and he afterwards reared it to luxuriance in a pot at his home. I have visited the cave often since, and did so in August last [1886], but have not seen, either there or in the vicinity, any specimens of the plant.'"

Mr. Cooke, whom I knew well as an enthusiastic and successful collector of marine algæ, assured me of the genuineness of the discovery, and I remember the plant, in the early years of my residence in Paisley, growing healthily in the possession of Mr. Hendry. I have not succeeded in finding any record by Mr. Hendry, who, however, was very unmethodical, as his botanical collections prove. These I have traced to the possession of Mr. Alexander Stewart, Kilbarchan, who describes them as very large and in much disorder, so that it has been impossible to examine them thoroughly at present. I have been unable to trace Mr. Young's Herbarium as yet.

The honour of the discovery of the second station in Arran belongs to Mr. Robert Kidston, F.R.S.E., F.G.S., who found this rare Fern on the west side in 1876. His statement, as recorded by the Rev. Mr. Landsborough in his note in the Botanical Society's *Transactions* before mentioned, is as follows:—"*Trichomanes radicans* was collected by me near Dougarie, Arran, in 1876. There were three small and depauperated roots, of which I took one; it is still alive [1887], and much increased in size since I collected it. The place of its occurrence was of such a nature as to entirely preclude the idea of its having been planted. For obvious reasons the exact locality need not be mentioned."

By the kindness of Mr. Kidston and Mrs. George J. Combe, I am able to exhibit the original fronds of the Corrie and the Dougarie finds.

In 1877 the late Mr. Morris Young, then Curator of the Museum in Paisley, sent for me to verify his identification of a basketful of fronds and rhizomes brought from Arran by Miss MacBean, a sister of Mr. A. F. MacBean, Rector of the Paisley Grammar School, These proved to be fronds and rhizomes of *Trichomanes radicans*, Sw. The basket contained about a dozen fronds, and portions of the rhizome amounting to upwards of a yard in length. The Fern was new to Miss MacBean, and was brought by her to Mr. Young for identification. Unfortunately it had lain in the basket exposed to the air for some days, and although Mr. Young planted and nursed it carefully he failed to save it. Miss MacBean's account of its discovery is as follows:—She and a friend were at Lochranza in August, and when walking between the edge of the cliffs and the hills towards the North end of the island, she stumbled and fell through putting her foot into one of the drains crossing the ground. On drawing aside the ferns and long grass, and looking down, she saw a small plant of Hartstongue, and knelt to reach it, but failed on account of the depth of the cutting. She brought up, however, in her grasp some fronds which appeared uncommon, and she secured as many as she could reach, together with portions of the "root," placing them in her flower-basket, where they had lain till brought to Mr. Young. There does not seem room for doubt as to the genuineness of the discovery, and this position in which the plant was found, as well as its luxuriance of growth, quite excludes the idea of its introduction. I am sorry that none of the fronds from this station, or, as far as at present known, from that on Lochfyneside have been preserved, but an examination of the fronds from Corrie in the Herbarium of the late Mr. Combe, or those from Dougarie in that of Mr. Kidston, leave no room for doubt as to their character as those of wild plants. As it has thus been found on the North-east side, on the West side, and at the North end of Arran, at different dates and by different discoverers, and some miles up Lochfyneside, by yet other botanists, I think it is satisfactorily established that *Trichomanes radicans*, Sw., is a native of Scotland, and that we are justified in placing it on our list.

A Census of Glasgow Rookeries.

By Hugh Boyd Watt.

[Read 29th May, 1900.]

A census of British Birds is one of the tasks which lie before our Ornithologists, and one which can be readily overtaken by the exercise, in a systematic manner, of attention, care, and patience. The numbers of some breeding species, such as the Bearded Titmouse, the Golden and Sea Eagles and other Accipitrine birds, the Gannet, the Heron, the Great Skua, and the game birds, are already approximately known; and as regards other species, and amongst them some of our commonest birds, each nesting season brings round an opportunity of enumerating them with fair accuracy. Constant controversy prevails as to increase or decrease in the numbers of our birds and the utility of protecting certain species, and a census made on one system over a series of years would furnish material for determining some disputed points. The Rook *(Corvus frugilegus*, Linn.)—one of our most common birds, with no concealment or seclusion in its nesting habits, and not shunning observation—is a species of which an example might be made, and this brief paper gives the results of an enumeration made this season of the

Rookeries in and around Glasgow. The limit-radius has been fixed at three miles, more or less, from the Royal Exchange, and it will be seen that eight of the nesting-places named are within the bounds of the municipality.

Beginning, like the sun, in the east, the nearest Rookery to Alexandra Park is at Gartcraig House, where there are apparently about 24 nests. This is outwith Glasgow, but as it is in close proximity to Barlinnie Prison, it may fairly be claimed as our own. At the Asylum, Carntyne, there are 10 nests in tall beech trees, and at the neighbouring Tollcross Park (which, although the property of the City, is not within the City bounds) there are no fewer than 350, mostly in the beech and elm trees by the burn which runs through the grounds to the east of the Mansion-house. This is the largest Rookery on my Glasgow list, and it is a stirring and busy place on a sunny spring day. It is said to be more than a century old (*Glasgow Herald*, 21st June, 1897). Coming to the Clyde, Dalmarnock House (the Easter one) has 6 nests in beech trees; and Belvidere has 9 in one beech growing on the west side of the Smallpox Hospital. The two last-named places are in the City, but we cross the boundary again when we reach Westthorn House, where are 13 nests. Easterhill House has 60, scattered in the beech trees through the policy; and Fullarton House (near the Clyde Ironworks) has 19, six of which are in slender birch trees, which, as I watched them, swayed about in the breeze, rocking the cradles of this bird-nursery. The other nests here are in beech and ash trees. Crossing the river, we enter Rutherglen, but we cannot offer this ancient and royal burgh the indignity of annexing its Rookeries to Glasgow. It may be noted, however, that there is one at Gallowflat; a small (and decreasing) one of about 10 nests at Farme Castle; one of 19 nests, in great maple and beech trees, at Muirbank, at the west end of the burgh; and one in which there seems to be from 200 to 300 nests at Castlemilk—many of the nests here are in the smaller trees, although there are larger trees near them unoccupied. On the Cart, at Netherlee, are 20 nests in lime trees in an avenue near the works, and at Cathcart House and Cartbank are 62 nests. There were 171 hereabouts last season (1899). At Langside, in the immediate neighbourhood of the Mansion-house (in the "Blue-bell" Wood), are 182 nests, and in the garden of the house called Mariaville there are 8, almost all in beech trees. This is an increasing colony, as in 1896 there were 124 nests; in 1897, 95; in 1898, 133; and in 1899, 144. At Camphill (which is part of the Queen's Park) are 13 nests in ash and beech trees. Last year there were 20, and in 1898, 17. In 1894 there are said to have been 50, and in 1887, 5.[1] Crosshill, up to this year, had a small Rookery at Devon Villa—probably the nearest nesting-place to the heart of the City. In 1896 there were 17 nests here; in 1897, 10; 1898, 4; in 1899, 1; and this year, none; these rooks may have joined the colony at Langside or at the neighbouring Crosshill House, which this year has 9 nests in elm and ash trees. In 1896 there were 8 nests here; in 1897, 1; in 1898, 1; and in 1899, 7. Ibroxhill has 44 nests, a solitary one being placed prominently in the top of the tallest beech there; and Bellahouston Park has 19 in elms and beeches, 13 being in one beech.[2] In Govan a Rookery is reported at Merryflats, and near Moore Park one nest was built this year, but it was destroyed—a fate which all the trees and old houses in the district seem destined to share. Crossing the Clyde in our circuit northwards, there are 21 nests in elms and beeches at Crosspark, Partick; and in the fine tall beeches in Victoria Park are a few, probably about half-a-dozen. Next to the Langside Rookery, that on the Kelvin at and near the Botanic Gardens is the best within the City, and it has the further advantage of being easily seen. It shares with Crosshill in proximity to the heart of the City. In the Gardens are 13 nests; at Queen Margaret College, 70; and across the river at Lismore House, 11 —making 94 nests in all, in ash, beech, elm, and great maple trees (20 being in one beech). In 1893 there are said to have been 90 nests.[3] In Kelvingrove Park, and extending into Kelvingrove Street and Sauchiehall Street, there were about 150 nests in 1855, but these gradually disappeared, the last being seen in 1891. This Rookery had its origin from that which flourished in the trees at the residence of Mr. James Ewing at the head of Queen Street, the birds being driven away from Queen Street

[1] Duncan M'Lellan's *Glasgow Public Parks* (1894), p. 83.

[2] Mr. J. Whitton, Superintendent of Parks, informs me that 23 nests were occupied this year; also 8 at Wearieston Farm in the Park.

[3] *Op. cit.*, p. 113.

when building operations in connection with the railway station began in 1842.[1] At Jordanhill a Rookery is reported, but I have no particulars, and for the northern circuit of the City my schedule is also blank. I am aware that the City boundary stretches to the Kelvin at Garscube Mill, including the Acre Plantation and other woods where Rooks may nest, and I should like information on this point, but the nearest Rookery I know in this locality is at Kenmure House, Bishopbriggs, where is a fairly large one. The north-east district does not seem to provide sustenance for a single Rook family; it is the "stricken field" in an actual sense—"a pillar of cloud by day and a pillar of fire by night." Thus I come back to Alexandra Park, from which I started, and my circuit is completed.

The eight Rookeries inside the City (Dalmarnock, Belvidere, Langside, Camphill, Crosshill, Ibroxhill, Bellahouston, and Botanic Gardens) contain 384 nests; and the other Rookeries of which I have given details, (say) 911 nests = 1,295 in all. I add to this 10 per cent. for omissions and oversights (my experience is that I under-estimate the numbers of birds, generally speaking), making a total of 1,425 nests. This represents 2,850 parent birds, and assuming that each nest sends out into the world two young birds, you have a further 2,850, making the native Rook population of the outskirts of Glasgow this summer amount to 5,700 birds.

There is nothing remarkable in any of the nesting-places I have named; they are all, as is usual, in close proximity to our houses, and sometimes on the public road; the majority of nests are in beech trees, but other kinds are used, and I can form no opinion as to why Rooks choose one species or one group of trees in preference to another. It may be remarked, however, that most of these Rookeries are close to or within sight of water, but, at the same time, you have a place, like the Nether Pollok policies, with the Cart flowing through them and abounding in wood, and yet not a Rook's nest therein.

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[1] *Op. cit.*, p. 67-8. The Rookery is figured in a drawing by the late Wm. Simpson, R.I., now in the Corporation Galleries, and entitled "Bell's Quarry and George Square in the Thirties."

Carboniferous Lycopods and Sphenophylls.

By Robert Kidston, F.R.S.E., F.G.S.

[Read 28th November, 1899.]

In accordance with the custom of this Society, on the termination of my office as President, it falls to me this evening to deliver a retiring address.

Before treating of the subject on which I specially wish to address you, I take this opportunity of thanking the Society for the honour they conferred upon me three years ago when they elected me their President, and the kind indulgence they have shown to me in the discharge of my duties. I would, however, specially express my thanks to the Council and to your two Secretaries for the kindly spirit which has pervaded all our meetings, public and private. They have been a pleasure to me, though I am afraid that personally I have not done much for the furtherance of the objects of the Society. This, however, has been well seen to by my colleagues in office.

Presidential addresses are of two kinds: the first is that which treats of science generally, the other that which deals with some special subject. Between these two there seems to be no middle course, and as I did not feel able for the first form of address, I have chosen the other alternative, and wish to speak to you to-night on the *Carboniferous Lycopods and Sphenophylls.*

CARBONIFEROUS LYCOPODS AND SPHENOPHYLLS.

When one begins the study of Carboniferous Fossil Plants, probably the first specimen acquired will be a piece of the stem or rhizome of a Lycopod. The group is widely distributed throughout the Carboniferous Formation, and of so frequent occurrence that perhaps we do not give them the consideration they deserve., The Sphenophylls are, however, more rare.

All text-books of geology, even the most elementary, refer to the Lycopods, and generally give a few rough illustrations. *Lepidodendron*, *Sigillaria*, and *Stigmaria* are so often mentioned that one is led to believe that their whole life-history is clearly made out, and that nothing further regarding them is left for future investigation. It is true that much is known about the Carboniferous Lycopods, but many points still await careful elucidation.

We could all probably recognise a *Sigillaria* or *Lepidodendron* in their typical forms were they placed before us, but how many of us could clearly point out wherein these two genera differ from each other?

In my endeavours to work up the Carboniferous Flora of Britain I meet with many collectors and students of fossil botany, and have found that a great deal of confusion exists as to the distinctive generic characters of some of the Carboniferous Lycopods, and this has suggested to me that I might profitably address you on this subject to-night.

The genera which will be brought before you this evening are of different values, for fossil plants usually occur in such a fragmentary condition that it is frequently—most frequently, I might say—impossible to refer the isolated leaves, fruits, and rhizomes—the parts which help to make up a whole—to their respective parent stems; hence it is necessary to place these separated parts provisionally in special genera until their relation to each other is ascertained.

As we proceed these relationships will be pointed out as fully as possible.

EXISTING LYCOPODS.

Before considering the structure and affinities of the Carboniferous Lycopods, it is necessary to consider briefly certain points connected with the structure and growth of existing Lycopods.

These may be classified as follows:—

Lycopodiaceæ.

A. *Lycopodieæ*—with only one kind of spore *(Isosporous).*

Lycopodium.

Tmesipteris.

Phylloglossum.

Psilotum.

B *Selaginelleæ*—with two kinds of spores *(Heterosporous).*

Selaginella.

Isoëtes.

As far as we are concerned at present it will be sufficient for our purpose to consider shortly the three following genera—of Section A, *Lycopodium;* and of Section B, *Selaginella* and *Isoëtes* —as it is amongst these that we will find the nearest allies to our Carboniferous Lycopods.

A. LYCOPODIEÆ.

Lycopodium, Linn.

The centre of the stem is occupied by a cauline central vascular cylinder. This usually consists of several parallel, transverse bands of xylem, composed of scalariform tracheides pointed at both ends. These bands anastomise at intervals. If such a band were dissected out it would appear as a somewhat irregular meshwork. Though the bands of the fibro-vascular portion of the bundle thus form a united whole, each of the bands composing the united structure may be regarded as an individual bundle.

The central portion of the fibro-vascular bands consists of large scalariform vessels; at the two extremities of the band are much smaller spiral vessels. Lying between and surrounding these fibro-vascular tracts is the phloem, in which the sieve-tubes lie in lines, and are distinguished by their large size. Lying outside the phloem are some layers of broader cells—the phloem-sheath of Hagelmaier, or pericycle, the whole being surrounded by the bundle-sheath, or endodermis.

Outside the phloem-sheath lies the cortex, the innermost layer of which is parenchymatous or sclerenchymatous, but not coloured as in the ferns. Surrounding this is a less indurated layer of tissue, the whole being enclosed by the epidermis.

Such is the general structure of the stem, but it varies in some minor details in the different species.

In some *Lycopods* the branching is monopodial, in others it is dichotomous. The leaves are small, single-nerved, and generally spirally placed on the stem.

The sporangia are borne on the base of unaltered leaves, as in *Lycopodium Selago*, Linn., or on the base of bracts or sporophylls aggregated into distinct terminal cones, as in *Lycopodium alpinum*, Linn. The sporangia are reniform, and placed transversely on the leaf or bract, to which they are attached by a broad short stalk. They open by a cleft which runs across the apex in their longer direction. The wall of the mature sporangium is composed of two layers of cells. The spores are numerous, very small, and of one kind, roundish or tetrahedral in form, with various markings on the exosporium.

For our present purpose it is not necessary to enter into further details of the structure or development of *Lycopodium*.

B. Selaginelleæ.

Selaginella, Linn.

The stem contains one or several cauline vascular bundles, which are ribbon-like in form. The xylem portion is chiefly composed of scalariform tracheides, the smaller and primary elements being at the ends, which are annular or spiral. The xylem is entirely surrounded by the phloem, and the stem vascular bundles are very similar in structure to those of ferns. The phloem is enclosed by two or three layers of parenchyma, which may be regarded as the pericycle. Surrounding these is a large air-space, "which is only interrupted by transverse cellular filaments, like flying buttresses, to support the bundles." These probably represent the endodermis.

The tissue surrounding the air-space and its contained bundle consists of thin-walled elongated cells, the whole stem being encased by an epidermis of long prosenchymatous tissue. The branching is lateral monopodial.

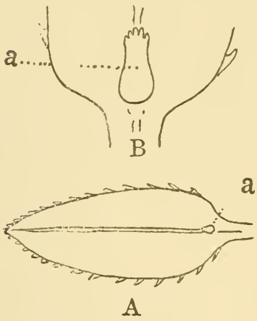

Fig. 1. *Selaginella sp.* A, Leaf showing position of ligule. B, Base of leaf with ligule *a*. Both figures enlarged.

On the typical *Selaginella* the leaves are generally of two kinds—"the two rows of the lower plane are more spreading; the two rows of the upper ascending, adpressed to the stem and imbricate."[1] On the upper side and near the base each leaf bears a *ligule*. (Fig. 1.)

The fruit is borne in the form of terminal cones. The lower bracts, or sporophylls, usually bear *macrosporangia*, the upper *microsporangia;* but occasionally the macrosporangia and microsporangia may be side by side with each other.

[1] Baker, *Handbook to the Fern Allies*, p. 31. 1887. London.

The sporangia are globular, shortly stalked, and spring from the stem at the insertion of the sporophyll. The microsporangia contain numerous spores, the macrosporangia generally four macrospores. The spores, both micro and macro, have three ridges, which radiate from the centre. Their surface is variously ornamented. In *Selaginella caulescens* the macrospores have an equatorial, zone-like wing.

Isoëtes, Linn.

The stem is very short, unbranched, and increases in thickness from a layer of meristem which surrounds its vascular body and produces new layers of parenchyma on the outside. This increase in the size of the stem usually takes place at two or three points, according to the species, so that in section the stem exhibits two or three projecting masses of tissue.

The leaves are long and sub-triangular, convex behind and concave in front, and consist of two parts—a basal portion or sheath, and an upright part or lamina. They are developed in a close rosette, and each leaf contains four air-cavities divided by septa.

The sporangia, which are attached by a narrow band, are placed in a hollow at the base of the leaf (the *fovea*). The hollow is covered more or less by the *velum* or *indusium*. Above the *fovea* is another small pit-like hollow, the *foveola*, from the base of which springs the *ligule*, a triangular scale-like outgrowth.

The sporangia are imperfectly divided into compartments by bands of tissue which stretch across from the ventral to the dorsal side. The lower leaves bear the macrosporangia, the upper the microsporangia.

The macrospores are large and globular, and bear three prominent ridges, which radiate from the apex to the middle; their outer surface is generally more or less granulated. The microspores are very small and trigonous, with a ventral rib.

Some members of the genus are aquatic or sub-aquatic, and a few are terrestrial.

CLASSIFICATION OF CARBONIFEROUS LYCOPODS AND SPHENOPHYLLS.

So many points still remain unknown, or are only insufficiently known, in connection with the structure and fructification of some of the Carboniferous Lycopods, that at present a provisional classification only is possible. With the exception of *Lepidodendron*, the fructification of all the other genera is imperfectly known. Hence it is only possible to define the genera of the Carboniferous Lycopods and their relationship to each other in a tentative manner.

It is necessary, therefore, in the absence of fuller information regarding their fructification, to depend largely for the classification of the Carboniferous Lycopods on characters derived from impressions of the outer surface of the plants, which, in addition to showing the structure of the leaf-scar, also show in many cases the position held by the fructification on the stem. The structure of the fructification is, of course, the most important and only satisfactory basis on which to found a reliable classification, and when this is known it is used, but, as already stated, there are few cases where it is available.

The following classification may, therefore, be adopted provisionally:—

LYCOPODIALES.

A. Lycopoditeæ.

Plants of moderate size, whose stems probably attained a diameter of several inches. In growth and habit resembling *Selaginella* and *Lycopodium*. Leaf-scars imperfectly defined and not possessing the prominent leaf-cushions of *Lepidodendron*. Vascular cicatricule of leaf single, unaccompanied by the lateral parichnos. Fructification in the form of terminal cones or sporangia placed in the axils of the leaves Leaves small.

I. *Lycopodites*, Goldenberg, 1855 (*Brongt. emended*).
II. *Archæosigillaria*, Kidston, n.g.

B. Lepidodendreæ.

Plants attaining to arborescent dimensions and ramifying by repeated dichotomy. Stems bearing fusiform or rhomboidal cushions, distant or approximate, arranged quincuncially, more or less prominent, and to some part of which are attached the single-nerved linear lanceolate or grass-like leaves. After the fall of the leaf, the cushion bears a well-defined leaf-scar, varying in shape, but generally more or less transversely rhomboidal, with upper and lower angles rounded and lateral angles acute.

Within the leaf-scar are three punctiform cicatricules, the central being the vascular scar, the two lateral the parichnos. Fructification in the form of cones, frequently if not always heterosperous, terminal, or spirally or distichously arranged on the stem. Sporangia single, attached to the upper surface of the basal portion of the bract or sporophyll. Rhizomes, *Stigmaria*.

III. *Lepidodendron*, Sternberg, 1820.
IV. *Lepidophloios*, Sternberg, 1820.
V. *Lepidostrobus*, Brongniart, 1828.
VI. *Lepidophyllum*, Brongniart, 1828.
VII. *Stigmaria*, Brongniart, 1822.
(?) *Stigmariopsis*, Grand 'Eury, 1877.[1]

C. BOTHRODENDREÆ.

Plants attaining to arborescent dimensions, ramifying by repeated dichotomy. Leaf-cushions very feebly developed on young twigs, absent on mature stem. Leaf-scars small, oval, without prominent angles, cicatrices three, punctiform. Interfoliar portion of bark ornamented with fine longitudinal flexuous striæ or delicate shagreen. Leaves small, linear deltoid or broadly lanceolate. Fructification in the form of cones of the Lepidostrobus type, terminal or arranged distichously on the stem.

VIII. *Bothrodendron*, Lindley and Hutton, 1833.

D. SIGILLARIEÆ.

Plants attaining to arborescent dimensions. Stem simple, cactus-like, or very rarely dichotomously branched, smooth or longitudinally ribbed. Interfoliar spaces of bark variously ornamented. True leaf-cushions absent, but represented occasionally by more or less prominent cortical projections. Leaf-scars transversely rhomboidal, with generally prominent lateral angles, frequently emarginate in the upper margin. Cicatricules three, central (vascular), punctiform or transversely elongate or sub-triangular, the lateral (parichnos) vertical, straight, or lunate. Leaves single-nerved, linear-lanceolate, or long, narrow, and grass like. Fructification strobiliform, stalked, forming irregular verticils on the trunks or sessile, and placed in two opposite

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[1] See p. 108.

vertical rows. Sporangia immersed within the tissue of the bract or sporophyll. Rhizomes, *Stigmaria* and *Stigmariopsis.*

IX. *Sigillaria*, Brongniart, 1822.
X. *Sigillariostrobus*, Schimper, 1870.
XI. *Stigmaria*, Brongniart, 1822.
XII. *Stigmariopsis*, Grand 'Eury, 1870.

E. Of Uncertain Affinity. (*Lycopodiaceous.*)

XIII. *Spencerites*, Scott, 1899.

SPHENOPHYLLALES.

Sphenophylleæ.

Plants of moderate size, with comparatively slender jointed and ribbed stems. Ribs not alternating at the somewhat tumid nodes. Branching irregular, not more than one given off from a node. Leaves verticillate, cuneate, toothed, cleft, or dichotomously divided into linear segments or thread-like divisions. Fructification in the form of long and narrow cones.

Sphenophyllum, Brongniart, 1822.

Genera of Uncertain Position.

I. *Cheirostrobus*, Scott, 1897.
II. *Psilotites*, Goldenberg, 1855.
III. *Traquairia*, Carruthers, 1872.

I. Lycopodites, Brongniart, 1828.

1828. *Lycopodites.* Brongniart, *Prodrome*, p. 83.

1849. *Lycopodites.* Brongniart (emend.), *Tableau d. végét. foss.*, p. 40.

1855. *Lycopodites.* Goldenberg, *Flora Saræpontana foss.*, Heft. I., p. 9.

Description.—Small herbaceous plants with whorled or spirally arranged leaves. Sporangia placed in the axils of the leaves or forming terminal cones.

Remarks.—The genus *Lycopodites* was first founded by Brongniart in 1828, but subsequent investigations showed the distinguished botanist that few of the plants included in it by him had any affinity to the recent Lycopods, some of the included species having eventually been shown to belong to the *Coniferæ.*

Subsequently[1] Brongniart removed from the genus all the plants originally placed in it except the *Lycopodites falcatus*, L. and H., from the Oolite.[2]

In 1855 Goldenberg added to the genus six new species from the Carboniferous of Saarbruck.[3]

Of these several have a great similarity in appearance to recent Lycopods, especially in their foliage to some *Selaginellæ.* His *Lycopodites primævus*[4] and *Lycopodites macrophyllus*[5] are described as having distichous leaves. In referring to these plants Solms-Laubach points out that "it is only in the case of a few of the heterophyllous Selaginella-like forms that the presence of the small ventral leaves can be ascertained; if the impression is seen from above, they are of course concealed, but in the opposite position also, they are usually withdrawn from observation through their clinging close to the stem. For this reason all Lycopoditæ with distichous leaves may be reckoned without hesitation among the heterophyllus forms."[6]

Schimper places Goldenberg's *Lycopodites denticulatus*, *L. leptostachys*, and *L. elongatus*[7] with leaves surrounding the stem on all sides in *Lycopodium.*[8]

The position here taken by Schimper in the present state of our knowledge seems scarcely tenable, as there are certain important points in their structure of which our knowledge is too incomplete to warrant our referring them to Lycopodium. It therefore seems much more satisfactory to include at present all in *Lycopodites.*

Geinitz figures a very fine example of *Lycopodites Gutbieri*, Göpp., showing the heterophyllous branches and terminal cones, from Bockwa, Saxony.[9] This and the majority of Goldenberg's figures have been reproduced by Schimper.[10]

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1 Brongniart, *Tableau d. végét. foss.*, p. 40. 1849.
2 Lindley and Hutton, *Fossil Flora*, i., Pl. LXI.
3 *Flora Saræpontana foss.*, Heft. i., pp. 11-12.
4 Goldenberg, *l.c.*, Pl. I., fig. 3.
5 *l.c.*, Pl. I., figs. 5^a and 5^b.
6 *Fossil Botany*, 1891, p. 187.
7 Goldenberg, *l.c.*, Pl. I.
8 Schimper, *Traité d. paléont. végét.*, Vol. II., p. 10.
9 *Vers. d. Steinkf. in Sachsen*, p. 32. Pl. I., fig. 1.
10 Schimper, *Traité d. paléont. végét.*, *Atlas*, Pl. LVII.

More recently several fossils have been placed in *Lycopodites*, but apparently without sufficient claim to be included in that genus. In illustration may be mentioned the *Lycopodites carbonaceus*, O. Feistmantel[1] and Zeiller,[2] and *Lycopodites selaginoides*, Roehl (not Sternberg).[3] The *Lycopodites carbonaceus* is founded on branches of *Bothradendron*—probably *B. minutifolium*, and *Lycopodites selaginoides*, Roehl (not Sternb.), may possibly belong to the same genus.

The study of the genus *Lycopodites* is inseparably connected with the genus *Selaginites*, Brongt.,[4] which, as its name implies, was created for the reception of plants supposed to have a relationship to *Selaginella*. Brongniart, however, regarded his genus of doubtful value and only figured one species *Selaginites patens*,[5] which is certainly a *Lepidendron*.

I possess a specimen from Hailes Quarry, near Edinburgh (No. 31), agreeing in every respect with Brongniart's figure of *Selaginites patens*. My specimen was collected by the late Mr. John Gibson, of the Museum of Science and Art, Edinburgh.

Among other fossils which have been placed in *Selaginites* are the rachis of ferns and perhaps their rhizomes which, when covered with scales, have been mistaken for leafy stems. As such may be mentioned the *Selaginites Erdmanni*, Germar.[6] This has been renamed *Spiropteris Erdmanni* by Schimper;[7] while the plant given by Geinitz[8] under the same name (*Selaginites Erdmanni*), and which is distinctly different from Germar's species, has been named *Rhizomopteris lycopodioides*.[9]

Several species originally described as *Selaginites* by Lesquereux[10]

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[1] Feistmantel, *Vers. d. Böhmischen Ablag.* II. Abth. Pl. I., figs. 1, 2 = *Lycopodium carbonaceum*—p. 9.

[2] Zeiller, *Flore foss. Bassin houil. d. Valenciennes*, p. 495. Pl. LXXIV., fig. 1.

[3] Roehl, *Foss. Flora d. Steink. Form. Westphalens*, p. 144. Pl. VII., fig. 3.

[4] Brongniart, *Prodrome*, p. 84. 1828.

[5] *Salaginites patens*, *Hist. d. végét. foss.*, Vol. II. Pl. XXVI.

[6] *Vers. v. Wettin u. Löbejun*, Heft. VI., p. 21. Pl. XXVI. 1849.

[7] *Schimper, Traité d. paléont. végét.*, Vol. I., p. 689. Pl. XLIX., fig. 3.

[8] *Vers. d. Steinkf. in Sachsen*, p. 33. Pl. I., fig. 5. 1855.

[9] *Schimper, Traité d. paléont. végét.*, Vol. I., p. 699. Pl. XLIX., fig. 3.

[10] *Geol. Survey of Illinois*, Vol. II., p. 446. 1866.

were subsequently placed by him in *Lycopodites*.[1] In the "Coal Flora" some additional species of *Lycopodites* are described. His *Lycopodites* (*Selaginites*) *uncinatus*[2] is a circinately-coiled fern, and referable to *Spiropteris*, Schimper. His *Lycopodites asterophyllitæfolius*[3] may possibly be a Lepidodendroid branchlet. Of those described in Vol. III. of the *Coal Flora* (1884) some seem to be very doubtful members of this genus. His *Lycopodites arborescens*[4] much resembles the branchlets of *Bothrodendron*, but I do not speak with any certainty on this point, as it is impossible to express any critical opinion without examining the original specimen. Of his *Lycopodites simplex*[5] and *Lycopodites Lacoei*[6] there seems no evidence, as far as one can judge from the data given, for including them in *Lycopodites*. Of all the species described by Lesquereux the one which appears to have most claim for inclusion in this genus is his *Lycopodites flexifolius*.[7]

Sir William Dawson has referred a few small fossils from the Devonian of Canada to *Lycopodites*, but the published descriptions and figures do not afford much evidence in support of the position assigned to them.

Two small stems from Autun, France, showing their internal organisation, were originally described as *Lycopodium punctatum*, B. Renault, and *Lycopodium Renaultii*, Ad. Brongt.,[8] but Renault has lately removed these from *Lycopodium* and placed them in the genus *Heterangium*, where they find their true position.

I have gone somewhat fully into the genus *Lycopodites*, Brongt., as it is an extremely interesting one and one which might be easily passed over. True members of it seem to be rare, but

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[1] *Coal Flora*, p. 357. 1880.

[2] *Geol. Survey of Illinois*, Vol. II., p. 446. Pl. XXXI., fig. 3.

[3] *Ibid.*, Vol. II., p. 447. Pl. XXXVII., fig. 3.

[4] *Coal Flora*, Vol. III., p. 778. Pl. CVI., fig. 1.

[5] *Coal Flora*, Vol. III., p. 779. Pl. CVI., fig 2.

[6] *l.c.*, Vol. III., p. 780. Pl. CVII., fig. 1.

[7] *l.c.*, Vol. III., p. 779. Pl. CVI., figs. 3, 4.

[8] Renault, *Recher. sur la struct. et les affinités botan. des végét. silicifiés recueillis aux environs d' Autun et du St. Étienne.* Autun, 1878, pp. 146-157. Pls. XXIII.-XXV. See also Solms-Laubach, *Fossil Botany*, pp. 187, 188. 1891.

perhaps it is commoner than suspected through being sometimes overlooked.

In Britain I have observed three species of *Lycopodites*, exclusive of *Lycopodites Vanuxemi*, Göpp. sp., which I now remove from *Lycopodites* and place in a new genus, *Archæosigillaria.*

The following are the British members of *Lycopodites* :—[1]

LYCOPODITES GUTBIERI, Göppert.

Fig. 2.—B.

1837. *Lycopodites Gutbieri*, Göpp., in Germar's *Lehrb. d. Mineral*, p. 440 (fide Geinitz).
1853. ,, ,, Geinitz. *Vers. d. Steinkf. in Sachsen*, p. 32. Pl. I., fig. 1.
1870. ,, ,, Schimper. *Traité d. paléont. végét.*, Vol. II., p. 9. Pl. LVII., fig. 4.
1894. *Lycopodites elongatus*, Kidston (not Goldenberg). *Proc. Roy. Phys. Soc. Edin.*, Vol. XII., p. 254.

Description.—Plant dividing by dichotomous ramification. Leaves dimorphic. The larger lateral leaves lanceolate, slightly sickle-shaped, single-nerved, and spreading. The two rows on the ventral surface much smaller and closely adpressed to the stem. Fructification in the form of long narrow terminal cones.

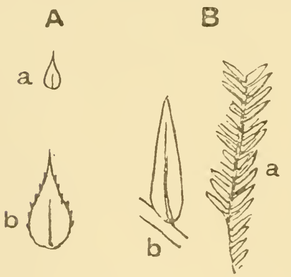

Fig. 2.—A, *Lycopodites ciliatus*, Kidston; *a*, natural size; *b*, leaf enlarged (No. 1743). B, *Lycopodites Gutbieri*, Göpp.; *a*, portion of branch, natural size; *b*, leaf enlarged (No. 1501).

Remarks. — This species is only known to me as British by two small specimens from the Radstock Series (Upper Coal Measures), Camerton, Somersetshire, which were collected by Mr. W. Hemingway. One of these shows the fossil (No. 1501), the other the impression (No. 1502). On the former the lateral leaves only are shown. The impression,

[1] The *Lycopodites? longibracteatus*, Morris, in Prestwick. *Geology Coalbrookdale.* Explanation to Pl. XXXVIII., figs. 8, 9, 10, is a *Lepidodendron. Trans. Geol. Soc. London*, 2nd Ser., Vol. V. 1840.

however, though not so clear, shows traces of the ventral leaves. It must be remembered that the small ventral leaves are only visible in one position. This species has a great resemblance in its general aspect to some forms of *Selaginella*.

LYCOPODITES CILIATUS, Kidston, n.sp.

Fig. 2.—A.

This species is only known by one small specimen, of which both fossil and counterpart have been preserved.

The fossil shows one arm of a fork and part of another, the larger being about $1\frac{1}{4}$ inches long. These two arms of the dichotomy evidently represent the fructification of the species, for mixed with the leaves are macrospores of small size. The fossil is flattened, and it is difficult to ascertain the arrangement of the leaves or bracts, but they appear to have been in several rows and were probably spirally placed.

The sporangia seem to have been borne at the base of the leaves on an ordinary branch which does not appear to have been much modified or to form a distinct cone. The leaves are very small, about $\frac{1}{5}$ of an inch long, oval-lanceolate and distinctly ciliate.

I am again indebted to Mr. W. Hemingway for this interesting specimen.

Loc. Monckton Main Colliery, near Barnsley, Yorkshire.

Hor. Barnsley Thick Coal, Middle Coal Measures.

LYCOPODITES STOCKII, Kidston.

1884. *Lycopodites Stockii*, Kidston. *Annals and Mag. Nat. Hist.*, Ser. 5, Vol. XIV., p. 115. Pl. V.

1891. *Lycopodites Stockii*, Solms-Laubach. *Fossil Botany*, p. 186.

This species has been fully described and figured in the *Annals and Mag. Nat. Hist.* for 1884. It is very distinct from the other members of the genus.

The leaves appear to have been arranged in whorls, as shown by their scars, on a portion of the stem from which they have been removed.

The larger leaves are oval cordate, acuminate, with a strong central midrib, and are rather more than a quarter of an inch long.

The smaller leaves are transversely oval and have very much the appearance of sporangia, but the occurrence of sporangia mixed with the leaves of a stem that terminates in a well-defined cone is a condition quite unknown amongst recent Lycopods. I am therefore led to regard these oval structures as a dimorphic condition of leaf.

Again, in the dimorphic-leaved Lycopods the leaves are placed in four rows, but in *Lycopodites Stockii* there appears to be at least six rows, though more probably there were eight rows, as shown by small scars left by the fallen leaves. The state of preservation of the fossil does not admit of a satisfactory determination of this point.

The specimen is about 4 inches long, of which the cone occupies about $1\frac{1}{4}$ inches, but it is incomplete.

Solms-Laubach refers to this fossil as "a remarkably fine form with the habit of *Lycopodium Phlegmaria*."[1]

It was collected by Mr. Thomas Stock from the Calciferous Sandstone Series, Glencartholm, Eskdale, Dumfriesshire.

II. Archæosigillaria, Kidston, n.g.

Plants with stems attaining a diameter of over 2·5 cm. Leaf-scars contiguous, broadly fusiform on younger branches, hexagonal on older stems, having a single vascular cicatrice.

Remarks.—This genus is formed for the reception of the plant which has usually been designated *Sigillaria Vanuxemi*, Göpp.

As far as I am aware the only known specimens of the plant are the original example figured, but not named, by Vanuxemi,[2] and to which Göppert applied the name of *Sigillaria Vanuxemi*,[3] and those in the Kendal Museum, some of which I described and figured in 1885.[4]

From the examination of the Kendal Museum specimens it appeared to me that the plant could not be included in *Sigillaria*, and I therefore placed it in *Lycopodites*.

Subsequent study has, however, shown that it must also be removed from *Lycopodites*, and that there is no existing genus in

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[1] *Fossil Botany*, p. 186.

[2] *Geol. of New York*, Part III., p. 184, fig. 51, 1842

[3] Göppert: *Foss. Flora d. Ubergangs*, p. 249, 1852.

[4] Kidston: *Linn. Soc. Jour. Bot.*, Vol. XXI., p. 560, Pl. XVIII.

which it can be suitably placed. I have therefore been under the necessity of creating the genus *Archæosigillaria* for its reception.

Archæosigillaria is distinguished from *Lycopodites* by the contiguous and distinct leaf-scars, which become hexagonal on the older stems from mutual pressure, and the apparently much larger growth of the plant; from *Lepidodendron* by the absence of a leaf-cushion and lateral cicatricules (parichnos) of the leaf-scar, and from *Sigillaria* by its single central vascular-scar, unaccompanied by the two lateral lunate parichnos. The small deltoid lanceolate leaf agrees with that of some species of *Lycopodites*, but not with the leaves of *Lepidodendron* or *Sigillaria*.

Archæosigillaria forms, therefore, a genus clearly separated from all the other genera of Palœozoic Lycopods.

From our imperfect knowledge of *Archæosigillaria Vanuxemi* and complete ignorance of its fructification, its systematic position is uncertain, but its place is probably in the *Lycopodiales*, and I provisionally place it there beside *Lycopodites*.

ARCHÆOSIGILLARIA VANUXEMI, Göppert sp.

1842. Vanuxem. *Geol. of New York*, Part III., p. 184, fig. 51.

1852. *Sigillaria Vanuxemi*. Göpp.: *Foss. Flora d. Ubergangs*, p. 249.

1862. *Sigillaria Vanuxemi*. Dawson: *Quart. Journ. Geol. Soc.*, Vol. XVIII., p. 307, Pl. XII., fig. 7.

1863. *Sigillaria Vanuxemi*. Hall: *16th Annual Rept. of Condition of State Cabinet of Nat. Hist.*, pp. 99 and 113, fig. 5. Albany.

1871. *Sigillaria Vanuxemi*. Dawson: *Foss. Plants of Devon and Upper Silur. Form. of Canada*, p. 21.

1880. *Sigillaria Vanuxemi*. Lesquereux: *Coal Flora*, Vol. II., p. 505.

1887. *Sigillaria Vanuxemi*. Weiss: *Sigillarien d. Preuss. Steinkohlengebiete, I. Gruppe der Favularien. König. Preuss. Geol. Landesanstalt*, Berlin, p. 65 (291), Pl. IX. (XV.), fig. 30.

1885. *Lycopodites Vanuxemi.* Kidston: *Linn. Soc. Jour. Bot.*, Vol. XXI., p. 560, Pl. XVIII.

Description.—Stem dividing dichotomously and attaining a diameter of over 2·5 cm. Leaf-scars arranged in spirals; on the younger branches fusiform, touching each other laterally, but separated vertically by a slight interval; those on the older branches hexagonal and contiguous. Vascular cicatricule single and situated slightly above the centre, leaves deltoid acuminate. Fructification unknown.

Horizon and Localities.—The type of the species was discovered in the Upper Devonian (Chemung Group) of New York.

The British specimens were collected in the neighbourhood of Shap Toll-Bar, Westmoreland, from the lower beds of the Mountain Limestone as developed in that area. These rocks are probably of the same age as part of the Calciferous Sandstone Series of Scotland.

III. Lepidodendron, Sternberg, 1820.

1820. *Lepidodendron.* Sternberg: *Essai flore monde prim.*, I. fasc. I., pp. 20 and 25; fasc. IV., p. 10.

1828. *Lepidodendron.* Brongniart: *Prodrome*, p. 84.

1822. *Sagenaria.* Brongniart: *Class. d. végét. foss.*, p. 9.

1824. *Lepidolepis.* Sternberg: *Essai flore monde prim.*, I. fasc. III., p. 39.

1826. *Knorria.* Sternberg: *Essai flore monde prim.*, I. fasc. IV., p. 37.

1838. *Bergeria.* Presl, in Sternberg: *Essai flore monde prim.*, II. fasc., 7-8, p. 183 (in part).

1838. *Aspidiaria.* Presl, in Sternberg: *Essai flore monde prim.*, II. fasc., 7-8, p. 180 (in part).

Description.—Plants of arborescent growth, attaining to a height of a hundred feet. *Stem* dividing dichotomously and forming a much ramified head. Outer surface of bark bearing contiguous or more or less distinct rhomboidal or fusiform *cushions* on whose surface, generally slightly above the centre, is situated the *leaf-scar.* Within the leaf-scar are three punctiform cicatricules, the central of which is the scar of the leaf-bundle—the two lateral are possibly glandular organs—the *parichnos*. *Leaves* simple, entire, single-nerved, lanceolate, short, or long and grass-like. *Fructification* in the form of *cones* (*Lepidostrobus*), the lower bracts of which bear *macrosporangia* and the upper *microsporangia*. The cones are borne at the termination of the branches, or sessile and placed in two opposite vertical rows—(*Ulodendron* in part). In the sub-cortical condition the trunk is irregularly striated longitudinally and the leaf cicatrice is single (the vascular bundle cicatrice).

Internal structure of stem. — As *Lepidodendron vasculare*, Binney, sp. (= *Lepidodendron selaginoides*, Carruthers and Williamson)[1] is the species most commonly met with showing its internal organisation, it may be conveniently taken in illustrating the anatomy of *Lepidodendron*.

In a young stem the central axile bundle consists of irregularly disposed tracheides, of which the outer and much smaller are mostly spiral, and the inner and larger scalariform. The centre of the bundle is composed of isodiametric spiral tracheides mixed with parenchyma.

The primary bundle is surrounded by a zone of delicate small-celled parenchyma—the inner cortex of Williamson.

Succeeding the inner cortex is a zone of large-celled but very delicate parenchyma—the middle vortex of the same author. This is enclosed by a zone of large thick-walled parenchyma which forms the ground tissue of the leaf-cushions.[2]

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[1] 1862, *Sigillaria vasculare*, Binney, *Quart. Journ. Geol. Soc.*, Vol. XVIII., p. 106, Pl. IV.; 1869, *Lepidodendron selaginoides*, Carruthers, *Monthly Mic. Journ.*, Octr., p. 177, Pl. XXVII. It is quite possible that the stems here described may really belong to *Lepidodendron selaginoides*, Sternberg, (*Essai flore monde prim.*, fasc. II., p. 29, Pl. XVI., fig. 3, Pl. XVIII., fig. 1.) which only represents the smaller branches of *Lep. lycopodioides*, Sternberg, *ibid.*, fasc. II., p. 29, Pl. XVI., figs. 1, 2, and 4), as that species is common in the Lower Coal Measures, the horizon in which the stems showing structure are found. This probability is further heightened by the fact that the imperfectly preserved leaf-cushions on specimens showing structure when removed from the matrix have very much the form of those of that species. As, however, its identification is by no means certain, it is much better to use Binney's name of *vasculare* for these specimens.

[2] See also Bower, "On the Structure of the Axis of *Lepidostrobus Brownii*, Schimper, *Ann. of Bot.*, Vol. VII., No. 27, Sep., 1893, pp. 343, 344.

When the stem of *Lepidodendron* has attained to the condition described, certain important changes take place by the formation of exogenously developed tissues. At some point of the circumference of the primary bundle a development of secondary xylem commences which is formed from a cambium ring. At first the secondary xylem appears as a crescent-like growth on the outside of the primary bundle; this gradually extends all round, and at length the original bundle is surrounded by an exogenously developed secondary zone of xylem, whose radial thickness is only limited by the death of the plant. The elongated scalariform tracheides forming the secondary xylem are radially arranged and separated by medullary rays.

A second source of increase in the girth of the stem arises from the formation of a cork cambium or *phellogen*, which appears immediately outside of the so-called middle cortex. The tissue developed on the inner side of the phellogen consists of long thick-walled prosenchymatous fibres, which add rigidity to the stem. If any true cork is developed in the outer margin of the phellogen, it is only to a very small extent.

The leaf-bundles spring from the small outer tracheides of the primary bundle, and, bending upwards and outwards, pass through the zone of secondary xylem into the leaves. In their course outwards they are accompanied by a parenchymatous sheath derived from the inner bark. The leaf-trace in passing through the inner cortex is further accompanied by a tract of parenchyma derived from the middle cortex. This tract immediately before passing into the leaf divides into two parts and forms the *parichnos*, one lying on each side of the foliar bundle.

Minor modifications of type occur in different species of *Lepidodendra*, some never possessing a pith cavity, but it is probable that in all a secondary zone of xylem was developed, though in some at a later period of their growth than in others.

It is true that in the plants originally described as *Lepidodendron fuliginosum*, Will., and *Lepidodendron Harcourtii*, Witham (? Will.), no secondary zone of xylem has been observed,[1] but the first is certainly a *Lepidophloios*, and there is strong evi-

[1] See following note.

dence to believe that the latter should also be transferred from *Lepidodendron* to *Lepidophloios*.[1]

There are many interesting points in the structure of *Lepidodendron* which cannot be dealt with in this paper, and some that are yet imperfectly understood.[2]

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[1] In the large stem of *Lepidophloios* from Dalmeny, recently described by Seward and Hill in the *Trans. Roy. Soc. Edin.*, Vol. XXXIX., Part IV., p. 907, 1900, there is a thick zone of secondary xylem. It seems very probable that we have here a large specimen of *Lepidodendron Harcourtii* of Witham, which is really a *Lepidophloios*, and that the stem later described by Williamson, from the Yorkshire and Lanarkshire Coal Measures, as *Lepidodendron Harcourtii*, Witham, is perhaps not Witham's plant.

[2] The literature of the subject is very large, but the following works may be specially mentioned in connection with the internal organization of Lepidodendron:—

C. Eg. Bertrand, Remarques sur le *Lepidodendron Harcourtii* de Witham. *Travaux et Mémoirs des Facultés de Lille*, Vol. II., Mem. No. 6, Lille, 1891.

Binney, "Observations on the Structure of Fossil Plants found in the Carboniferous Strata," *Palæont. Soc.*, Part II., "*Lepidostrobus* and some allied Cones," 1871.

Binney, *ibid.*, Part III., *Lepidodendron*, 1872.

Binney, *ibid.*, Part IV., *Sigillaria and Stigmaria*, 1875.

Bower, "On the Structure of the Axis of *Lepidostrobus Brownii*, Schimper," *Ann. of Bot.*, Vol. III., No. 27.

Hick and Cash, "The Structure and Affinities of *Lepidodendron*," *Proc. Yorkshire Geol. and Polytechnic Soc.*, Vol. XI., Part II., p. 316, 1889.

Hovelacque, "Recherches sur le *Lepidodendron selaginoides*, Sternb." *Mém. Soc. Linn de Normandie*, Vol. XVII., fasc. I., 1892, Caen.

Renault, *Cours d. botan. foss. Deux. anneé* (Vol. II.), 1882.

Renault, *Études d. gîtes Minéraux de la France, Bassin Houiller et Permien d'Autun et d'Épinac*, fasc. IV., "Flore Fossile," Deux Part, Text. 1896. Atlas, 1893.

Solms-Laubach, *Fossil Botany*, English Edition, Oxford, 1891.

Schenk, *Die Fossilen Pflanzen*, 1888, Breslau.

Williamson, "On the Organization of the Fossil Plants of the Coal Measures," *Phil. Trans.*, Memoir II., 1872; Mem. III., 1872; Mem. X., 1880; Mem. XI., 1881; Mem. XII., 1881; Mem. XIV., 1889; Mem. XIX., 1893; "General Morphological and Histological Index, &c., *Mem. and Proc. Manchester Lit. and Phil. Soc.*, Part II., Session 1892-1893. 1893.

Witham, *The Internal Structure of Fossil Vegetables found in the Carboniferous and Oolitic Deposits of Great Britain*, 1883.

Witham, "On the *Lepidodendron Harcourtii*," *Trans. Nat. Hist. Soc. Northumberland*, Vol. II., 1838.

Remarks.—The leaf-cushion consists of a clearly-defined and more or less elevated rhomboidal or fusiform area, generally longer than broad, whose lateral angles are usually prominent. On the greater number of specimens the leaf-cushions are flat or very little elevated (fig. 3). This condition is most probably due to pressure. From the deep impressions of *Lepidodendra* frequently found, the leaf-cushions, when uncompressed, must have possessed a considerable amount of elevation in many, if not in all species.[1]

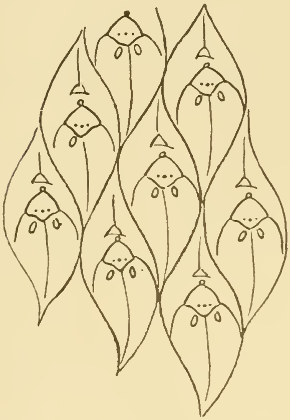

Fig. 3.—*Lepidodendron aculeatum*, Sternb., Lower Coal Measures, Stevenston (No. 2482).

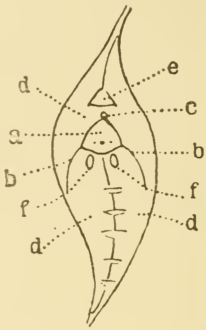

Fig. 4.—Leaf cushion of *Lepidodendron aculeatum*, Sternb., slightly enlarged. For description see text.

Within the cushion, usually, situated slightly above the centre is the rhomboidal or transversely elongate rhomboidal leaf-scar (*a*) fig. 4, whose upper and lower angles are more or less rounded, the two lateral acute and generally produced as two downward keels (*b*). Within the leaf-scar (*a*) and usually below the centre are three punctiform cicatricules, the central of which is the scar of the foliar bundle. The two lateral cicatricules are possibly glandular organs and have been termed the *parichnos (f)*.

[1] The following specimens in my collection show this very well:—*Lepidodendron Veltheimianum*, Sternb. (No. 2453); *Lep. Veltheimianum*, Stbg., (?) (No. 61); and *Lepidodendron ophiurus*, Bgt., (?) (No. 1474).

Extending both above and below the leaf-scar is a central keel, which often bears transverse notches on its lower part. Above the leaf-scar and in the line of the central keel is a small cicatricule (*c*), which has been named by Stur the *ligule* scar. This little cicatricule is immediately above the leaf-scar in *Lepidodendron aculeatum*, Sternb., fig. 4*c*. In *Lepidodendron rimosum*, Sternb., it is placed a short distance above the leaf-scar (fig. 5). Above the ligule-scar is a transverse triangular notch (fig. 4*e*), which has been regarded as the homologue of the "sporangium attachment" by Stur.[1]

Fig. 5. — *Lepidodendron rimosum*, Sternb. Leaf cushion, natural size (No. 2438).

The area surrounding the leaf-scar is called the *field* (*d*). In most species of *Lepidodendron* immediately underneath the leaf-scar are two oval pits (*f*), one on each side of the keel. These also appear to be glandular or secreting organs.[2] Some *Lepidodendra*, such as *Lepidodendron dichotomum*, Zeiller (not Sternb.?), do not possess them.[3]

On many specimens the so-called ligule-scar cannot be observed, but as it is very small, only well-preserved examples can be expected to show it. In a less degree the same remark applies to the "sporangium notch." I am inclined to think, however, that sometimes these are absent from some individuals—an absence which cannot be ascribed to an imperfect preservation of the fossil. Specimens in my collection support this view.

If we regard the so-called "ligule-scar" of *Lepidodendron* as homologous with the ligule-scar occurring in *Selaginella*—and this interpretation finds support in the investigations of Mr. Maslen,[4] who describes the occurrence of a ligule on the sporophyll of *Lepidostrobus* immediately in front of the sporan-

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[1] Stur, *Culm Flora*, p. 228, and Explan. to Pl. XIX., fig. 1.

[2] Transpiration openings of Potonié, *Lehrb. d. Pflanzenpalæontologie*, p. 220. 1899.

[3] Zeiller, *Flore foss. Bassin Houil. d. Valenciennes*, Pl. LXVII., fig. 1.

[4] *Annals of Botany*, Vol. XII., No. XLVI., 1898, p. 257. This is referred to more fully under *Lepidostrobus*.

gium—then we must regard the leaf-cushion as a persistent basal portion of the leaf remaining permanently attached to the bark. The so-called "ligule-scar"[1] in *Lepidodendron* is really a small pit from whose base the ligule springs. This structure has been described by the late M. Hovelacque in his work on *Lepidodendron selaginoides.*[2]

The leaf-cushions are arranged in steep spirals and are contiguous, as in *Lepidodendron ophiurus*, Brongt., or more or less distant, as in *Lepidodendron rimosum*, Sternb., or *Lepidodendron serpentigerum*, König, where the cushions end in tail-like prolongations, by which the various members of the same spiral series are connected to each other. In some species, however, the leaf-scars are contiguous or more or less distant, according to the conditions of growth or age of the individual. This is seen in *Lepidodendron aculeatum*, Sternb.

× 2

Fig. 6. — *Lepidodendron Wortheni*, Lx. Leaf cushion, natural size, showing ornamentation (No. 2731).

In some species, as in *Lepidodendron serpentigerum*, König, the leaf-cushions are always distant as far as at present known, and the interfoliar space is ornamented with fine irregular wavy lines, and a somewhat similar form of ornamentation of the bark appears to be a constant character on all species where the leaf-cushions are distant.

As a rule, the surface of the leaf-cushion is free from all ornamentation except the transverse notches, which are frequently present on the lower portion of the keel. In some cases this may be due to shrinkage of the tissues through decay, but probably it is not always so caused. In *Lepidodendron Wortheni*, Lx., how-

[1] The "ligule" of MM. Bertrand and Hovelacque has been named the "Adenoid Organ" by Prof. Williamson, who could not see in it the homologue of the ligule of *Selaginella* and *Isoëtes.*—See Williamson, Mem. XIX., *Phil. Trans.*, Vol. 184, pp. 9-10, 1893.

[2] Hovelacque, "Recherches sur le *Lepidodendron selaginoides*, Sternberg," *Mem. de Soc. Linnéenne de Normandie*, Vol. XVII., fasc. I., 1892. Caen.

ever, an important character of this species is the presence of well-defined irregular transverse *ridges* which extend over the whole area of the leaf-cushion, which also does not appear to be keeled. (Fig. 6.)

In the great majority of *Lepidodendra* the bark and leaf-cushions keep pace in growth with the increase in diameter of the stem, but in *Lepidodendron Veltheimianum*, Sternb., and a few other Carboniferous Lycopods,[1] although the leaf-cushions and bark increase in size with age, as in other species, to a certain extent, the bark becomes longitudinally fissured from the increase in the girth of the stem. These fissures in casts of the specimens necessarily appear as elevated, more or less irregular, ridges. Pressure often flattens these ridges, which then extend over neighbouring portions of the bark and entirely obliterate the leaf-cushions, and such specimens of *Lepidodendron Veltheimianum* have frequently been mistaken for *Sigillaria*. This condition is only seen in aged specimens,[2] some of which are figured by Schimper.[3] I believe the *Lyginodendron Landsburgii* of Gourlay is founded on an extreme, though similar, condition of an old Lepidodendron stem with which the *Lyginodendron* of Williamson has no affinity.[4]

The fructification is in the form of cones. In the great majority of the species these terminate the small branches as in *Lepidodendron ophiurus*, Brongt. (No. 912), and *Lepidodendron lycopodioides*, Sternb. (No. 2232). In a few species, as *Lepidodendron Veltheimianum*, Sternb., and *Lepidodendron Landsburgii*, Kidston, the cones are sessile, and are borne on the large stems in two opposite rows, the cones in one row alternating with those of the other row. It is a most peculiar and marked character of the so-called Ulodendroid Lycopods that the fructification is only produced on stems of considerable size and age.

A stem of *Lepidodendron Veltheimianum*, Sternb., in my possession, about 4 inches wide, shows the point to which the cones

[1] *Sigillaria discophora*, König sp., is another example.

[2] I possess several specimens of *Lep. Veltheimianum* showing various states of this condition.—See Nos. 62, 62*a*, and 76.

[3] Schimper—(Koechlin-Schlumber and Schimper), *Le terr d. Transition de Vosges*, Pl. XXIII., 1862.

[4] Gourlay, Description of *Lyginodendron Landsburgii*, *Proc. Phil. Soc. of Glasgow*, Vol. I., Part II., p. 108, 1841-44.

had been attached as mamillæ-like elevations.[1] This must indicate that the cone when removed was in a very early state of development, for the cup-like depressions are formed by the base of the sessile cone pressing against the bark which grows up round it. These cups participate in the increase of the stem, and long after the fall of the cone continue to increase in size, and thus is formed the characteristic cup-like depressions on the bark, which gave rise to the genus *Ulodendron*, L. and H.[2] In the Ulodendroid scars of *Lepidodendron* the scar of the cone attachment—the *umbilicus*—is approximately central.

But this mode of fructification is not restricted to *Lepidodendron*, for it also occurs in *Sigillaria* and *Bothrodendron*.

The cones are *heterosporous*, the lower tracts bearing the *macrosporangia* and the upper the *microsporangia*. There is, of course, the possibility of some *Lepidodendra* having had *homosporous* cones, but there is no clear evidence that this was the case. The detailed structure of the cones will be described under the genus *Lepidostrobus*, Brongt., for, unfortunately, in the majority of cases, the cones are found separated from their stems, and it is then frequently impossible to refer them to their parent species. This circumstance has necessitated the formation of the genus *Lepidostrobus*, Brongt., for their reception.

When the epidermal layer of the bark is removed, the exposed surface is irregularly striated longitudinally and only shows the cicatrice of the foliar bundle. The genus *Aspidiaria*, Presl, is in part founded on such specimens of *Lepidodendron*.[3]

The leaves of *Lepidodendron* are entire and single-nerved. On *Lepidodendron lycopodioides*, Sternb., *Lepidodendron ophiurus*, Brongt., and many other species, they are lanceolate. On *Lepidodendron longifolium*, Brongt., and *Lepidodendron obovatum*, Sternb., they are very long and grass-like—on the larger stems of the latter species attaining a length of 30 inches.[4] The leaves must have remained on the branches a long time, increasing in size with age. This is clearly seen on specimens on which the

[1] See Kidston, *Ann. and Mag. Nat. Hist.*, Ser. 5, Vol. XVI., Pl. IV., Fig. 2, 1885.

[2] Lindley and Hutton, *Fossil Flora*, Vol. I., p. 22, 1831.

[3] *Presl, in Sternberg*, Vers. II., p. 180, 1838.

Zeiller, *Flore foss. Bassin houil de Valenciennes*, p. 442.

foliage is still attached, where the leaves on the stems are always much larger than those on the twigs—the general rule being the larger the stem the larger the leaves, up to the period at which the leaves are shed.

In some species the leaves remain attached to the stem for a greater length of time than in other species. In *Lepidodendron lycopodioides*, Sternb., the leaf-base seems to have remained on the cushion for some time after its upper portion had been separated or decayed, and in this species one can seldom observe the form of the leaf-scar which is placed towards the upper end of the cushion.

A specimen from Oaks Colliery, Barnsley, collected by Mr. Hemingway, shows a leaf-cushion of this species with a leaf attached (No. 2165). In this state no line of demarcation can be detected between the leaf and the cushion. The upper portions of the other leaves on this example are broken off (probably, in the case of the specimen under discussion, by mechanical means), but the lower part remains attached to the cushion and extends down each side some distance past the apex, giving the upper part of the cushion the appearance as if winged. The lower portion of the leaf is here much wider than the leaf-scar left after the removal of the leaf, as shown by specimens from which the leaf has been shed, from which one is led to presume that it was partially attached to the cushion. In other species the leaf seems to be cut off by some special provision, though in *Lepidodendron lycopodioides* it seems to wither away.

In *Lepidodendron Haidingeri*, Ett. (No. 1022), where also the leaf-scar is situated toward the upper end of the cushion, there appears to be a somewhat similar mode of attachment of the leaf.

The leaf-scar and cushion increase in size with the increase of the stem in growth, though in a few species, as in *Lepidodendron Veltheimianum*, Sternb.—to which reference has already been made in this connection—the stem increases in girth quicker than the bark, which becomes longitudinally cleft.

The leaves are often found separated from their parent stems, and as in this condition they can seldom be identified with the species to which they belong, they are placed in a separate genus —the genus *Lepidophyllum*, Brongt.

The rhizome of *Lepidodendron* is *Stigmaria*, but as *Stigmaria* is also the rhizome of *Sigillaria*, if not also of other Arborescent Lycopods, it will be considered separately.

The genus *Knorria*, Sternberg,[1] is founded on a decorticated condition of *Lepidodendron*, and other Lycopod stems. It arises in this way. The inner tissues having decayed, the firm, outer portion of the bark is left as a hollow cylinder. When this has become filled with sediment and subjected to pressure, the contained infilling material is pressed into the openings in the outer bark, through which the vascular bundles pass to the leaves. On the subsequent decay of the bark, the casts of the bundle passages are left as so many spine-like points attached to the central inorganic core which filled up the hollow cylinder. It must be remembered that these passages not only represent the space occupied by the leaf-bundle, but also the cellular sheath which accompanied it, and which divided out two arms when in the leaf-cushion to form the parichnos.

I possess an interesting specimen of which the core is *Knorria acicularis*,[2] but the impression on the rock which surrounded the *Knorria* is *Lepidodendron Veltheimianum*, Sternb. The space between the *Knorria* and the *Lepidodendron* was filled in with coaly matter when found (Nos. 50-51).

There remains still to be considered the question of the affinity of *Lepidodendron*.

That it is Lycopodiaceous is clearly shown from the development of the sporangium, but as to which of the existing genera of Lycopods *Lepidodendron* stands closest is a very difficult point to determine.

In the structure of the vascular axis perhaps it stands closer to *Lycopodium* than to *Selaginella*. Some *Lepidodendra* are certainly heterosporous, though some species may have had homosporous cones, but on this point there is at present no certainty.[3] The known heterospory of at least some *Lepido-dendra* point to closer affinities with *Selaginella* than with

[1] Sternberg, *Flore monde prim.*, Vol. I., fasc. IV., p. 37, 1826.

[2] *Knorria acicularis*, Goppert, *Die fos. Flora des Ubergangsgebirges*, p. 200, Pl. XXX., fig. 3, 1852.

[3] See remarks under *Lepidostrobus*, p. 61.

Lycopodium.[1] If we add to this the presence of a ligule on the *leaves* (?) of *Lepidodendron* and on the sporophylls of *Lepidostrobus* (and as far as I can judge from the investigations of Bertrand, Hovelacque, and Maslen, the *cushions* of *Lepidodendron* and sporophylls of *Lepidostrobus* possess a small scale), then the position of *Lepidodendron* points to a closer relationship with *Selaginella* than with any other existing genus.

Though I have seen the so-called ligule in transverse sections of leaf-bases, or cushions as they have been usually termed, as figured by Hovelacque,[2] I have not seen it in profile as figured in *Lepidostrobus* by Maslen.[3]

As already mentioned, if we regard the small point above the leaf-scar as the cicatricule, or, more correctly, the opening of the ligule cavity, we must consider what has usually been termed the leaf-cushion as a persistent part of the leaf, and not a cortical outgrowth. In *Lepidodendron* the "leaf-cushion" is generally clearly circumscribed, and one can imagine it to be the very much shortened portion of a persistent leaf-base, though I do not know of any other plant that sheds part of the leaf while the remaining portion persists as a cushion on the bark.[4]

When, however, one applies the same explanation in regard to the "ligule-scar" of *Sigillaria*, and I presume there is no doubt that the small cicatrice so frequently seen a short distance above the leaf-scar is homologous to the so-called ligule-scar in *Lepidodendron*, additional difficulties arise in explaining its position as representing the ligule of *Selaginella.*

In *Sigillaria* there is no "*field*" surrounding the leaf-scar, or any other mark to define an area corresponding to the field in *Lepidodendron*, and still we must presume here also that the "ligule-scar" on *Sigillaria* is placed on the leaf-base if the homology is to hold good, for if it is not on the leaf-base, but on

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[1] Perhaps, however, too much importance is being placed on the heterosporous and homosporous condition in the classification of the recent Lycopods.

[2] *Recherches sur le Lepidodendron selaginoides*, Sternb., Pl. VII., fig. 2.

[3] Maslen, *Annals of Botany*, Vol. XII., 1898, p. 258.

[4] In many species of *Lepidodendra* the leaf when shed leaves behind so clearly defined a scar, that I think one must conclude that the leaf has been cut off by some structure specially adapted to perform this function.

the stem, it seems very doubtful to me if it is possible to regard this little cicatricule above the leaf-scar as indicating the position of an homologous structure to the scale on the leaf of *Selaginella.*

If the figure given by Mr. Maslen, already referred to, is a correct representation of the specimen, there appears to be no room for doubt that the ligule there shown is homologous with the ligule of *Selaginella*, but though in *Sigillaria mamillaris*, Brongt., *Sigillaria Brardii*, Brongt., and other *Sigillariæ*, the leaves are placed on more or less prominent elevations, and in *Sigillaria MacMurtrei*, Kidston, this elevation almost amounts to a pedicel, still all these swellings to which the leaves are attached have a different appearance and structure from the clearly-defined *Lepidodendron* leaf-scar, and it makes one reluctant to accept as proved beyond all further question the true homologue of the little cicatricule under discussion.

A similar little cicatricule occurs above the leaf-scar of *Bothrodendron*, and in *Pinakodendron*, Weiss, which is closely related to *Bothrodendron*, there are two, frequently three, small cicatricules, above the leaf-scar,[1] which it is diffienlt to regard as different in significance or function from the single cicatricule found in *Bothrodendron* and in many *Sigillaria*, and such a plurality of ligules is entirely unknown amongst recent Lycopods.

It would appear then that though *Lepidodendron* has some points which accord more with *Lycopodium* than with *Selaginella*, especially in regard to the arrangement of its leaves, it has others which point to a closer relation with *Selaginella.* With *Tmesipteris* the bundle of those species of *Lepidodendron*, which have a solid axis devoid of a pith cavity, has a greater similarity than to that of either *Lycopodium* or *Selaginella.*

Like so many palæozoic types, *Lepidodendron* embraces within itself characters which we do not now find united in the individual, but which occur in the group, and to attempt to force a special relationship to any existing genus is a course which cannot be advocated.

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[1] Weiss and Sterzel, *Die Sigillarien d. Preuss. Steink. u. Rothliegenden Gebiete.* II. *Die Gruppe der Subsigillarien, Abhandl. d. k. Preuss. Geol. Landesanstalt Neue Folge.*, Heft. 2, p. 61, 1893. (*Pinakodendron Ohmanni*, Weiss, p. 62, Pl. III., figs. 17, 18.)

IV. Lepidophloios, Sternberg, 1826.

1826. *Lepidophloios*, Sternberg. *Essai flore monde prim.*, Vol. I., fasc. iv., p. 13.
1833. *Halonia*, Lindley and Hutton. *Fossil Flora*, Vol. II., pp. 11-14.
1836. *Pachyphlœus*, Göppert (in part). *Die foss. Farrnkräuter*, p. 468. (*Nova Acta Acad. C.L.C. Nat. Curios.* Vol. XVII. Breslau.)
1838. *Zamites*, Presl, in Sternberg (*in part*). Vol. II., fasc. 7 and 8, p. 195.
1848. *Lomatophloios*, Corda, *Beitr. z. Flora d. Vorwelt*, p. 17.
1855. *Cyclocladia*, Goldenberg (not L. and H.). *Flora Sarœpont. foss.*, Lief. I., p. 18.

Plants of arborescent growth with dichotomous ramification. Stems and branches bearing well-developed scale-like leaf-cushions, at or near whose summit is placed the leaf-scar. Leaf-cushions imbricated, pedicel-like, upright or deflexed, exposed portion with slightly curved or straight sides or rhomboidal in outline, smooth or carinate, sometimes provided with a small tubercle immediately beneath the leaf-scar. Leaf-scar transversely oval, rhomboidal, or rhomboidal-elongate, lateral angles rounded or acute, upper and lower angles generally rounded, sometimes pointed. Within the leaf-scar are three punctiform cicatricules, of which the central (vascular) is sometimes the largest, and occasionally triangular in form. Fructification borne on specialized branches, and consisting of deciduous stalked cones arranged in several spirals (*Halonia*). In the corticated condition the Halonial protuberances rise little above or are on a level with the bark, and are surrounded by a circle of deflected leaf-cushions; when decorticated the fruiting branches bear several spiral rows of tubercle-like prominences. Leaves linear, lanceolate, entire, single-nerved. Sub-cortical cicatricule single.

Remarks.—The genus *Lepidophloios* is not so commonly met with as *Lepidodendron* and *Sigillaria*, and contains a very much smaller number of species; still it is fairly common in Britain. *Lepidophloios Scoticus*, Kidston, is frequent in the oil-shales and associated rocks of the Calciferous Sandstone Series; *Lepidophloios acerosus*, L. and H. sp., is not very uncommon in the

Middle and Lower Coal Measures; while *Lepidophloios laricinus*, Sternberg, is very rare. These are the only species of whose occurrence in Britain we have certain knowledge.[1]

Lepidophloios has given rise to the creation of many genera, formed on the various conditions under which it appears, as evidenced by the generic synonymy given above, but on this point I shall not enter further, as I have already dealt with this question in a paper published in the *Trans. Roy. Soc. Edin.*[2]

Lepidophloios is easily distinguished from *Lepidodendron* by the form and structure of the leaf-cushion and the position of the leaf-scar. The leaf-scar is always placed at the top, or very near the top, of the cushion. When the cushion becomes deflexed it *appears* as if placed at the base. The leaf-scar is shown at *c*, fig. 7, and immediately beneath it and on the line of the keel is a small tubercle. This small tubercle is not always present, and on *Lepidophloios Scoticus* it has never been observed, though I have examined very many beautifully-preserved specimens.[3]

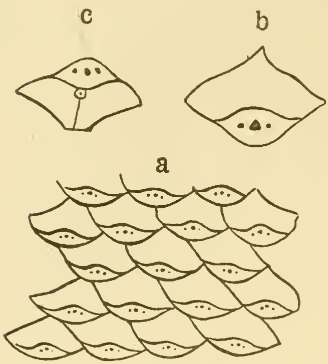

Fig. 7.—*a*, *Lepidophloios Scoticus*, Kidston, natural size; *b*, cushion and leaf-scar, enlarged (No. 529); *c*, *Lepidophloios acerosus*, L. and H. sp., cushion and leaf-scar, enlarged (No. 768).

The form of the cushion varies according to the species and age of the plant. On old stems, from the lateral strain caused by increase in girth, it is often transversely elongated.

In the fragments of bark as usually found it is impossible to determine the direction of growth, but occasionally one meets

[1] Mr. Hemingway has brought under my notice a Yorkshire specimen of a *Lepidophloios*, which may be the *Lepidophloios auriculatus*, Lesqx. *Geol. Rep. Illin.*, Vol. IV., p. 439, Pl. XXX., fig. 1, 1870; also *Coal Flora*, p. 421, Pl. LXVIII., fig. 3.

[2] "On *Lepidophloios*, and on the British Species of the Genus," Vol. XXXVII., Part iii., pp. 529-563, Pls. I.-II.

[3] It clearly occurs beneath the leaf-scar, but has the same appearance as the "ligule-scar" in *Lepidodendron*. Its true function and significance do not appear to me to be satisfactorily determined.

with a bifurcation or branch bearing foliage which permits of this being determined.

I have only seen one such specimen of *Lepidophloios acerosus*, L. and H. sp., from Abersychan, near Pontypool, South Wales, which is preserved in the Bristol Museum. This I have already figured.[1] It represents the termination of a branch with the foliage attached, and shows that the leaf-cushions are directed upwards. This is probably the normal position in all species, for on all the small branches of *Lepidophloios Scoticus* they are also directed upwards, whereas on all the larger and older stems of this plant they are directed downwards.

On *Lepidophloios laricinus*, on the older stems the cushions are directed downwards, as is proved by figures given by Goldenberg.[2] It must, however, be borne in mind that even here the leaf-scar morphologically occupies the top of the cushion, and its present position evidently results from a subsequent deflection of the cushion.

Lepidophloios Scoticus, Kidston, is the species which I have had the most opportunity of studying, as it is comparatively plentiful in the oil-shales and associated rocks of the Calciferous Sandstone Series of Midlothian. I have, therefore, had many opportunities of examining specimens of this species in various conditions of age and preservation.

The cushions are generally rounded, and very rarely keeled; in fact, the only specimen I possess which shows a distinct keel is one from the oil-shales, Bathgate, Linlithgowshire, which I received from Mr. Dunlop (No. 2404). This specimen is very interesting in being the only one I have seen from the Carboniferous Limestone Series, and the prominent keel on the cushion made me at first hesitate in identifying it as *Lepidophloios Scoticus*, though I now believe it is referable to that species. The fossil is about 4 inches long and 2½ inches wide, and shows within this small space the alteration in direction of the leaf-cushions. It is impossible to determine which is the upper end of the specimen, for at one end the leaf-cushions are directed

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[1] *Trans. Roy. Soc. Edin.*, Vol., XXXVII., Part iii. (No. 25), p. 558, Pl. I., fig. 1. 1893.

[2] Goldenberg, *Flora saræp. foss.*, Lief. I., p. 22, Pl. III., fig. 14; and Lief. III., p. 30, Pl. XVI., fig. 6.

upwards and at the other extremity downwards. This specimen shows, independent of other and satisfactory evidence, that the direction of the cushion is not even of specific value, much less of generic importance, though in the past the direction of the leaf-cushion was the distinguishing character between *Lomatophloios* and *Lepidophloios.* When preparing my Memoir on the British species of the genus *Lepidophloios* I unfortunately did not possess this specimen.

The leaf-cushions are directed upwards on all the young branches of *Lepidophloios Scoticus* I have examined on which the direction of the branch could be determined, and these were either stalked cones or bifurcated branchlets. On the other hand, on all the larger specimens whose direction could be determined by the presence of branches or bifurcations, they are directed downwards, and above I have referred to a specimen showing the transition in the direction of the cushions taking place. It is therefore certain that in *Lepidophloios Scoticus* the originally upward-directed leaf-cushions become subsequently deflexed.[1]

The fossils known as Halonia, L. and H., are the fruiting branches of *Lepidophloios.* All the British species possessed such fruiting branches; hence, unless the Halonia condition shows the leaf-scales, it is impossible to determine the species to which it belongs. The name "*Halonia*" is, therefore, frequently employed to indicate a fruiting branch of a specifically undetermined *Lepidophloios.*

That Halonia is the fruiting branch of *Lepidophloios* has been proved beyond all doubt, as several specimens have been described and figured showing the characteristic *Lepidophloios* leaf-scar and scale on stems bearing Halonial tubercles. These Halonial tubercles are arranged in spiral series of always a greater number than two.[2] In decorticated specimens the

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[1] See *Trans. Roy. Soc. Edin., l.c.* Pl. I., fig. 3; Pl. II., fig. 6.

[2] Mr. James Lomax, in a paper entitled "Recent Investigations on Plants of the Coal Measures," published in the *Trans. Manchester Geol. Soc.*, Part ix., Vol. XXVI., 1899, gives on Pl. V., fig. 22, and Pl. VI., fig. 23, a specimen which he describes as "A new Halonia-like form of *Lepidodendron fuliginosum* of Williamson." This specimen I cannot accept as belonging to *Lepidophloios fuliginosus*, Will. sp., and is clearly

Halonial tubercles appear as prominent mammillæ-like protuberances. On corticated specimens the depressions between the mammillæ are filled up with the cortex when their apices only rise to the general level of the stem or slightly above it, and appear as surrounded by little rosettes formed by the bent-back leaf-cushions which surround the point of attachment of the caducous-stalked cone.[1]

Another important distinguishing point between the fruiting or Halonial condition of *Lepidophloios* and the Ulodendroid condition of *Lepidodendron*, *Sigillaria* and *Bothrodendron* is the circumstance that *Lepidophloios* bore its fruit on the young branches, as shown by the frequent occurrence of very small twigs bearing several rows of Halonial tubercles, whereas the *Ulodendroid* stems only bore their sessile cones on stems of considerable age and size.[2]

I have been unable to ascertain the arrangement of the sporangia in the cones of *Lepidophloios*, which when separated from their parent stems cannot be distinguished from those commonly included in the genus *Lepidostrobus*.

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referable to the Ulodendroid section of Lycopods. I believe the plant is a decorticated specimen of *Sigillaria discophora*, König sp., which is the *Ulodendron minus*, L. and H. It was collected by Mr. George Wild, and is in the hands of Professor Weiss, Manchester, for description.

[1] Of specimens showing *Halonial* tubercles associated with *Lepidophloios* leaf-cushions, the following may be cited:—*Lepidophloios laricinus*, Goldenberg, *Flora saræpont. foss.*, Pl. XVI., fig. 6; the specimen figured by Eichwald under the name of *Halonia tuberculata* in *Lethæa Rossica*, Pl. XI., figs. 1-2, show a *Halonial* core, but the impression shows the *Lepidophloios* leaf-scar. Under the name of *Lepidodendron laricinum*, Feistmantel also gives some figures which show the leaf-scar of *Lepidophloios* on the Halonial stem (*Vers. d. böhm. Ablager.* Abth. II., Pl. VII., pp. 1-2, and another on Pl. VIII., fig. 1, under the name of *Halonia regularis*). A fine specimen, exhibiting most clearly the union of *Halonia* and *Lepidophloios* (*L. Scotica*), is given by Dr. Macfarlane in the *Trans. Bot. Soc. Edin.*, Vol. XIV., Pl. VII.; and a similar condition of the same species is given by me in the *Trans. Roy. Soc. Edin.*, Vol. XXXVII., Part iii., No. 25, Pl. II., figs. 5-6, where I also figure a specimen of *Lepidophloios laricinus* showing the same union of *Lepidophloios* and *Halonia*.

[2] See Kidston, *Ann. and Mag. Nat. Hist.*, Ser. 5, Vol. XVI., p. 163, Pl. IV., fig. 2.

The leaves when detached from the stem are known as *Lepidophyllum*, some of which are of considerable size, and are indistinguishable in general appearance from those of *Lepidodendron.*

Internal Organization.—The internal structure of *Lepidophloios* is similar in type to that of *Lepidodendron.* In fact, all the *Lepidophloios*, with the exception of the *Lepidophloios* described by the late Sir William Dawson,[1] were first placed in the genus *Lepidodendron.* To *Lepidophloios* belong the *Lepidodendron fuliginosum*, Williamson,[2] and the *Lepidodendron Wunschianum*[3] of the same author. Not only are *Halonial* branches of *Lepidophloios fuliginosus* known, but Messrs. Cash and Lomax showed me a specimen having the structure of *Lepidodendron fuliginosum* on which the characteristic leaf-scars of Lepidophloios were exhibited.[4] The *Lepidodendron Wunschianum*, Will.,[5] from Arran, is also seen to be a *Lepidophloios* from its possessing Halonial branches.[6] The first described specimens of *Lepidophloios fuliginosus* were identified as *Lepidodendron Harcourtii*, but this was corrected by Professor Williamson in his Memoir No. XIX., where the name of *fuliginosus* is given to the plant. Irrespective of other distinguishing points, *Lepidodendron (Lepidophloios) fuliginosus* is known at first sight from *Lepidophloios Harcourtii* by the constant occurrence of the beautifully-preserved inner bark, while the corresponding structure in *Lepidodendron? (Lepidophloios) Harcourtii* is invariably destroyed.

Last year Messrs. Seward and Hill communicated a paper to the Royal Society of Edinburgh, in which they describe what is probably the finest specimen of a Carboniferous Lycopod yet found. It was collected by Mr. J. Kerr, Edinburgh, at Dalmeny Railway Cutting, Linlithgowshire. The stem is 13 inches in

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[1] *Lepidophloios Acadianus*, Dawson. *Quart. Journ. Geol. Soc.*, 1865, p. 163, Pl. X., fig. 50. This species is now recognised as the same as the *Lepidophloios laricinus*, Sternb.

[2] First described under the name of *Lepidodendron Harcourtii* in error. Mem. II., *Phil. Trans.*, 1872; Mem. XI., *Phil. Trans.*, 1881. Under name of *Lepidodendron fuliginosum*, Mem. XIX., *Phil. Trans.*, 1893.

[3] *Phil. Trans.*, Mem. X., 1880.

[4] Cash and Lomax, *Rept. Brit. Assoc. Leeds*, 1890, p. 810. 1891.

[5] Memo. X., *Phil. Trans.*, 1880; Memo. XII., *ibid.*, 1881.

[6] Memo. XII., *Phil. Trans.*, 1881.

diameter, the vascular axis being slightly over $1\frac{1}{2}$ inches in diameter, of which the secondary xylem measures $\frac{9}{10}$ of an inch and the primary xylem $\frac{1}{10}$ of an inch in thickness. The structure of the vascular axis and outer bark is beautifully preserved. All these species of *Lepidophloios*, to which genus this fine specimen from Dalmeny evidently belongs, show certain characters which, though perhaps not restricted to *Lepidophloios*, appear to be more pronounced in that genus than in *Lepidodendron*. These are the little points of small tracheides which jut out from the periphery of the primary bundle, forming what has been called the "*corona*," and the late period at which the development of secondary xylem occurs.

A secondary development of "*tissue*"[1] has been observed in *Lepidophloios fuliginosus*, termed by Williamson "a very rudimentary form of secondary xylem strand,"[2] and a strongly-developed secondary xylem occurs in *Lepidophloios Wunschianus* and in the Dalmeny specimen, where it forms a thick zone.

There is strong reason to believe that the *Lepidodendron Harcourtii*, Witham, is also a *Lepidophloios*. It has all the peculiarities of the genus, and I feel strongly inclined to place it provisionally in *Lepidophloios*. One of the characters which, according to Williamson, distinguishes *Lepidophloios Harcourtii* from his *Lepidophloios fuliginosum* is the presence of a *diploxyloid* leaf-trace in the former. Mons. Bertrand,[3] and more recently Seward, have examined the leaf-traces of *Lepidophloios fuliginosum*, and found that in structure they are identical with those of *Lepidophloios Harcourtii*, Will. sp. (With.?). What were previously supposed to represent a strand of bast fibres is in reality a strand of laticiferous tubes.[4] Whether this laticiferous tissue may have performed the functions of the bast elements is uncertain.

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[1] Seward, *Lepidophloios fuliginosus*. *Proc. Camb. Phil. Soc.*, Vol. X., Part iii., p. 140, 1899.

[2] Williamson, "General, Morph., and Histol. Index," Part ii. *Mem. and Proc. Manchester Lit. and Phil. Soc.*, Session 1892-93. Ser. IV., Vol. VII., 1893, p. 13.

[3] *Remarques sur le Lepidodendron Harcourtii de Witham*, p. 119. 1891.

[4] Seward, "Notes on the Binney Collection of Carboniferous Plants—I. *Lepidophloios*." *Proc. Camb. Phil. Soc.*, Vol. X., Part iii., pp. 140-141. 1899.

In the Dalmeny specimen the leaf vascular bundle has a most pronounced development of secondary xylem. This plant is very probably the true *Lepidophloios Harcourtii*, Witham sp.

It is unsafe to generalize on the differences in the structure of the vascular systems of *Lepidodendron* and *Lepidophloios* here pointed out, as our knowledge of them is still very imperfect, but evidence is tending to show that though they both possess the same type of stem structure, there are differences which may enable one to separate the two genera by their internal structure alone. In the case of *Lepidophloios fuliginosus* and *Lepidophloios Wunschianus*, their possessing Halonial branches is conclusive evidence of their belonging to *Lepidophloios*. It is interesting to note here that though the specimen of *Lepidophloios Acadiacus*, Dawson (=*Lepidophloios laricinus*, Stern.), whose internal structure was described by Sir William Dawson, is 5 inches in diameter, it only shows the primary xylem with the characteristic peripheral corona.[1]

In his Memoir III.[2] Professor Williamson describes some specimens from Pettycur, near Burntisland, Fife, under the name of *Lepidophloios brevifolium*, Will. (not Ett.).[3] In a footnote he says—"In a letter from Dr. Dawson, dated November 28, 1872, that observer informs me that he regards the Burntisland plant as identical with *Lepidodendron Veltheimianum*." Professor Williamson further says—"Until the very characteristic macrospheres of my plant are shown to exist in some of the localities in which the *Lepidodendron Veltheimianum* is common, I think it best to retain my proposed provisional name."[4]

The external characters of the plant, which Professor Williamson originally described as *Lepidophloios brevifolium*, and subsequently as *Lepidodendron brevifolium*, are well seen in weathered surfaces of the blocks containing the specimens, and there is no

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[1] *Quart. Journ. Geol. Soc.*, Vol. XXII., p. 163, Pl. X., fig. 5. 1865. *Acadian Geology*, 2nd edition, 1868, p. 489, fig. 171*i* (p. 457).

[2] *Phil. Trans.*, 1872, p. 310.

[3] Though originally described as *Lepidophloios*, Professor Williamson places this plant in *Lepidodendron* in his "General, Morphological, and Histological Index," *Mem. and Proc. Manchester Lit. and Phil. Soc.*, Session 1892-93, p. 10. 1893.

[4] *l.c.*, p. 310.

doubt that it is the *Lepidodendron Veltheimianum*, as suggested by Sir William Dawson. *Lepidodendron Veltheimianum* is very common in the *horizon* in which the Pettycur material occurs.

But, further, the very characteristic macrospores of *Lepidodendron brevifolium*, Will. (not Ett.), with the long hirsute appendages, are the *Lagenicula I.* described by Mr. J. Bennie and myself from several localities in the Calciferous Sandstone Series where *Lepidodendron Veltheimianum* is plentiful.[1]

V. Lepidostrobus, Brongniart, 1828.

1828. *Lepidostrobus*, Brongniart. *Prodrome*, p. 87.

1865. *Flemingites*, Carruthers. *Geol. Mag.*, Vol. II., No. xvi.

Cylindrical, ovoid, or oblong cones, composed of a ligneous axis, to which are attached the single-nerved bracts or sporophylls in steep spirals. The bracts consist of two parts, a basal portion or pedicel springing from the axis almost at a right angle, and on which is placed the single sporangium, and a limb which extends upwards from the extremity of the pedicel and forms with it at their point of union an acute angle. The lower bracts bear the macrosporangia, the upper the microsporangia. Macrospores larger, smooth or apiculate, and provided with a triradiate ridge. Microspores very small, tetrahedral.

Internal Organization.—The axis consists of a central bundle surrounding a pith of delicate parenchyma. The vascular elements are composed of scalariform tracheides, the smaller members being placed on the outer edge, and are the first-formed tracheides of the bundle. The vascular ring of the cone axis corresponds to the primary xylem of the stem, and, like it, is developed centripetally.[2]

From the small outer tracheides spring the bundles which go to the bracts.

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[1] *Proc. Roy. Phys. Soc. Edin.*, Vol. IX., Pl. VI., figs. 20*a* to 20*s*. 1886. "On the Occurrence of Spores in the Carboniferous Formation of Scotland."

[2] For a detailed account of the structure of Lepidostrobus, see Maslen, *Trans. Linn. Soc. London*, 2nd Ser. Bot., Vol. V., Part xi., p. 337

The vascular axis is surrounded by a cortex composed of three zones. The inner and middle zones are formed of delicate cells and the outer of dense thick-walled cells.

Each pedicel supports a single oblong sporangium attached to it by a longitudinal band of parenchyma.

From the distal end of the pedicel the limb of the sporophyll rises abruptly upwards and is frequently "heeled," giving a slightly peltate termination to the pedicel. In the angle formed by the outer (end) wall of the sporangium and the upright blade of the sporophyll is a small ligule.

The sporangium wall consists of a single layer of palisadal cells, the structure of the *macrosporangia* and *microsporangia* being similar.[1]

Remarks.—The structure of the bracts or sporophylls is illustrated in fig. 8, which shows *Lepidostrobus anthemis*, König sp., in transverse section. The limb of the bract is shown at *a* and the basal portion or pedicel at *b*. At *c* is marked the position of the axis. In the uncompressed condition the limb *a* would rise up at almost right angles to the sporangial portion *b*.

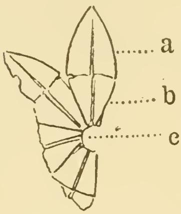

Fig. 8. — *Lepidostrobus anthemis*, König sp. Transverse section of cone—*a*, limb of bract; *b*, portion to which sporangium is attached; *c*, axis. Natural size (No. 1032).

In *Lepidostrobus fimbriatus*, Kidston,[2] the limb is strongly ciliated, but, as only the bracts of this species are known, it is uncertain whether it belongs to *Lepidodendron* or one of the allied genera. In all cases where *Lepidostrobi* can be definitely ascribed to *Lepidodendron*, as far as we know the bracts are free from such ciliate appendages.

The form of the bract varies according to the species, being generally more or less lanceolate. They vary also in size from less than an inch to over four inches in length in *Lepidostrobus*

[1] There is no development of secondary xylem, and its absence is characteristic of the vascular system of fugaceous organs.

[2] From the Cement-stone Group of the Calciferous Sandstone Series, Lewisburn, North Tyne, Northumberland, *Trans. Roy. Soc. Edin.*, Vol. XXX., p. 543, Pl. XXXI., figs. 2-4.

(*Lepidophyllum*?) *major*, Brongt. Fig. 9. In this latter species I believe are sometimes included leaves of *Lepidophloios* as well as bracts.

In *Lepidostrobus*, as generally employed, are almost certainly included, not only cones of *Lepidodendron*, but also of *Lepidophloios* and *Bothrodendron*, if not even of *Sigillaria*, and I strongly suspect that the cones with naked pedicels figured by me from the Ayrshire Coal-field under the name of *Lepidostrobus* (?) *spinosus* may belong to *Sigillaria*,[1] but without some knowledge of the structure and arrangement of the sporangia it is impossible to determine their true systematic position.

When perfect specimens of *Lepidostrobi* are examined the lower portion of the cone contains the macrosporangia and the upper the microsporangia,[2] the macrospores representing the female and the microspores the male elements. It is of course quite possible that some cones produced only microsporangia and others macrosporangia, and one whose structure was described by the late Prof. Williamson is supposed to have been of this nature, but the supposition may rest on imperfect knowledge.[3]

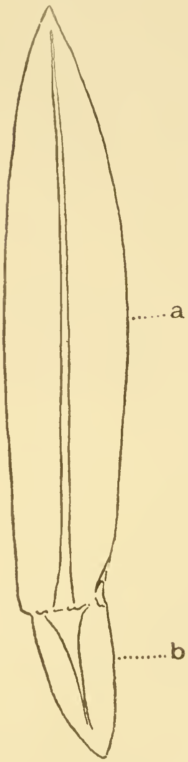

Fig. 9. — *Lepidophyllum (Lepidostrobus?) majus*, Brongt. (No. 2527.) Natural size.

When the bracts are removed from the axis it exhibits a number of close, spirally-placed, small, elongated

[1] *Trans. Roy. Soc. Edin.*, Vol. XXXVII., p. 341, Pl. II., fig. 7; Pl. III., figs. 11-12.

[2] See Williamson, "Organization of the Fossil Plants of the Coal Measures," Part xix. *Phil. Trans.*, 1893, Bot., Pl. VIII., figs. 51-52 = cone of *Lepidodendron brevifolium*, Will. (not Ett.); also Binney, Palæont. Soc., Observations on the Structure of Fossil Plants, Part ii. Pl. IX., fig. 1 = *Lepidostrobus Russellianus*, Binney. Pl. X., fig. 1 = *Lepidostrobus levidensis*, Binney. Pl. XI., fig. 2 = *Lepidostrobus Wunschianus*, Binney.

[3] Maslen, "The Structure of *Lepidostrobus*," *Trans. Linn. Soc. London*, 2nd Ser. Bot., Vol. V., Part xi., p. 358. 1899. (*Lepidostrobus Oldhamius*, Will.)

points, which correspond to the vascular bundles that enter the bracts. Their appearance is very similar to the vascular scar on decorticated stems.

When the limb of the bract only is removed the exposed end of the sporangia exhibits a roughly rhomboidal outline, somewhat similar to that of the leaf-scar on the cushion.

Many specimens of *Lepidostrobi* with more or less perfectly preserved internal organisation have been described, and their internal structure is now fairly well known. Fig. 10.

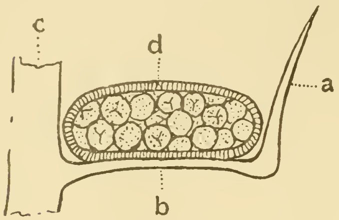

Fig. 10.—*Lepidostrobus*—*c*, axis; *b*, bract or sporophyll, bearing sporangium; *d*, containing macrospores; *a*, limb of bract. (Restored.)

The earliest Memoirs dealing with the internal structure of *Lepidostrobus* are by Sir Joseph Hooker[1] and Robert Brown.[2] In 1871 Binney published Part II. of his "Observations on the Structure of Fossil Plants found in the Carboniferous Strata," in which he deals with "Lepidostrobus and some Allied Cones."[3] Some of his figures show very clearly the microsporangia occupying the upper part of the cone and the macrosporangia the lower portion. Prof. Williamson also describes a number of *Lepidostrobi* in his Memoirs.[4] A valuable paper "On the Structure of the Axis of *Lepidostrobus Brownii*, Schimper," by Prof. Bower,[5] contains a careful description of the cone described by Robert Brown in 1847, but whose paper was only published in 1851.

More recently Mr. Arthur J. Maslen published a description of some *Lepidostrobi* in the collection of the late Prof. Williamson, now in the British Museum.[6] On some of these he has detected

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[1] "Remarks on the Structure and Affinities of some Lepidostrobi." *Mem. Geol. Survey*, Vol. II., Part ii., p. 440. Plates. 1848.

[2] "Some Account of an Undescribed Fossil Fruit," *Trans. Linn. Soc. London*, Vol. XX., p. 469, Pls. XXIII.-XXIV. 1851.

[3] *Palæont. Soc.*, 1871, pp. 33-62, Pls. VII.-XII.

[4] *Phil. Trans.*, Memoir III., 1872; *ibid.*, Mem. XIX., 1893.

[5] *Annals of Botany*, Vol. VII., pp. 329-354, Pls. XVI.-XVII.

[6] *Annals of Botany*, Vol. XII., No. XLVI., 1898, p. 257.

the presence of a ligule situated in a small pit formed by the free distal extremity of the sporangium and the limb of the bract.

In a second communication he enters fully into the structure of *Lepidostrobus Oldhamius*, Williamson, of which he notes and describes several varieties.[1] The various structures of the axis, vascular bundles of the sporophylls, and parichnos are here correlated to similar structures in the Lepidodendron stem. The paper is one which demands the careful study of Palæobotanists.[2]

The genus *Flemingites*, Carr.,[3] was founded on a misconception of the true structure of the specimen which formed the type of the genus – *Flemingites gracilis*. The macrospores were mistaken for sporangia. The specimen is a typical *Lepidostrobus*.

Macrospores, associated with microspores, occur in great quantity in many coals, and form in some cases a considerable proportion of the whole mass.[4] A small spore forms from 30 to 40 per cent. of *Tasmanite*, a bituminous shale from the River Mersey, Tasmania.

VI. Lepidophyllum, Brongniart, 1828.

1828. *Lepidophyllum*, Brongniart, *Prodrome*, p. 87.

Under this name are placed the isolated leaves of *Lepidodendron*, and of probably other Lycopods which, when separated from the stem, cannot be definitely referred to their parent species.

They are linear, lanceolate, or subtriangular in form, with entire margins and a single nerve. Many specimens which have been placed under this name are the bracts of cones and really fall to be included in the genus *Lepidostrobus*.

It is almost impossible to distinguish between Lycopod leaves and bracts, for a bract with the basal portion removed cannot be distinguished from a leaf.

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[1] *Trans. Linn. Soc. London*, 2nd Ser. Bot., Vol. V., Part xi., pp. 357-377, Pls. XXXVI.-VIII. 1899.

[2] See also Schimper, *Traité d. paléont. végét.*, Vol. II., p. 59 *seq.*, 1870; Vol. III., pp. 544-546, 1874. Solms-Laubach, *Fossil Botany*, p. 232, 1891. Renault, *Cours d. botan. foss.*, Vol. II., 1882, p. 31 *seq.*

[3] Carruthers, *Geol. Mag.*, Vol. II., No. XVI., Oct., 1865.

[4] See Huxley "On the Formation of Coal," *Contemporary Review*, Vol. XV., p. 618. 1870.

The leaf appears to consist of two parts, the blade and the basal portion. The basal portion, which is separated from the blade by a slight constriction, is probably the part which was attached to the cushion, and whose removal from the stem exposes the leaf-scar.

The long grass-like leaves of such species as *Lepidodendron longifolium*, Brongt., and *Lepidodendron obovatum*, Sternb., form, in part, the *Cyperites* of Lindley and Hutton.[1]

VII. Stigmaria, Brongniart, 1822.

1822. *Stigmaria*, Brongt., *Class. d. végét. foss.*, p. 9.

1820. *Variolaria*, Sternberg (*non* Person). *Essai flore monde prim.*, Vol. I., fasc. I., pp. 23 and 26.[2]

1826. *Stigmaria*, Sternberg, *Essai flore monde prim.*, Vol. I., fasc. IV., p. 38.

Rhizome of the Arborescent Lycopods, diverging from the base of the trunk in four main branches. Shortly after separating from the trunk each of the four primary arms bifurcates, giving rise to eight rhizome branches; at a distance of a few feet these again bifurcate, forming sixteen branches. They do not again divide, or only very rarely do so, but gradually terminate in a tapering or blunt point.

The outer surface of the cortex bears quincuncially-arranged rootlet-scars, consisting of a slightly raised rim containing a hollow circular depression placed about midway between the central single vascular cicatrice and the outer rim. (Fig. 11.) Rootlets long and bifurcating towards their extremity, or simple (?).

The internal organization consists of a medulla, or pith, surrounded by an exogenously developed zone of xylem enclosed in a thick cortex.

Medulla.—The Medulla is composed entirely of parenchyma, extensions from which form the primary medullary rays. The cells forming the pith seem to have been very delicate, and it is extremely seldom that any of their remains are preserved.

Xylem Cylinder.—In the earliest stage this consists of a ring of very small vascular-bundles surrounding the Medulla. These

[1] *Fossil Flora*, Vol. I., p. 123, 1832.

[2] Previously employed for a genus of Lichens. (*Fide*, Brongniart, *Class. d. végét. foss.*, p. 28.

bundles, whose individual elements are parallel to each other, run in a sinuous course, the neighbouring bundles bending from and towards each other, and thus form a netted cylinder. The meshes so made form the openings of the primary medullary rays. By exogenous growth from a meristem ring, the bundles increase in size, and form the wedge-shaped bundles separated by the primary medullary rays, so characteristic of *Stigmaria*.

The primary medullary rays were continued outwards like spokes of a wheel as additions were made to the outer surface of the bundle through which they passed. The number of the primary rays was therefore fixed by the original number of meshes formed in the young xylem cylinder.

In tangential section the primary medullary rays are elongate lenticular in outline, and are formed of delicate parenchyma.

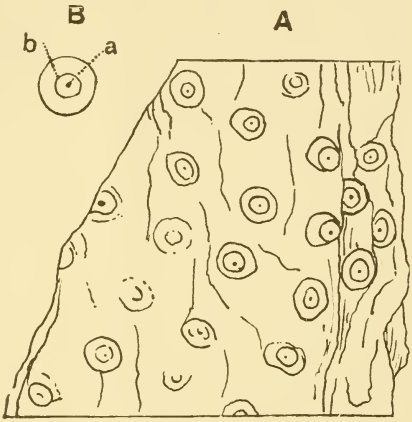

Fig. 11. — *Stigmaria ficoides*, Sternb. sp. A, portion of rhizome, natural size; B, rootlet scar—*a*, vascular cicatrice; *b*, circular depression.

In addition to the primary medullary rays, numerous secondary medullary rays are developed as the xylem cylinder increases in diameter. These are very clearly seen in transverse and tangential sections, and consist generally of a single vertical plate of cells. The number of cells entering into the formation of these secondary medullary rays varies considerably. Sometimes they consist of only one cell, or of two, three, or several superimposed cells.

The ring of bast surrounding the xylem cylinder seems to be very rarely preserved, though Solms-Laubach has "seen tolerably distinct remains of this portion of the rind in a specimen belonging to the collection at Strassburg." [1]

[1] *Fossil Botany*, p. 274.

Cortex.—In the fully-developed rhizome the cortex consists of three zones—an inner, outer, and middle zone. The inner layer, probably composed of delicate parenchyma, never seems to have resisted decay in any specimens yet discovered. The middle layer consists of radially-arranged dense prosenchymatous tissue with small lumen. The dividing line between the middle and outermost zones is very clearly seen in longitudinal sections—the long, narrow, prosenchymatous fibres standing in marked contrast to the outer layer of isodiometric, firm-walled parenchyma.

This so-called middle zone is the product of a meristem layer (phellogen) which appears at an early period, and lies between the inner and outer zone. On the inner side of the phellogen, the middle bark (phelloderm) is developed. Probably additions were also made to the outer bark or zone, but to a less extent. This outer zone differs in structure from the cork layer (phellem) of recent plants, being a thin, though firm-walled, parenchyma. To the exterior surface of the outer bark were attached the rootlets.

Rootlets.—The rootlet bundles spring from the first-formed small vessels of the xylem cylinder, and pass out through the basal angle of the primary medullary rays. At first they consist of a single vessel, but as additions are made to the exogenous zone, special radial lamina of small vessels are added to the rootlet bundle, which not only increases vertically but also laterally. The rootlet bundle therefore holds a certain proportional size to that of the vascular cylinder.

The increase in the volume of the rootlet bundles is well seen in transverse sections of the xylem cylinder and in serial longitudinal sections. Immediately after leaving the vascular cylinder, the rootlet bundle is generally more or less deltoid in section, with the angles rounded. Their size varies, but holds a certain relation to the size of the axis with which they are connected. The earlier-formed vessels, or tracheides, are generally placed without any order, but those subsequently added are usually radially arranged.

The rootlets of *Stigmaria* are long cylindrical bodies, varying in length according to the age of the parent rhizome. Messrs. Binney and Harkness state they traced them for over a distance of three feet.[1] This is a greater length than that usually ascribed to them, but it is extremely rarely that their full length can be seen. They bifurcate, but specimens showing this character are not very common. Such bifurcations are figured by Artis,[2] Corda,[3] and Goldenberg.[4] In the example given by Corda the rootlet, including the bifurcation, is about nine inches long. The extremity of a dichotomous rootlet is also figured by Williamson.[5] At the point from which the arms of the dichotomy spring there is a slight contraction, but specimens of dichotomizing rootlets which retain their structure do not show any indication of this constriction.[6] It may be due to a contraction of the tissues through shrinkage.

The outer layer of the rootlet is formed of thick-walled parenchyma, which is an extension of the outer cortical layer of the rhizome. The space within this outer wall is almost invariably devoid of all structure, the delicate tissue which once surrounded the bundle-cylinder having disappeared, if such ever existed. Prof. Williamson thinks it is probable that the rootlets were fistular as in *Isoëtes lacustris*, except at the extreme base of the rootlet where it was embedded in the outer parenchyma of the bark.[7]

I have, however, detected slight remains of a cellular tissue which may have filled this part of the rootlet, but not knowing the exact position of my section, it may be from the basal region of the rootlet, where we know a parenchymatous tissue existed.

Within the outer envelope described above, is the *bundle-cylinder*, composed of a few roses of very delicate cells, and containing the vascular bundle. At first the rootlet bundle consists of a single small scalariform tracheid, but to this others are subsequently added. In form the bundle is oval or deltoid, with

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[1] *London, Edin., and Dublin Phil. Mag.*, 3rd Ser., Oct., 1845, p. 243.

[2] Artis, *Antedil. Phyt.*, Pl. III.

[3] *Flora d. Vorwelt*, p. 32, Pl. XII., fig. 1.

[4] Goldenberg, *Flora Sarœp. foss.*, Heft. III., p. 17, Pl. XIII., fig. 1. *Ibid.*, p. 19, Pl. XIII., fig. 5 (under name of *Stigmaria anabathra*).

[5] "*Monog. Stigmaria ficoides*," p. 32, Pl. XIII., fig. 27. (*Palæont. Soc.*, 1887.)

[6] Williamson, *Monog. Stigmaria ficoides*, p. 33, Pl. XI., fig. 63.

[7] *Monog. Stigmaria*, p. 25.

the angles somewhat rounded. The original vessels forming the bundle, and which form the apex of the triangle, generally rest on the bundle-sheath. The subsequent additions are usually of larger tracheides, though sometimes, from some cause, smaller vessels may be added external to the larger ones. We see the same phenomenon in the vascular wedges of the axis, where occasionally some very small vessels are interpolated among the larger and normal-sized vessels of the xylem, and there is likewise found similar small vessels interpolated among larger ones in the rootlet bundles. The phloem elements, which are very delicate, are seldom preserved, but Prof. Williamson has figured one rootlet bundle shewing this tissue.[1]

The rootlet bundles must have passed outwards through the vascular axis in an approximately horizontal direction, as their course follows the primary medullary rays. After leaving the axis they bent upwards towards the growing point, and so through the cortex. No specimen showing structure has yet been discovered which permits of the course of the rootlet bundles being traced from the point where they leave the xylem till they enter the rootlet, but they were probably surrounded by a bundle cylinder, for it is otherwise difficult to account for the vermicular tube-like structures which Williamson has figured and described in his Memoir on *Stigmaria ficoides*, pp. 26-27, Pl. XII., fig. 39. The *Caulopteris gracilis*, L. and H.,[2] is founded on the axis of a *Stigmaria*, and shows on its outer surface the collapsed rootlet bundles in a similar manner to those exhibited on the specimen figured by Williamson. This condition is brought about by the decay of the supporting tissue, which causes the rootlet bundles to fall against the vascular cylinder, and these in the fossil condition adhere to its outer surface. In the two figures cited the tube-like structures are too large to represent the vascular trace alone. I possess a similar example, and possibly a piece of the same specimen as that figured by Prof. Williamson, which I received from Mr. B. Holgate. It was collected at Mr. Bayles' Brickyard, Nippet Lane, Leeds. The vermicular tube-like structures on my specimen are scarcely half the diameter

[1] *Monog. Stigmaria*, p. 32, Pl. XI., fig. 62.
[2] *Fossil Flora*, Vol. II., Pl. CXLI.

of those figured by Prof. Williamson, whose example seems to have been much encrusted (No. 815).

We are therefore dependent on amorphous casts, some of which show more or less plainly the course of the rootlet bundles from the xylem cylinder to the rootlets. One such specimen is figured by Williamson,[1] two are given by Göppert,[2] and another by Zeiller.[3] Solms-Laubach also describes a specimen which shows the course of the rootlet bundles.[4]

A specimen in my collection (No. 981) also shows the course of the rootlet bundles. The fossil is preserved in fine-grained sandstone and has been split through the axis. The position of the vascular cylinder is indicated by a depression up the centre of the fossil, from which narrow channels run outwards and upwards. Occasionally associated with these are small cord-like casts, smaller than the channels through which they pass, and which are the bundles or bundle with bundle-sheath. The outer surface of the specimen exhibits the characteristic scars.

The rootlets are attached to a specialized structure in the outer bark, which Prof. Williamson has designated the *rootlet-cushion.*[5] This consists of a cylindrical mass of very dense cells embedded in the parenchyma of the bark, and ending in a conical point within the base of the rootlet. The outer surface of this cushion bears a layer of elongated branching tubular cells, whose special function is not yet ascertained. In impressions of *Stigmaria* the small area enclosed within the circle which contains the small central vascular cicatrice is the peripheral limit of the rootlet-cushion. Prof. Williamson was of opinion that there was "no kind of 'articulation' where the root was planted upon the bark," and that the separation of the rootlet was either the result of external force or decay "producing a variable contour in what remained of the *torn* tissue of the rootlet."[6]

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[1] Williamson, *Monog. Stigmaria*, p. 24, Pl. XII., fig. 37.

[2] Göppert, *Gatt. der Foss. Pflanzen*, Lief. I.-II., Pl. X., fig. 17; Pl. XI., fig. 18.

[3] Zeiller, *Flore foss. Bassin houil d. Valenciennes*, p. 617, fig. 45, Text, 1888.

[4] Solms-Laubach, *Fossil Botany*, p. 274.

[5] Williamson, *Monog. Stigmaria*, p. 26.

[6] Williamson, *ibid.*, p. 38.

From the clear manner in which well-preserved specimens show the rootlet-scar I am inclined to think the rootlet did possess some provision for effecting a separation from the rhizome when its period of usefulness ceased. Possibly their mode of removal was primarily by decay, but when that took place they appear to have been removed in a definite manner, leaving behind them a clearly-defined scar without any remains of a shrivelled rootlet.

Stigmaria being the most common of all fossil plants was naturally one of the earliest to be observed and described by writers on Palæobotany. As early as 1720 Volkmann gives a figure of *Stigmaria.*[1] Neither was *Stigmaria* overlooked by Ure, who in his "History of Rutherglen and East Kilbride"[2] gives a rather interesting portion of a rhizome, showing the scar surrounded by rhomboidal meshes. On the same Plate, at fig. 7, he further gives a representation of the basal portion of a rootlet.

Stigmaria is also illustrated by Parkinson[3] and Martin,[4] who, under the name of *Phytolithus plantites*, publishes three plates of this fossil. The specimen given on Pl. XII. represents a very interesting state of preservation. Here, owing to the manner in which the stone has been fractured, the fossil has been so split that it exhibits the cast of the pith-cavity on which is impressed the openings of the primary medullary rays.[5] This specimen therefore shows one of the chief distinguishing points between *Stigmaria* and *Stigmariopsis*, Grand 'Eury.

Among the earlier writers on *Stigmaria*, Steinhauer holds an honourable position. His paper "On Fossil Reliquia of Unknown Vegetables in the Coal Strata"[6] contains an admirable description of *Stigmaria* as far as then known. Among the specimens figured by Steinhauer is a "termination" of a rhizome.[7]

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[1] Volkmann, *Silesia subterranea*, Pl. XI., fig. 1.

[2] Pl. XIII., fig. 2. Glasgow, 1793.

[3] Parkinson, *Organic Remains of a former World*, Vol. I., p. 438, Pl. III., fig. 1. London, 1804.

[4] Martin, *Petrificata Derbiensia; or, Figures and Descriptions of Petrifactions collected in Derbyshire.* Wigan, 1809. Pls. XI., XII., and XII*.

[5] See also similar condition figured by Williamson, *Monog. Stigmaria*, Pl. XIV., fig. 69.

[6] Steinhauer, *Amer. Phil. Soc.*, Vol. I., New Series, 1818, pp. 265-297, Pls. IV.-VII. Philadelphia.

[7] *l. c.*, Pl. IV., fig. 3.

Let us now turn our attention to those examples which show the organic connection of *Stigmaria* with its parent stem.

That *Stigmaria* is the subterranean portion of *Lepidodendron* and some *Sigillaria* is, I believe, now accepted by all Palæophytologists. In the generic diagnosis I have termed *Stigmaria* a rhizome, though physiologically it probably performs more of the functions of a root, but this part of our subject will be dealt with more fully on a later page. In addition to *Stigmaria* being the rhizome of *Lepidodendron* and *Sigillaria*, it is most probably also the rhizome of *Bothrodendron* and *Lepidophloios*, though its organic connection with the stems of these two genera has not yet been proved.

As early as 1823 the Rev. Patrick Brewster described some upright stems found in Nitshill Quarry, about three miles S.E. of Paisley. He mentions that there were four principal roots, and at fig. 5 of his Plate he gives a sketch of "four converging branches," which are clearly *Stigmaria.*[1]

The next notice of the occurrence of upright stems with roots attached, of which I am aware, is that given by Sir John Hawkshaw. The trees here described were discovered at Dixon Fold, while making the railway between Manchester and Bolton. Five of them are figured and described. The rhizomes did not, however, exhibit any surface markings by which their nature could be determined.[2]

That *Stigmaria* was the subterranean portion of *Sigillaria*, and not an independent plant as supposed by many, was conclusively proved by Messrs. Binney and Harkness in their description of the trees found in the White Grit Quarry at Scotchrow, near St. Helens, in 1843.[3] Their paper is a most valuable contribution and contains a clear description of *Stigmaria* and the trunks to which they were united. It is stated that four arms spring from the base of the stem, shortly after these bifurcate into eight, and

[1] Brewster, *Trans. Roy. Soc. Edin.*, Vol. IX., p. 103, Pl. IX. 1823.

[2] Hawkshaw, *Trans. Geol. Soc. London*, 2nd Ser., Vol. VI., p. 173, Pl. XVII. 1837.

[3] *London, Edin., and Dublin Phil. Mag.*, Ser. 3, Vol. XXVII., p. 241, Pls. V.-VI. 1845. Previous notices of this discovery had been given at the Cork Meeting of the Brit. Assoc., 1843, and at the Manchester Geol. Soc., which were published in the *Phil. Mag.*, March, 1844.

then again into sixteen,[1] which seems to be the characteristic number of arms in *Stigmaria.* The same number of dichotomies was observed in the fine example of *Stigmaria* which was found at Clayton, and figured by the late Prof. Williamson in his Memoir on *Stigmaria.*[2] Messrs. Binney and Harkness were able to trace some of the rootlets attached to their *Stigmaria* for a distance exceeding three feet in length.[3]

Mr. Binney records a second and somewhat similar discovery in the Colliery of Messrs. Swire, Lees, & Co., at Duckenfield, Lancashire.[4]

Additional proof in regard to the true nature of *Stigmaria* was given in 1848 by Richard Brown in a "Description of an Upright *Lepidodendron* with *Stigmaria* Roots in the Roof of the Sydney Main Coal in the Island of Cape Breton."[5] This was followed in 1849 by the "Description of Erect *Sigillaria*, with Conical Tap-roots, found in the Roof of the Sydney Main Coal in the Island of Cape Breton."[6] These "tap-roots" will be referred to later on.

The fossil stems and their Stigmarian rhizomes discovered in 1888 in Lower Carboniferous Rocks at Victoria Park, Whiteinch, Glasgow,[7] will be remembered by many of those present. From the fact that the shale surrounding them contained many impressions of the branchlets and stems of *Lepidodendron Veltheimianum*, Sternb., and of that Lycopod alone, I have no doubt that these examples were the stems of that species. It seems to me almost hopeless to expect to find the leaf-scars preserved on the bark at the base of such large and old stems, for in the course of nature the leaf-scars would become effaced by the natural fissuring and exfoliation of the bark.

It is not necessary to give further evidence in proof of *Stigmaria* being the rhizome of *Lepidodendron* and *Sigillaria.*

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1 This is well shown on their Plate.
2 *Palæont. Soc.*, 1887, Pl. XV.
3 *l. c.*, p. 243.
4 Binney, *Quart. Journ. Geol. Soc.*, Vol. II., p. 390. 1846.
5 Brown, *Quart. Journ. Geol. Soc.*, Vol. IV., p. 46. 1848.
6 Brown, *ibid.*, Vol. V., p. 354. 1849.
7 *Trans. Geol. Soc. Glasgow*, Vol. VIII., p. 227. 1888.

Of specimens of Stigmarian stools which cannot be definitely referred to their parent genus, some very fine examples are given by Williamson in his "Monograph of the Morphology and Histology of *Stigmaria ficoides*." [1] His figs. 3-4, Pl. II., exhibiting the under surface of stools, show the cross-formed furrow caused by the growth of the four arms pressing on each other. This is even better seen on his figs. 5-6, Pl. III., where the Stigmarian rootlet-scars are preserved.

Possibly the finest specimen of *Stigmaria* yet discovered was that found at Clayton, near Bradford, and now in the Museum of Owens College, Manchester. This specimen has been described several times, but no more accurate description or admirable figure can be found than that given by Williamson.[2] One of the chief interests of this specimen was the opportunities it afforded for a careful uncovering of all the main rhizomes, and in one case they were able to trace one of them to its termination, when the entire length was found to be 37 feet 4 inches. All *Stigmaria* rhizomes which have been carefully traced, as far as I am aware, only show two bifurcations, and the portion of the rhizome referred to above, when measured from the last bifurcation, was 28 feet long. It was also found to terminate in a sharp point, a character which had been previously mentioned by Richard Brown, who, in the description of some *Stigmaria* rhizomes, says: "Two of the roots, it will be observed by fig. 3, have been followed to their terminations, where they gradually thinned out to a mere line in one direction, being about three-fourths of an inch in width." [3]

Now it is a very remarkable circumstance, when taken in connection with what has just been stated, that the terminations of some *Stigmaria* rhizomes which have been described and figured, have blunt apices "like thick cucumbers." Steinhauer gives one,[4] and Goldenberg gives another, though his example [5]

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[1] *Palæont. Soc.* for 1886 (1887).

[2] "Monog. Stigmaria," *Palæont. Soc.*, 1887, Pl. XV.

[3] Brown, *Quart. Journ. Geol. Soc.*, Vol. II., p. 396. 1846.

[4] *Trans. Amer. Phil. Soc.*, 1818, Pl. IV., fig. 3. *Note.*—It is impossible to decide from the figure whether the specimen is a *Stigmaria* or *Stigmariopsis*.

[5] Goldenberg, *Flora Saræpont. foss.*, Heft. 3, p. 15, Pl. XII., fig. 3, 1862.

belongs probably to *Stigmariopsis*. I possess two cucumber-like terminations, both of which also belong to *Stigmariopsis*.[1] It is very possible, therefore, that at least some of these blunt-pointed Stigmarian extremities may be the so-called "tap-roots" described by Richard Brown, as suggested by Prof. Williamson.[2] It must be noted, however, that the extremities figured by Steinhauer and Goldenberg, and those in my possession, appear to be larger than the "tap-roots" on the *Stigmaria* from the Roof of the Sydney Main Coal, Cape Breton, and, further, that none of the other *Stigmaria* whose under surface could be examined, have shown any indication of a tap-root appendage. Still, some species of *Stigmaria* may have had such additional growths attached to their under surface, of which at present we have no knowledge. What data we possess, however, tends to show that the "tap-root" appendage is a character of *Stigmariopsis*.[3, 5]

Another large stool of *Stigmaria* from Osnabrück has been described by Dr. H. Potonié.[4] It is not so perfect as the Clayton example in so far as the *Stigmaria* portion is concerned, nor does it appear to be so large. The Clayton specimen had a diameter of four feet four inches at the base of the trunk, the Osnabrück trunk was rather less than a meter ($39\frac{1}{3}$ inches) in the lower portion.

Several well-marked forms of *Stigmaria* occur, which are distinguished by markings on the bark or the size and arrange-

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[1] One (No. 2547) from Woodyett Pit, Denny, Stirlingshire—*Hor.* Main Coal—Carboniferous Limestone Series. The other from the Middle Coal Measures of Yorkshire—Communicated by Mr. Wm. Henningway.

[2] Williamson, *Palæont. Soc.* for 1886, p. 16. 1887.

[3] Grand 'Eury, *Géol. et paléont. du Bassin Houil. du Gard.*, 1890, Pl. XIII., fig. 12; Solms-Laubach, "Uber Stigmariopsis, Grand 'Eury, Dames and Kayser," *Palæont. Abhandl.*, Neue folge, Band II., Heft. 5, Pl. III., fig. 3.

[4] Potonié, *Naturwissenschaftlichen Wochenschrift*, Vol. VII., No. 34, p. 337, figs. 1, 2, 5, 6. Aug., 1892.

[5] Since this was written I have seen in the Museum, Owens College, Manchester, some specimens of true *Stigmaria* ending in blunt points, and a very interesting example has been shown me by Mr. J. W. Bond, Burmantofts, Leeds, which shows the early stage of a bifurcation of a blunt-pointed *Stigmaria*. I do not think that these specimens can be explained as Brown's "Tap-roots."

ment of the rootlet-scars. Among these may be mentioned *Stigmaria stellata*, Göpp.,[1] where the rootlet-scar is surrounded by a radiating circle of oblong elevations. In *Stigmaria reticulata*, Göpp.,[2] fine irregular lines radiate from the scars. In *Stigmaria Eveni*, Lx., the scars are very small and close.[3] Many other varieties occur.

We must now consider the question as to whether *Stigmaria* should be regarded as a root or a rhizome.

It must at once be conceded that *Stigmaria* differs in several important points from any root or rhizome with which we are acquainted in recent botany, and it is not my intention to enter with any detail into the points at issue. These have been fully treated of by Prof. Williamson[4] and Solms-Laubach.[5] Prof. Williamson regards *Stigmaria* as a *root*, while Solms-Laubach treats it as a rhizome. I incline to the latter view.

The idea that *Stigmaria* was a rhizome first originated with Göppert,[6] who found near Bochum some rounded and elongated nodules which sometimes divided at the extremities and which showed Stigmarian scars. These Göppert thought were young *Stigmaria*, which, by subsequent growth, would branch and divide into true *Stigmaria*, from some point of which might be put up a Sigillarian stem, or they might indefinitely continue their underground growth and retain their Stigmarian form.

These tuber-like bodies,[7] some of the original of which were examined by Solms-Laubach, are, according to that botanist, "shapeless objects, in part slickensided, and can prove nothing."[8] Göppert adduces what he believed to give further support to this

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[1] *Stigmaria ficoides var. stellata*, Göpp. *Gatt. d. foss. Pflanzen*, Lief. 1-2, p. 13, Pl. X., fig. 12. 1841.

[2] *Stigmaria ficoides var. reticulata*, Göpp., *ibid.*, p. 30, Pl. IX., fig. 11.

[3] Lesquereux, *Geol. Survey of Illin.*, Vol. II., p. 448, Pl. XXXIX., fig. 9. 1866.

[4] Williamson, *Monog. Stigmaria, l.c.*

[5] Solms-Laubach, *Fossil Botany*, p. 261 *et seq.* 1891, English Edition.

[6] Göppert, "Uber die Stigmaria ficoides," *Zeitsch. d. deut. geol. Gesell.*, Vol. III., p. 278 *et seq.* 1851. Also "Die fossile Flora der permischen Formation," *Palæontographica*, Vol. XII., p. 187. 1864.

[7] See Göppert, *Foss. Flora d. perm. Form.*, p. 190, Pl. XXXIV., figs. 2-8; Pl. XXXV., figs. 1-2.

[8] Solms-Laubach, *Fossil Botany*, p. 292.

theory, and figures the specimen on which it is based, but it does not really support his contention.[1] The real proof that *Stigmaria* is a rhizome rests on altogether different grounds.

In 1877 Grand 'Eury distinguished two forms of *Stigmaria*—true *Stigmaria* and what he named *Stigmariopsis.*[2] The distinctive characters given by this botanist were quite insufficient for their separation, though subsequent investigations have shown that *Stigmariopsis* is essentially distinct from *Stigmaria*, and, though little is yet known of the genus, it cannot be united with *Stigmaria*. *Stigmariopsis* will be considered presently.

Renault,[3] influenced perhaps by the investigations of Grand 'Eury, advocated strongly a dual nature in *Stigmaria.* Some *Stigmaria* he regards as *roots*, others as *rhizomes*, and some *Stigmaria* he believes have root leaves and rootlets on the same organ. The evidence on which Renault formed this opinion is the structure of the vascular bundles which go to the *appendicular organs*, by whatever name these may be called. The evidence he relies on in support of this view appears to rest on a misinterpretation of the structure of the bundle which enters the *appendicular organs.* The question resolves itself into whether the bundles are monarch (Collateral) or triarch, or whether some are monarch and others triarch on the same rhizome. Williamson and Solms-Laubach believe they are monarch (Collateral)—and Renault some monarch and some triarch.

Among the rootlet-bundles—for such I believe the appendicular organs to be—several slight modifications of form and arrangement of the vessels can be observed, and Solms-Laubach distinguishes three types.[4] In extreme cases these three forms are tolerably distinct, but they run into each other. That variations in minor details will occur in the form of the bundle is to be expected, when we remember that *Stigmaria* is not only the rhizome of several species, but even of different genera.

In certain bundles, like fig. 12, we see at (*a*), according to one view, the primary strand of the bundle to which additions have

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[1] Göppert, *l.c.*, Pl. XXXV., fig. 3.

[2] Grand 'Eury, *Flore carbon. du Départ. de la Loire et du Centre de la France*, pp. 166 and 171.

[3] Renault, *Cours d. botan. foss.*, Vol. I., p. 159. 1881.

[4] Solms-Laubach, *Fossil Botany*, p. 276, fig. 34.

been made, and that the smaller vessels at (*b*) and (*c*) belong to the same series, but are only of weaker development, and Prof. Williamson has pointed out that the smaller vessels are occasionally developed in the central axis[1] and from the mode of increase in the rootlet bundles, when smaller vessels are developed in the axis, they may be added to the rootlet bundle.

In the axis of a specimen in my collection from Pettycar, Fife, some patches of small vessels occur, followed by the development of others of normal size,[2] and in one of the rootlet bundles of this example, seen in transverse section, immediately after leaving the central axis, similar small vessels occur *within* the rootlet bundle. In other rootlet bundles in the same fossil, admixtures of small and large vessels are seen, having a different arrangement from that just referred to. In another Stigmarian axis from Oldham, these small vessels form rings very similar in appearance to the rings of annual growth in Dicotyledons. These groups or bands of smaller vessels seem therefore to be dependent on vital changes in the axis, in which the rootlet strands participate, and do not represent in the rootlet bundle initial strands or primary points of growth. This I believe to be the true explanation of the formation of the small vessels shown in fig. 12 at (*b*) and (*c*), to which so much importance has been given by Renault, who regards such bundles as *triarch*, in distinction from the more normal monarch form.

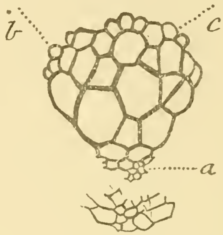

Fig. 12.—Rootlet bundle of *Stigmaria* (after Williamson). For description see text.

The bundles of the "appendicular organs" appear, therefore, to be of only of one form or type, that in which only one initial strand exists. It may, therefore, be justly concluded that whether the "appendicular organs" are looked upon as rootlets or leaves, only one of these is present, and that no admixture of roots and leaves occurs in *Stigmaria*. The views advocated here in regard to the structure of the rootlet bundles are very similar to those expressed by Solms-Laubach in his *Fossil Botany*, who,

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1 Williamson, *Monog. Stigmaria*, p. 17, Pl. IV., fig. 20.

2 Slide No. 545A.

after a critical examination of the subject, rejects the triach theory of their formation.

It may be noted that it is not by any means clear that all the specimens described by Renault under the name of *Stigmaria* really belong to that plant. In a few cases his identification is open to great doubt.

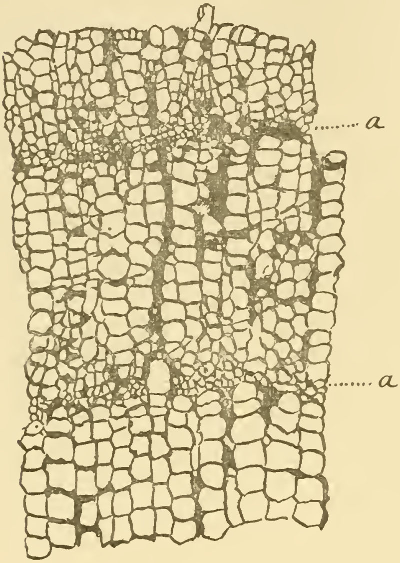

Fig. 13.—*Stigmaria.* Transverse section of portion of vascular cylinder, showing irregular development of tracheides at *a* and *a*. Specimen from Oldham (Slide No. 565A).

Notwithstanding the adverse criticism to the view promulgated by MM. Renault and Grand 'Eury, these authors still believe in some Stigmaria being rhizomes and others true roots. Grand 'Eury in his *Géologie et Paléontologie du Bassin Houiller du Gard*,[1] makes the following remarks on *Stigmaria*, which I give in full. I do not see, however, that any further data is given in support of the statement again brought forward. The figures given in illustration appear to be rather in the form of diagrams than of carefully executed illustrations of individual specimens, and there is an absence of any definite proof of a single case of Sigillarian stem having been developed from Stigmaria as the product of a bulb:—[2]

"Those constant in diameter, with cicatrices disposed in regular quincunc are the rhizomes; the other, short, very variable in diameter, the roots of *Sigillaria*, to the base of which one often

[1] P. 236. St. Étienne, 1890.

[2] In Britain all the stems which have shown the rhizome attached to their base have been *true Stigmaria*, even according to the description given by these authors.

finds them still attached. It is to those latter, very different from the first, that I have applied the name of *Stigmariopsis.*[1]

"The true *Stigmaria* are the rhizomes, which, having been incapable of supporting themselves, have floated on the water or crept in the mud, which they have also penetrated. These aquatic and creeping plants are generally unconnected with any stem. They are bifurcated, and provided with simple, rarely bifurcated appendicular organs radiating all round the stem, which circumstance proves that they lie in the place of their birth. Only once have I found them diverging from a centre without a stem. I have seen them also, but with great rarity, associated with bulbs, or giving rise (*ébauches*) to stems of *Sigillaria*, only at La Trouche and in the Gagnières bed, and still, although these *Stigmaria* are connected by various intermediaries to the *Sigillaria*, one may hold for certain that in the interior of the 'géogenique' basin the rhizomes develop themselves without stem at the bottom of the water or in the mud. These are the true *Stigmaria*, which I proceed first to consider and describe, having examined the relationship which they present with the *Sigillaria* at the edge of the basin of deposit of the fossil forests.

"Very similar opinions are expressed by Renault in one of his later works.[2] Under the name of *Stigmaria* one designates the much-developed appendages which go from the base of the stems of *Sigillaria*, sometimes in a downward direction, when they rapidly decrease in diameter, at other times extending horizontally in all directions, and preserving in this case an observably regular size.

"The first would be the true roots of Sigillaria, the second a kind of rhizome or stolon, radiating in great numbers around its stem, floating in the shallow water or on the surface of the mud until the bud-bearing terminal extremity may develop a root and supply a stem to a new plant."

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[1] Though I retain *Stigmariopsis* as a distinct genus, I do so only on account of structural differences first pointed out by Solms-Laubach, not on supposed developmental differences.

[2] *Études sur le terrain houiller de Comentry. Livre Deux. Flore fossile. Deuxième partie.* Saint Étienne, 1890, p. 549.

Referring to this mode of development and the possession by *Sigillaria* of both rhizomes and roots, Renault says:—"It explains also the difference of organization found in certain parts of these organs."[1] In describing a specimen he figures on Pl. LXII., fig. 1, he further says, "To the right of the figure one sees a young branch bent at its extremity and on the way of elongation."[2]

The figure to which he refers represents what I presume he regards as a rhizome arrived at the stage of producing an aerial stem. If I am correct in this interpretation of his meaning, I fail to see where the figure supports the contention.

But we must remember that Renault believes that the rhizomes also developed roots,[3] and that these roots, which appeared subsequently to the leaves, also added additional cicatrices to the outer surface of the rhizome, and that this was a common, if not constant, occurrence. Why, then, do specimens not show this? They should be common. It is true Zeiller figures a specimen of *Stigmaria* which shows on one side a greater number of cicatrices than on the other side,[4] and these additional scars on one side of the specimen he regards as those left by the roots. The mere fact that at one part of the specimen a greater number of scars occur than at another is no evidence that these additional scars are those of roots. An absolute regularity in the arrangement or number of the scars on the rhizomes cannot be expected in all cases. Surely the root and leaf scars should show some difference in structure, but it is stated, "These two sorts of organs had, however, the same exterior aspect, and they cannot be distinguished the one from the other on the imprint."[5] If these two organs, leaves and roots, have a similar exterior aspect, and when removed from the rhizome leave behind scars indistinguishable from each other, then we have in *Stigmaria* a condition which exists in no other plant, recent or fossil, with which I am acquainted.

Functionally *Stigmaria* performs the duties of a root. I believe of a root alone; but from a true root it differs in the

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[1] Renault, *l.c.*, p. 549.

[2] *l.c.*, p. 551.

[3] Renault, "Étude sur les Stigmaria rhizomes et racines de Sigillaires," *Ann. des Sc. Géol.*, Vol. XII., pp. 23-24, 1881.

[4] *Flore foss. Bassin Houiller d. Valenciennes*, Pl. XCI., figs. 3-4.

[5] Zeiller, *l.c.*, p. 615.

quincuncial arrangement of the rootlets, which in their arrangement are a counterpart of the leaves on the stem. It also differs from typical roots in the structure of the vascular axis and rootlets, which are *collateral* and not centipetally developed. From a typical rhizome it also differs according to the general acceptation of that term, for it has never been shown to give birth to a stem or leaves. It agrees more with a rhizome than a root, in the arrangement of the rootlets and the structure of the vascular axis and the rootlet bundles. Taking, then, the whole circumstances of the case into consideration, Schimper's suggestion is probably the best and only one we are at present warranted in adopting when he asks "if these curious fossils do not represent rather a rhizome than a root."[1] The specimen of *Stigmaria* discovered by Solms-Laubach at Dudweiler, near Saarbruck, which he describes in his *Fossil Botany*,[2] certainly seems to favour this view. After giving a general description of the fossil, he says, "This specimen is particularly important and interesting, because the appendages appear in tolerably good preservation on both sides of the terminations of the axes. They grow successively smaller and shorter as they approach the terminations, and the distances between them diminish. They also become curved in the forward direction, and close together bud-like round the apex. Hence it is only as they develop that they acquire their definite position at right angles to the axis, resembling in this respect foliage leaves."

Although, then, in the description of *Stigmaria*, I have used the terms *rhizome* and *rootlets*, it arises from the necessity of having definite terms to apply to these two organs, and as these two organs have more the character of rhizomes and rootlets than roots and rootlets, in the absence of any other available descriptive word, the former has been adopted.

Stigmaria is a palæozoic type of structure which has no counterpart in recent times.

NOTE.—In addition to the papers to which reference has already been made, the following may be mentioned :—

HOOKER, Sir JOSEPH D., "On Some Peculiarities in the Structure of *Stigmaria*," *Mem. Geol. Survey of Great Britain*, Vol. II., Part 2, p. 431. Plates. 1848.

[1] Schimper, *Traité d. paléont. végét.*, Vol. II., p. 111. 1870.

[2] Solms-Laubach, *l.c.*, pp. 268-269.

MORRIS, J., in J. PRESTWICH, "Geology of Coalbrookdale," *Trans. Geol. Soc. London*, Vol. V., Explanation to Pl. XXXVIII., figs. 3, 3*a*, 3*b*. 1840.

GÖPPERT, H. R., *Die Guttungen der fossilen Pflanzen*, Lief. 1-2, p. 13. Plates. 1841.

BINNEY, E. W., "Some Observations on Stigmaria Ficoides," *Quart. Journ. Geol. Soc.*, Vol. XV., p. 76, Pl. IV., 1858.

BINNEY, E. W., "Observations on the Structure of Fossil Plants found in the Carboniferous Strata, Part IV., *Sigillaria and Stigmaria*," *Palæontographical Soc.*, Vol. for 1875. Plates.

WILLIAMSON, W. C., "On the Organization of the Fossil Plants of the Coal Measures," Part II., *Phil. Trans.*, 1872, p. 197. Plates.

WILLIAMSON, W. C., Part XI., *Phil. Trans.*, Part ii., p. 285, 1881. Plates.

WILLIAMSON, W. C., "A Reply to Mr. Hick," *Nat. Science*, July, 1892, p. 365.

WILLIAMSON, W. C., and HARTOG, "Les Segillaires et les Lepidodendrons," *Ann. d. Sc. Nat.*, Ser. 6, Vol. XIII., 1882, p. 339.

DAWSON, Sir WM., and Prof. W. C. WILLIAMSON, *Nat. Science*, May, 1892, p. 211.

HICK, T., "Is Stigmaria a Root or a Rhizome?" *Nat. Science*, July, 1892, p. 360.

HICK, T., "A Rejoinder," *ibid.*, p. 370.

LESQUEREUX, L., *Coal Flora*, Vol. II., p. 509, 1880.

SCHIMPER, WM. PH., in J. KŒCHLIN-SCHLUMBERGER, *Le Terrain de Transition des Vosges*, p. 323 *et seq.* 1862. Plates.

PLATT, S. S., "Notes on a large Fossil Tree recently found in Shale of the Coal Measures at Sparth Bottoms, Rochdale," *Trans. Manchester Geol. Soc.*, Vol. XXIII., Part iii., Session 1894-95, p. 65. Plates.

VIII. BOTHRODENDRON, Lindley and Hutton, 1833.

1833. *Bothrodendron*, L. & H., *Fossil Botany*, Vol. II., p. 1.

1860. *Cyclostigma*, Haughton, *Ann. and Mag. Nat. Hist.*, 3rd Ser., Vol. V., p. 443.

1876. *Rhytidodendron*, Boulay, *Terr. houil. du Nord de la France*, p. 39.

Arborescent Lycopods ramifying by dichotomous division. Bark ornamented with a series of fine wrinkles and corrugations (*Both. punctatum*, L. & H., and *Both. minutifolium*, Boulay), or striated longitudinally with fine smooth slightly flexuous striæ (*Both. Wükianum*, Kidston), or striate with cross-hatching (*Both. Kiltorkense*, Haughton sp.), or smooth (*Both. Kidstoni*, Weiss). Leaf scars distant, very small, transversely oval or oval with lateral angles more or less prominent, containing three punctiform cicatrices. Resting on or a short distance above the leaf-scar is a small circular cicatricule. Leaves small, lanceolate, single-nerved. Fructification in the form of cones, terminating delicate branches (*Both. minutifolium*, Boulay), or sessile and placed in two opposite vertical rows (*Both. punctatum*, L. & H.), which form cup-like depressions on the older stems, and whose umbilicus is below the centre and near the lower margin.

Subepidermal leaf-scar double (*Both. minutifolium*), in other species single (?) The internal structure of the stem is unknown.

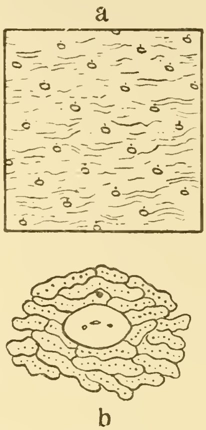

Fig. 14.—*Bothrodendron minutifolium*, Boulay sp. *a*, Portion of stem, natural size; *b*, leaf-scar and ornamentation of bark, enlarged.

Remarks.—Bothrodendron comprises a small but most interesting class of Lycopods, about which, however, there is still much to learn. From the somewhat imperfect description of the genus by Lindley and Hutton, and the absence of enlarged drawings of the leaf-scars, it was presumed by several writers that the genus *Bothrodendron* had been founded on a decorticated specimen of *Sigillaria discophora*, König sp. (= *Ulodendron minus*, L. & H.), and this erroneous view I also originally held.

M. Zeiller has, however, shown most conclusively that *Bothrodendron* forms a most distinct and clearly-defined genus, and at my request most kindly figured and described a specimen of *Bothrodendron punctatum*, L. & H., from Newcastle, presented by Hutton in 1836 to the Museum of Natural History, Paris, on which the leaf-scars are very well preserved.[1]

The leaf-scars are very minute, and the leaves, which are broadly lanceolate, resemble very much those of some Lycopodium.

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[1] *Bull. Géol. Soc. de France*, 3rd Ser., Vol. XIV., p. 168, Pl. VIII., figs. 1 and 1*a*. 1885.

Bothrodendron punctatum, L. & H., ramified by repeated dichotomy.[1] This species is rare in Britain, and I have never had the good fortune to meet with any specimens on which the leaf-scars are well preserved. The fructification of *Bothrodendron punctatum* consisted of sessile cones borne in two opposite vertical rows, which gave rise to the cup-like depressions on the stem. I have seen a number of specimens of the plant in this condition, and they can easily be distinguished from the so-called *Ulodendra* by the umbilicus of the scar being always placed near the lower margin. The stems attained to great size, as indicated by the size of the cone-scars, which reached a longitudinal diameter of four inches (No. 1671).

It has also been shown by Zeiller that the genus *Rhytidodendron*, Boulay, is not generically distinct from *Bothrodendron*, L. & H.

Bothrodendron minutifolium, Boulay sp. (fig. 14), is by far the most common member of the genus, and is frequent in the Middle and Lower Coal Measures of Britain. Like *Bothrodendron punctatum* it possesses a wrinkled and corrugated bark with small oval leaf-scars whose lateral angles are not prominent, but differs from *B. punctatum* in having its fructification in the form of narrow lanceolate cones which terminate the small branchlets.

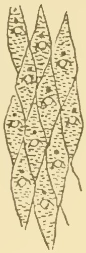

Fig. 15.—*Bothrodendron minutifolium*, Boulay sp. Leaf-scars from young branch, enlarged (No. 1568).

On the smaller and young branches of *Bothodendron minutifolium*, Boulay (and probably on other species also), the leaf-scars are situated on approximated, slightly elevated, elongate rhomboidal cushions, which are ornamented with fine corrugations. The young branches exhibiting these rhomboidal cushions might easily be mistaken for *Lepidodendron* twigs.

At an early period, probably from the increase of the stem in girth, the cushions are entirely effaced and the leaf-scars become distant. As the leaf-scars become more distant, the corrugations

[1] See Zeiller, *l.c.*, Pl. VIII., figs. 2, 2*a*, 2*c*, 3, and 3*a*; also *Flore foss. Bassin houil de Valenciennes*, Pl. LXXVI., fig. 1.

on the bark become more prominent, and are a very characteristic feature of *Bothrodendron punctatum*, L. & H., and *Bothrodendron minutifolium*, Boulay sp. Exquisite figures illustrating this structure have been given by Weiss and Sterzel.[1]

In *Bothrodendron minutifolium*, Boulay sp., the subepidermal scar is double, like that of *Sigillaria*, though on other species it only appears as a longitudinal ridge, but this may arise from the two scars becoming confluent. In some cases the two subepidermal scars are united in their basal extremities, and are continued downwards in a longitudinal ridge, having the appearance of a stalked fork.[2]

The cones of *Bothrodendron minutifolium* are comparatively rare, but, from examples attached to the branches, I was able to identify them as belonging to this species. I have met with very few such specimens.[3]

In a specimen I have figured[4] the cone-bearing branch is very slender and leafy, and the cone is narrow, and, though incomplete, measures $3\frac{1}{2}$ inches long by rather over $\frac{1}{3}$ inch wide. From its state of preservation it is difficult to determine whether the bracts are arranged in whorls or in spirals. The whorls or spirals, as the case may be, are placed very close to each other, being about $\frac{1}{20}$ of an inch apart. The basal or sporangium-bearing portion of the bract springs from the axis at almost a right angle, and the blade rises up from it almost parallel with the axis. The structure of the sporangia cannot be ascertained. If the bracts are in whorls, the structure of the cone differs much from those of *Lepidodendron* and *Sigillaria*, where the bracts are spirally placed on the axis. The cone is also longer and narrower than

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[1] "Die Sigillarien der preussischen Steinkohlen-und Rothliegenden-Gebiete II. Die Gruppe der Subsigillarien."—*Abhandl. der König. Preuss. geol. Landesanstalt.* Neue Folge. Heft. 2, p. 49., Pl. I., figs. 3-4; Pl. II., figs. 8-9, var.; Pl. I., fig. 6; Pl. II., figs. 7 and 10. 1893.

[2] See *Annals and Mag. Nat. Hist.*, 6 Ser., Vol. IV., p. 64, Pl. IV., fig. 5b. 1889. Also, *Proc. Roy. Phys. Soc. Edinburgh*, Vol. X., p. 93, Pl. IV., fig. 5b. 1889.

[3] These specimens have been communicated to me by Mr. Hemingway, from Yorkshire. Their horizon is shale over the Barnsley Thick Coal, Middle Coal Measures.

[4] *Proc. Roy. Phys. Soc. Ed.*, Vol. X., Pl. IV., fig. 6; *Ann. and Mag. Nat. Hist.*, 1889, Pl. IV., fig. 6.

those of most *Lepidodendra*, and much more slender than any known *Sigillarian* cone.

The plant figured by Lindley and Hutton in their *Fossil Flora*, Vol. I., Pl. XII., as *Lepidodendron selaginoides*, is a fine specimen of *Bothrodendron minutifolium*, Boulay sp., and shows well the characteristic leaf-scars. Their figure is most misleading, but the type is fortunately preserved in the Hutton Collection, Newcastle-on-Tyne. Had it not been for the preservation of the type it would not have been suspected that their plant was *Bothrodendron*.

The other British species are *Bothrodendron Wükianum*, Kidston,[1] and *Bothrodendron Kidstoni*, Weiss.[2] They both occur in the Calciferous Sandstone Series, and are extremely rare. Only portions of the stems are known.

Cyclostigma, Haughton, from the Upper Old Red of Kiltorkan, must be placed in *Bothrodendron*. When Dr. Haughton described *Cyclostigma*, the real characters of *Bothrodendron* were not understood. On well-preserved specimens of *Cyclostigma* the leaf-scars are seen to be oval or almost circular, and show slightly above their centre three little cicatricules. The outer surface of the bark between the leaf-scars is ornamented with cross-hatched delicate longitudinal lines. The Geological Department of the British Museum possesses specimens which show these characters very clearly. The leaves are long, linear, single-nerved, and end in a setaceous point.[3]

Weiss[4] includes *Bothrodendron* among the *Sigillaria* as a sub-genus, and though some of its characters point to *Sigillaria*, others militate against this position being given it. The leaf-scars on the older stems agree in some respects with those of *Sigillaria* in their form and arrangement, especially with the *Leiodermaria* section, but the three punctiform cicatricules are very exceptional in *Sigillaria*, while they are constant in *Bothrodendron*, and the leaf-scar on the young branches of *Bothrodendron minutifolium* is surrounded by a "field" scarcely distinguishable from *Lepidodendron*, though it is effaced at an early period. The

[1] See *Annals and Mag. Nat. Hist.* and *Proc. Roy. Phys. Soc.* already mentioned.

[2] *Die Sigillarien d. Preuss. Steinkohlen*, etc., p. 56, Pl. XXVIII., fig. 110.

[3] Kidston, *Catalogue of Palæozoic Plants*, p. 236. 1886.

[4] *l.c.*, pp. 39 and 43.

cone of *Bothrodendron* is also apparently of the *Lepidostrobus* type, and it is certainly very different in general appearance from any known Sigillarian cone. I therefore prefer to assign to *Bothrodendron* a position intermediate between *Lepidodendron* and *Sigillaria*, with which two genera it seems to form a connecting link, though it possesses distinctive characters by which it can be separated at first sight from either.

IX. Sigillaria, Brongniart, 1822.

1820. *Lepidodendron*, Sternberg (in part). *Essai flore monde prim.*, I., fasc. 1, pp. 20 and 25.
1822. *Sigillaria*, Brongniart. *Class. d. végét. foss. (Mém. Mus. Hist. Nat.*, Vol. VIII., p. 9).
1822. *Clathraria*, Brongniart. *Class. d. végét. foss.*, p. 9.
1823. *Rhytidolepis*, Sternberg *Essai flore monde prim.*, I., fasc. 2, p. 36; fasc. iv., p. xxiii.
1826. *Favularia*, Sternberg. *Essai flore monde prim.*, I., fasc. iv., p. xiii.
1860. *Asolanus*, Wood. *Proc. Acad. Nat. Sciences, Philadelphia*, p. 237.
1877. *Pseudosigillaria*, Grand 'Eury. *Flore carbon. du Départ. de la Loire et du centre de la France*, p. 142.
1841. *Calamosyrinx*, Petzholdt. *De Balano et Calamosyringe*, p. 28 (Dresden and Leipzig).

Decorticated Conditions.

1820. *Syringodendron*, Sternberg. *Essai flore monde prim.*, I., fasc. 1, pp. 23 and 26; fasc. iv., p. xxiv.
1826. *Catenaria*, Sternberg. *Essai flore monde prim.*, I., fasc. iv., p. xxv.

Arborescent Lycopods, with cactus-like or columnar trunks, or very sparingly dichotomously-branched stems. Outer surface longitudinally ribbed or smooth. Leaf-scars contiguous or distant, hexagonal, with more or less rounded angles, the two lateral angles being most prominently developed; cicatricules three, small, the central punctiform, elongate, or sub-triangular, the two lateral, lunate or straight, larger than the central vascular bundle-scar. Leaf-scar frequently placed on a more or less prominent elevation, in which case it holds a backward sloping position in relation to the surface of the cortex. A small cicatricule frequently occurs immediately above the leaf-scar. Subepidermal cicatrices three, the two lateral large, lunate or straight, united in the centre by a circular or oblong scar; or two, through obliteration of central scar, straight or lunate, frequently attaining a considerable size on old stems, or single, through confluence of the two lateral scars. Subepidermal surface striated longitudinally. Leaves linear-lanceolate or long and grass-like, single-nerved. Fructification *(Sigillariostrobus)* strobiliform, caducous, stalked, leaving scars on the bark, which are placed in the hollows between the ribs, or on the ribs, or between the leaves on the non-ribbed species, irregularly disposed or forming verticils of greater or less width, or sessile and placed in two opposite vertical rows, when, from the pressure of the cone on the bark, cup-like depressions are formed on the stem, whose umbilicus is approximately central (*Ulodendron* in part). Rhizome, in some species *Stigmaria*, in others *Stigmariopsis*.

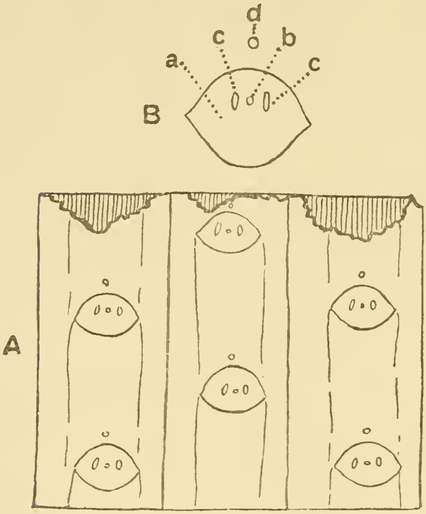

Fig. 16.—*Sigillaria principis*, Weiss. Old Mills Pit, Farrington-Gurney, Somerset. *Hor.* Lower Series of the Upper Coal Measures. A, natural size; B, leaf-scar enlarged; *a*, area of scar; *b*, cicatrice of vascular bundle; *c c*, parichnos; *d*, "ligule" scar. (No. 421.)

Section I.[1]—Rhytidolepis, Sternberg, 1823.

Stem ribbed, ribs separated by distinct furrows, straight or slightly flexuous, surface smooth or variously ornamented; leaf-scars alternate, occupying the whole width or

[1] These sections are only used as a means of dividing a large and difficult genus into convenient groups, and must not be regarded as of sub-generic value.

only part of the width of the ribs, distant or approximate, frequently having a transverse lunate depression above the scar. Cone-scars situated in the furrows. Type, *Sigillaria (Rhytidolepis) ocellata*, Sternb. Typical form, *Sigillaria scutellata*, Brongt.

Section II.—Favularia, Sternberg, 1826.

Stem ribbed, ribs flexuous, divided into sub-hexagonal compartments by transverse depressions; leaf-scars alternate, approximate, or only separated by a very short distance, usually occupying the width of the rib. The lateral angles of the leaf-scars project slightly, and alternate with those of the neighbouring ribs, imparting to the longitudinal furrows a more or less zigzag course.

Its chief distinguishing character is the approximate leaf-scars and zigzag furrows. Type, *Sigillaria (Favularia) alveolaris*, Sternb. Typical form, *Sigillaria elegans*, Sternb. sp.

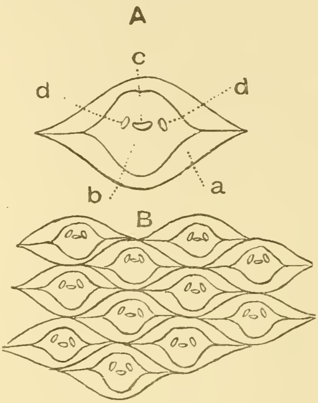

Fig. 17. — *Sigillaria Brardii*, Brongt. Cope's Marl Pit, Longton, Staffordshire. Shale above Peacock coal, Middle Coal Measures. A, Leaf cushion (*a*). Leaf-scar (*b*); *c*, cicatricule of vascular bundle; *d d*, parichnos; enlarged. (No. 817.)

Section III.—Clathraria, Brongt., 1822.

Cancellata, Weiss. *Foss. Flora der jüngst. Steinkohlf. u. d. Rothliegenden*, p. 161. 1869.

Stems without ribs, leaf-scars placed on contiguous rhomboidal slightly elevated cushions, which are separated by deep oblique furrows. Cone-scars placed in the furrows between the leaf-cushions. Type, *Sigillaria Brardii*, Brongt.

Section IV.—Leiodermaria, Goldenberg, 1857.

Leiodermaria, Goldenberg. *Flora sarœp. foss.*, Heft. 2, p. 7. 1857.

Stem without ribs, leaf-scars distant and leaf-cushions absent. Surface of bark between the leaf-scars variously ornamented with fine longitudinal flexuous striæ, frequently cross-hatched with delicate lines. Type, *Sigillaria leioderma*, Brongt. Typical form *Sigillaria Brardii*, forma *spinulosa*, Germar sp.

Remarks.—The two sections, *Rhytidolepis* and *Favularia*, pass into each other, and only in a few species are distinctly separable. In practice, *Favularia* is seldom mentioned now even as a section of *Sigillaria*, as all the species originally placed in it fall naturally into the *Rhytidolepis* Section. It is only the zigzag appearance of the furrows, brought about by the projecting lateral angles of the alternate leaf-scars, which has given rise to the separation of these forms into different sections.

In the *Rhytidolepis* Section the leaf-scars are almost always more or less distant, and the ribs frequently enlarge slightly at the part where the leaf-scar is placed, which imparts to the furrow a slightly wavy course. The surface of the ribs is seldom, if ever, entirely free from surface ornamentation, for even in *Sigillaria ovata*, Sauveur, which is generally supposed to have a smooth bark, when well-preserved specimens are examined with a lens its outer surface is seen to be covered with very short, fine transverse lines. These impart a granular appearance to the surface. A similar condition occurs in other species with "smooth ribs." Such delicate lines are, however, frequently effaced through imperfect preservation.

The most common form of ornamentation is two rows of short transverse lines or notches, which extend from the base of the leaf-scar, separating as they proceed, till they reach, or nearly reach, the scar below them.

A short distance above the leaf-scar is frequently a transverse lunate or straight furrow, accompanied by a few faint irregular transverse lines, and immediately above the scar is generally seen a small punctiform cicatricule.

The leaf-scar in many species rises up towards its lower margin; this is well seen in *Sigillaria mamillaris*, Brongt. This character was probably more constant than generally supposed, but has been effaced in the majority of cases through pressure.

The ornamentation of the interfoliar space of the rib varies much in the different species. In *Sigillaria scutellata* it consists of one irregular band down the centre of the rib, which extends almost to the succeeding leaf-scar, and above the leaf-scar are fine lines which cluster round the small punctiform cicatricule.

In some species, such as *Sigillaria rugosa*, Brongt., *Sigillaria elongata*, Brongt., and *Sigillaria Deutschi*, Brongt., the ornamentation forms a very distinct band extending from one leaf-scar to the other, and thus divides the rib into three longitudinal tracts, the two lateral being smooth and the central ornamented, and bounded by the two lateral lines which descend from the lateral angles of the leaf-scar. The ornamentation of the central band consists of short transverse ridges or dots, or a mixture of both. The markings are generally stronger immediately beneath the leaf-scars, and become more faint as they reach the next lower scar, shortly above which they generally assume a slightly different arrangement. Modifications of this form of ornamentation occur.

The cone-scars form verticils, sometimes of a single series of sub-circular or oval cicatrices, as in *Sigillaria elegans*. In *Sigillaria tessellata* and other species the cone-scars form broad verticils, the number of contiguous cone-scars placed in vertical rows varying from three to twenty.[1] The cone-scars are frequently deformed from the pressure of the ribs, and at the same time they generally cause a deformation of the leaf-scars in their immediate neighbourhood.

The remaining two sections—*Clathraria* and *Leiodermaria*—are also most intimately connected. The conditions which gave rise to these two groups have not only been found in the same species, but on the same specimen, though some species seem only to possess a *Leiodermarian* condition.

Weiss was the first to point out that *Sigillaria Brardii*, Brongt. (belonging to the *Clathraria*), passed by gradual transitions into *Sigillaria spinulosa*, Germar (*Leiodermaria* Section), and that this latter species was consequently only a condition of the former.[2]

Shortly afterwards M. Zeiller figured a specimen showing the organic union of *Sigillaria Brardii*, Brongt., and *Sigillaria*

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[1] Zeiller, *Flore foss. Bassin houil. de Valenciennes*, Pl. LXXXV., figs. 1 and 5.

[2] Weiss, *Zeitsch. d. deut. geol. Gessell*, 1888, p. 566.

spinulosa, Germar.[1] It was also shown that *Sigillaria rhomboidea*, Brongt.,[2] only represented an intermediate state.

In 1893 appeared a most elaborate memoir, by the late Dr. Weiss and Dr. T. Sterzel,[3] on the Clathrate and Leiodermarian Sigillariæ. Here are most admirably figured and described many forms of *Sigillaria Brardii*, including conditions which were at one time supposed to represent distinct species.

A very interesting specimen (No. 818), showing the organic union of *Sigillaria Brardii*, Brongt., *Sigillaria denudata*, Göpp.,[4] and *Sigillaria rhomboidea*, Brongt., from a railway cutting, Florence Colliery, Longton, North Staffordshire, which was collected by Mr. F. Barke, was figured by myself in 1896.[5] In the *Sigillaria Brardii* form the leaf-scars are placed on slightly-elevated cushions, but in the *Sigillaria denudata* state the leaf-cushions are entirely effaced.

Weiss has suggested that the Leiodermarian forms of *Sigillaria Brardii* (*Sigillaria spinulosa*, *Sigillaria denudata*, &c.) may represent an older condition of the plant—a condition brought about by the increase in the girth of the stem, which has caused the leaf-scars to be drawn apart and the leaf-cushions to be effaced. In some cases this may probably explain the occurrence of the Leiodermarian condition, but at other times it may have been caused by a period of more rapid growth.

But it must be noted that the approximation and separation of the leaf-scars is not restricted to the *Clathraria-Leiodermaria* Sections of *Sigillaria*. The same phenomenon occurs in the *Rhytidolepis* Section. I have figured a specimen of *Sigillaria reniformis*, Brongt.,[6] from Hampstead Colliery, Great Barr,

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[1] Zeiller, *Bull. Soc. Géol. d. France*, Sér. 3, Vol. XVII., p. 603, Pl. XIV., fig. 1. 1889.

[2] *Hist. d. végét. foss.*, p. 425, Pl. CLVII., fig. 4.

[3] "Die Sigillarien der preuss. Steink. u. Rothl. Gebiete. II. Die Gruppe der sub-Sigillarien."—*Abhandl. d. König Preuss. Géol. Landesanstalt.* Neue Folge, Heft. 2, Berlin, 1893, pp. i.-xvi. and 1-225, with atlas of xxviii. plates.

[4] *Die foss. Flora d. permischen Formation*, p. 200, Pl. XXXIV., fig. 1.

[5] *Proc. Roy. Phys. Soc. Edin.*, Vol. XIII., p. 233, Pl. VII., fig. 1.

[6] *Trans. Roy. Soc. Edin.*, Vol. XXXV., Part 5, p. 327, Pl. I., fig. 11. 1888.

Staffordshire, showing an approximation of the leaf-scars on the lower half of the fossil. Similar conditions are shown on a specimen of *Sigillaria mamillaris*, Brongt., given by Lesquereux,[1] and on *Sigillaria Sauveuri*, figured by Zeiller,[2] and many other cases can be cited.[3]

I possess a specimen of *Sigillaria Sauveuri*, Zeiller, from Longton Hall Colliery, Longton, Staffordshire (No. 2199), for which I am indebted to Mr. John Ward, F.G.S., which shows a similar approximation of the leaf-scars to that shown on the specimen figured by Zeiller. Another specimen in my collection which I have provisionally referred to, *Sigillaria Boblayi*, Brongt. (No. 1879), not only shows an approximation and lessening of the leaf-scars, but a sudden narrowing of the ribs, which must have caused a great reduction in the diameter of the stem. All these specimens probably represent an enfeebled state of growth; in some cases the enfeebled portion is succeeded by the normal condition of the species as to the size of the leaves and their distance apart. It is difficult to suggest a cause for these apparently enfeebled states of growth; probably they may have resulted from unfavourable climatic conditions.

In the *Clathraria* Section of *Sigillaria* the cone-scars are distributed on the stem in two distinct modes of arrangement.

On the typical form of *Sigillaria Brardii* the cone-scars form an irregular girdle round the trunk, and are placed in the furrows which divide the leaf-cushions. Normally they are circular with a raised border, and in the centre show the cicatrice of the vascular bundle which passed into the cone pedicil. The cone-scars are, however, usually deformed from the pressure of the surrounding leaf-cushions, and in turn they produce in most cases a great deformation of the leaf-cushions and leaf-scars. The cone-scars measure about $\frac{1}{8}$ inch in diameter, but their size

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[1] *Coal Flora*, Vol. III., Pl. CVIII., fig. 6. 1884.

[2] *Flore foss. Bassin houil. d. Valenciennes*, Pl. LXXXIV., fig. 1. 1886.

[3] Potonié, "Die Wechsel-Zonen-Bildung der Sigillariaceen."—*Jahrbuch der König Preuss. Géol. Landesanstalt fur 1893* (1894), p. 24, Pls. III.-V. Frech., *Lethæa geognostica*, 1 Theil. *Lethæa palæozoica*, 2 Band, 2 Lief., Pl. L*b*, fig. 12 *(Sigillaria Brardii)*. Stuttgart, 1899. *Sigillaria Brardii* and *Sigillaria dimorpha* (=*Sigillaria camptotœnia*, Wood sp.). *Géol. et Paléont. du Bassin Gard.*, Pl. XI., fig. 1, and Pl. IX., fig. 7.

varies according to the amount of lateral pressure to which they have been subjected.[1] The cones have evidently been stalked.

On the form of *Sigillaria Brardii*, described by Germar as *Sigillaria spinulosa*,[2] are a number of small circular scars with a raised margin and central depression. These occur without any definite order, are either single or in pairs, and are generally placed below the leaf-scars and not far distant from them. Owing to the absence of lateral pressure these small scars on *forma spinulosa* are always circular. They were supposed by Germar to be the scars of deciduous spines. Schimper[3] and Renault,[4] however, think they are the scars of aerial rootlets, and that view was shared in by Weiss and Sterzel.[5]

I am more inclined to regard these scars as cone-scars, and similar to those on *Sigillaria Brardii*, which I think undoubtedly mark the position of deciduous stalked cones.[6]

Renault, in describing a specimen of *Sigillaria Brardii*, on whose cone-scars were still attached fragments of small branches, 1 to 2 cm. long by 5 mm. in diameter, states that these spring perpendicularly from the stem, and bear small foliage cicatrices, which are distant from each other, instead of being contiguous like those of the main stem. It is certain here that the scars in question did not bear aerial rootlets, and one appears to be justified in believing that, whatever organ the small circular scars between the cushions bore on *Sigillaria Brardii*, the same organ was most probably borne by the similarly-formed scars in *Sigillaria Brardii forma spinulosa*.

In the other arrangement of the fructification the cones were borne in two opposite vertical rows, the cones on one side

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[1] Kidston, *Proc. Roy. Phys. Soc. Edin.*, Vol. XIII., Pl. VII., figs. 2, 2*a*.

[2] Germar, *Vers. d. Steink. v. Wettin u. Löbejun*, Heft. V., p. 28, Pl. XXV., figs. 1-2. Refigured by Weiss and Sterzel, *l.c.*, Pl. X., fig. 50; Pl. XI., fig. 50*a*.

[3] Schimper, *Traité d. paléont. végét.*, Vol. II., p. 102. 1870.

[4] Renault, *Cours d. botan. foss.*, 1881, p. 131.

[5] Weiss and Sterzel, *l.c.*, p. 107.

[6] For figures see—Zeiller, *Végét. foss. terr. houil. de la France*, Pl. CLXXIV., fig. 1; Renault, *Cours d. botan foss.*, 1881, Pl. XVII., fig. 1; Kidston, *Proc. Roy. Phys. Soc. Edin.*, Vol. XIII., Pl. VII., figs. 2 and 2*b*; Sterzel and Weiss, *l.c.*

alternating with those on the other side. I only know of two species belonging to the *Sigillariæ* which bore their fructification in this manner, and both belong to the Clathraria group. One of these is *Sigillaria discophora*, König sp.[1] (=*Ulodendron minus*, L. & H.[2]). The leaf-scars of this species are characteristically Clathrarian, and on a specimen from Bonnyton Pit, Kilmarnock,[3] the three cicatricules are distinctly preserved (No. 1298).[4]

The other species is the *Sigillaria Taylori*, Carr. sp.,[5] from the Carboniferous Limestone and Calciferous Sandstone Series. The leaf-scars are small, but also Clathrarian.

In these two plants the sessile cones are borne on the older stems, and the cup-like depressions on the bark have been caused by the pressure of the base of the cone, but after the fall of the cones—which seem to have been caducous in all the *Sigillaria*—the cup-like depressions, as well as the leaf-cushions and scars, increased in size as the bark increased in diameter with the growth of the trunk, though in old stems the bark also becomes longitudinally fissured, as in some *Lepidodendra*. On a specimen of *Sigillaria discophora* from near Halifax, which was given to me by Mr. William Cash, F.G.S., the cone-scar is fully 5 inches

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[1] König, *Icones fossilium sectiles*. London, 1825. The first part, Plates I.-VIII., was issued in 1825. The subsequent parts are said not to have been issued. It is quoted, however, by Bronn in *Index Palæontologicus*, Stuttgart, 1848. The *Sigillaria (Lepidodendron) discophora* occurs on Pl. XVI., fig. 194. If it is the case that this plate was never issued publicly, then Lindley and Hutton's name of *Sigillaria (Ulodendron) majus* should have priority, but as there is still doubt as to what plant the *Ulodendron majus*, L. & H., really represents, the use of König's name prevents all confusion. I believe *U. majus*, L. & H., and *U. minus*, L. & H., represent different ages of the same species. *U. minus*, L. & H., is certainly the *Sigillaria discophora*, König sp. A cast of König's specimen is contained in the collection of the British Museum (Geol. Department), and the counterpart of the type of *U. minus* is in the Hutton Collection, Newcastle-on-Tyne.

[2] Lindley and Hutton, *Fossil Flora*, Vol. I., Pl. VI. 1831.

[3] From Shale over the Whistler Seam, Lower Coal Measures. Received from the Rev. D. Landsborough.

[4] Kidston, *Proc. Roy. Phys. Soc. Edin.*, Vol. X., p. 91, Pl. IV., fig. 1; also, *Annals and Mag. Nat. Hist.*, Ser. 6, Vol. IV., Pl. IV., fig. 1. 1889.

[5] "*Ulodendron Taylori*, Carruthers," *Monthly Micros. Journ.*, Vol. III., p. 152, Pl. XLIII., fig. 1, 1870.

in diameter, and the leaf-scar measures a quarter of an inch across (No. 2135).[1]

In both *Sigillaria discophora* and *Sigillaria Taylori* the cone scars are usually more or less distant, but in the former species I have observed on some specimens the cone-scars little distant from each other, or even touching (No. 423), when the plant becomes the *Sigillaria* (?) *(Ulodendron) sub-discophora*, Weiss and Sterzel, which, however, is merely a varietal form of *Sigillaria discophora*, König sp.[2]

The Ulodendroid *Sigillariæ* and *Lepidodendræ* are frequent in Scotland, and I have been able in *Lepidodendron Velthemianum*, Sternb., to trace the formation of the cup-like depressions from its earliest condition to that of their occurrence on aged stems. In the earliest state the young cone is placed on a slightly-elevated blunt boss, on the whole of whose surface the leaf-scars are still present, radiating in spirals from the point to which the cone is attached, which point subsequently forms the umbilicus of the scar.[3] Gradually the bark grows up round the base of the sessile cone, and thus a cup-like depression is formed, which continues to increase in size after the cone has been shed. During the period of attachment of the cone the pressure exerted by its base on the bark effaces the leaf-scars, whose existence is eventually only indicated by the little "dot" of their vascular bundle.

Professor D'Arcy Thomson figured a specimen of *Sigillaria Taylori* with a cone attached to the stem,[4] under the name of *Ulodendron minus*. Another example showing the cones attached in a young condition, and now in my possession (No. 16), was discovered by Dr. Macfarlane in the Midlothian Oil Shales. This specimen I figured and described in 1885.[5]

The stem of *Sigillaria* seems very rarely to have been branched, and certainly never to have produced the much-dichotomously

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[1] From Nab End Fly, near Halifax, Yorkshire. Millstone Grit.

[2] *Die Sigillarien der preuss. Steink. u. Rothl. Gebiete.* II. *Die Gruppe der Subsigillarien*, p. 58, Pl. XXVIII., fig. 107. 1893.

[3] Kidston, *Ann. and Mag. Nat. Hist.*, Ser. 5, Vol. XVI., p. 163, Pl. IV., fig. 2. 1885.

[4] *Trans. Edin. Geol. Soc.*, Vol. III., Part iii. 1880.

[5] Kidston, *Annals and Mag. Nat. Hist.*, *l.c.*, Pl. V., fig. 9.

divided ramification of *Lepidodendron or Bothradendron* (i.e., *Bothradendron minutifolium*, Boulay sp.). In some cases the stem consisted of a narrow conical trunk, as figured by Goldenberg.[1] This stem was 18 feet in height.[2] In other cases the stems of *Sigillaria* seem to have diminished little in girth but to have possessed an upright columnar mode of growth. Of this type Goldenberg has also given figures.[3] Two good Sigillarian stems of this form are preserved in the Museum, Newcastle-on-Tyne, and another in the Sunderland Museum. All these columnar stems belong to the Rhytidolepis Section.

In the Rhytidolepis Section the ribs increased in number as the plants advanced in age. Hand specimens occasionally show the interpolation of an additional rib, and such have already been figured.[4] I have also specimens showing the same occurrence; but the most beautiful example with which I am acquainted is a trunk in the Sunderland Museum. It shows the lower portion of a stem, 6 feet 6 inches in height. It is slightly bottle-shaped at the base, where it measures 5 feet in circumference. On this part of the stem there are 29 broad ribs. About two feet from the base many of these ribs *divide*, and their number is then increased to 40, with a stem circumference of 3 feet about four feet from the base. All these additional ribs do not arise from a division of the primary basal ribs, but new ribs, with pointed extremities, are inserted between the older ones; thus, about 6 inches below the broken-over extremity of the trunk, there are 45 ribs, though the stem is considerably smaller than at the base, where the number is 29.[5] A transverse section of such a specimen, supposing its internal structure were preserved, would show at the base a much smaller number of leaf-traces than a section taken immediately below the broken-over extremity.[6]

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[1] Goldenberg, *Flora Saræpont. foss.*, Pl. B., fig. 13.

[2] See also Goldenberg, *l.c.*, Pl. IV., fig. 1; Grand 'Eury, *Géol. et Paléont. du Bassin houil. du Gard*, Pl. XIII., figs. 7, 8, 9, 10. 1890.

[3] Goldenberg, *l.c.*, Pl. X., fig. 6.

[4] Zeiller, *Flore foss. Bassin houil. d. Valenciennes*, Pl. LXXVIII., fig. 3 (*Sig. lævigata*). Pl. LXXXV., fig. 1 (*Sigillaria tessellata*).

[5] See Goldenberg, *Flora Saræpont. foss.*, Heft. I., pp. 26 and 37-38, Pl. IV., fig. 1.

[6] Kidston, *Trans. Roy. Soc. Edin.*, Vol. XXXIX., Part 1 (No. 5), pp. 46-47. Woodcut.

In the *Rhytidolepis Sigillariæ* branching appears to be extremely rare, and the only specimen of this section which I have seen exhibiting a dichotomized stem was an example of *Sigillaria tessellata* found by Mr. George Wild at Bardsley Colliery in a bed of shale, about 50 feet below the "New Mine."[1]

In the scarcely separable *Favularia* Section three figured specimens showing a bifurcation recall themselves—two of *Sigillaria elegans*[2] and one of *Sigillaria Eugenii*, Stur.[3]

The *Clathraria Sigillaria* also branched, but apparently very sparingly. Renault gives a figure of *Sigillaria Brardii* showing a dichotomy.[4] Possibly the *Sigillaria Brardii* figured by Germar,[5] and re-figured by Weiss and Sterzel,[6] may be also a portion of a bifurcated example.

Examples showing the foliage attached to the stem, though rare, are occasionally met with. In some the leaves are narrow lanceolate, as on *Sigillaria discophora*, König sp., and on others long and grass-like, as on *Sigillaria camptotænia*, Wood sp.

The leaves appear to have been articulated, otherwise how can one explain the occurrence of the clearly-defined leaf-scar which is almost universally met with throughout the genus, the only exception being perhaps *Sigillaria discophora* and *Sigillaria Taylori*, where the leaf seems to have remained long attached to the stem and eventually withered off, as clearly-defined leaf-scars are all but unknown in the case of these two species.

Some species of *Sigillaria* had *Stigmaria* as their rhizomes. This was the form attached to some *Rhytidolepis* trunks. It is

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[1] Wild, "On a Section of Shaft sunk through the Middle Coal Measures at Bardsley Colliery, and an interesting discovery of Calamites," *Manchester Geol. Soc.*, Feb. 2, 1886.

[2] Roehl, *Foss. Flora d. Steinkohlen Form. Westphalens*, Pl. XXVIII., fig. 17, 1869; Achepohl, *Das Niederrheinsch-Westfälische Steinkohlen-Gebirge.*, Pl. IX., fig. 20, 1880. The bifurcated specimen figured by Potonié—*Lehrbuch d. Pflanzenpalæontologie*, 1899, Pl. III., fig. 1, "*Favularischer-Sigillaria-Gabelzweig*"—is probably referable to *Sigillaria elegans*.

[3] Stur, *Culm Flora*, Heft. II., Pl. XXV., figs. 2-3. 1877.

[4] *Bassin houil. et perm. d'Autun et d'Épinac. Flore foss.* Deux part, 1893, Pl. XXXV.

[5] *Vers. d. Steink. v. Wettin u. Löbejun*, fasc. III., Pl. XI.

[6] *Die Sigillarien d. preuss. Steink.-u. Rothl. Gebiete II. Die Gruppe der Subsigillarien*, Pl. XV., fig. 61. 1893.

equally clear that *Stigmariopsis* was the rhizome of some other species of *Sigillaria.* In no case, however, where the rhizome has been found attached to the trunk, has it been possible to determine satisfactorily the species to which the trunk belonged, though the generic determination of several examples is placed beyond dispute.

Internal Organization.—Our first knowledge of the internal structure of *Sigillaria* is due to Brongniart,[1] who in 1839 described a small specimen about 2 cm. long and 4 cm. in diameter, which he identified as *Sigillaria elegans.*[2]

It consisted of a cortical cylinder, on whose outer surface the leaf-scars were preserved, from which not only the genus but the species has been identified. Within the cortex lay the vascular cylinder, separated from it by a clear space, from which the intervening tissue had decayed. The vascular cylinder was composed of a number of distinct but contiguous vascular wedges, forming a hollow cylinder about 14 mm. in diameter, but the width of the vascular band itself was only 1 mm. The pith which once filled this hollow cylinder had entirely disappeared. Such is a general description of the arrangement of the parts of the stem, which must now be considered in fuller detail.

Vascular Zone.—Each of the vascular wedges forming the xylem portion of the stem is composed of two parts—the inner primary or centripetally developed zone, and an exogenous or centrifugally developed zone.

In transverse section the primary bundles have the form of a segment of a circle, whose convexity points towards the centre of the stem. The tracheides composing it are arranged without any definite order. The larger tracheides occupy the inner part of the bundle, their walls being marked by transverse

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[1] *Observations sur la Structure intérieure du Sigillaria elegans comparée a celle de Lepidodendron et des Stigmaria et a celle des végétaux vivants. Archives du Museum,* Vol. I., pp. 405-461, Pls. XXV.-XXXV. (I.-XI.). 1839.

[2] This specimen was so identified by Brongniart in error. In reality it appears to be his *Sigillaria menardi, Hist. d. végét. foss.*, Pl. CLVIII., fig. 6 (?not fig. 5), which again is only a young state of *Sigillaria Brardii,* Brongt., the type of the *Clathraria* Section of *Sigillaria.* See Zeiller, *Ann. d. Sciené Nat.*, 6e Sér. Bot., Vol. XIX., p. 259, 1884; also Weiss, *Sitz. Bericht d. Gesell. natur Freunde.*, Berlin, No. 5, p. 70. 1886.

thickenings (scalariform) or spiral striæ, some tracheides having one kind of thickening, some the other, and occasionally both forms of marking occur on the same tracheide. The smaller tracheides are placed externally, and contain spiral fibres.

The exogenous zone is formed of scalariform tracheides in radiating series, separated by medullary rays. Those in the inner portion of the exogenous zone are small, but increase in size as they proceed outwards, and become almost as large at the periphery of the bundle as the large tracheides of the primary bundle. In transverse section they are roughly hexagonal in form.

The smallest vessels of the exogenous zone are in contact with the smaller tracheides of the primary bundles, and form at their point of contact a distinct line of demarcation between the primary and exogenous portions of the xylem.

In tangential section the medullary rays are seen to be composed of plates of cellular tissue of little vertical extent, generally of one series of cells, but occasionally they are of more than one cell layer in thickness.

Outside of the exogenous zone, and situated close to it, are small isolated lenticular or circular bundles, composed of small uniform tissue disposed without order. These are the foliar bundles, which spring from the outer surface of the primary xylem, and are entirely composed of scalariform tracheides.

The cortical envelope is composed of two distinct layers, which are intimately connected and pass almost insensibly into each other. The inner layer or zone is formed of elongated prosenchymatous fibres, very dense, and terminated by oblique extremities; and as many of the contiguous cells are of about the same length, their terminations form zigzag lines. They are placed in regular uniform radiating series, and their walls are destitute of markings.[1] The outer portion is composed of parenchymatous tissue, more or less regular; the smooth cells are closely packed without lacunæ, and are not arranged in radiating series, nor are they parallel to the surface. In the epidermal region their walls appear to be thickened, and form the surface of the leaf-cushion.

In this type of Sigillarian stem structure the wedges of the vascular system, though contiguous, are perfectly distinct, and,

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[1] This is probably developed from a phellogen zone, as in *Lepidodendron*.

from the presence of an exogenous zone, *Sigillaria* was supposed to represent a phanerogamous type of plant structure. It is now well known, however, that the presence of an exogenous zone is characteristic of palæozoic cryptogams.[1]

For many years nothing was added to the knowledge of the internal structure of *Sigillaria* until Renault and Grand 'Eury described the structure of a specimen they identified as *Sigillaria spinulosa*.[2] This specimen shows the same type of vascular structure as that originally described by Brongniart, and it was supposed that the separate bundles, composed of primary and secondary xylem, which formed the hollow vascular cylinder, gave to *Sigillaria* a type of structure peculiar to itself and quite distinct from that of *Lepidodendron*, where both the primary and secondary xylem formed a *closed* ring—that is, that in *Lepidodendron* the vascular system did not consist of a number of separate bundles, but of a ribbon-like band. This distinction does not really exist, for the so-called *Sigillaria* type passes insensibly into the *Lepidodendron* type. Solms-Laubach has pointed out in the specimen of *Sigillaria spinulosa* which he figures in his *Fossil Botany* that some of the primary vascular bundles are clearly united laterally,[3] and in a specimen of the same species, which was most kindly given to me by Monsieur Renault, the lateral union of the primary bundles is more complete.[4] In this example there is, in part at least, the occurrence of the closed primary bundle of *Lepidodendron*.

There is also in the British Museum a specimen of a *Rhytidolepis-Sigillaria*, with the internal structure preserved, still awaiting description, but which, according to the statement of Williamson and Hartog, "has the continuous cylinder and all the internal organization of Corda's *Diploxylon*."[5] I had also

[1] A secondary development of tissue occurs in the bundle of *Isoëtes*. See A. de Bary, *Comparative Anatomy of the Vegetative Organs of the Phanerogams and Ferns*, English Ed., p. 623. 1884.

[2] "Recherches sur les végétaux silicifiés d'Autun : Étude du *Sigillaria spinulosa*." Mém. présentés par divers savants a l'Acad. d. Sciences, Vol. XXII. 1875. Paris.

[3] *Fossil Botany*, English Ed., p. 253, fig. 29. 1891.

[4] Kidston, *Trans. Roy. Soc. Edin.*, Vol. XXXIX., Part i., No. 5, p. 41, figs. A, B, C. 1897.

[5] See Solms-Laubach, *Fossil Botany*, p. 254.

the pleasure of seeing, in the possession of Professor Bertrand this summer, sections from another *Rhytidolepis-Sigillaria* in which the structure was also preserved. Here there was the closed primary xylem zone, surrounded by secondary exogenous xylem; and had it not been for the preservation of the outer surface of the specimen, which showed the fossil to be a *Sigillaria*, I do not believe it would have been possible, from the study of the vascular axis alone, to separate this specimen from that type of structure which has usually been regarded as distinctive of *Lepidodendron*.[1]

This may explain why *Sigillariæ* showing structure appear to be so rare in the Lancashire and Yorkshire beds, which have yielded so much fine material for the study of the internal organization of the Coal Flora. *Sigillaria* may not then be so rare as generally supposed, for, in dealing with vascular axes deprived of their bark, the chief, if not only, character by which we could separate *Sigillaria* from *Lepidodendron* in the absence of their fructification is lost.

The fructification of *Sigillaria* will be considered under the genus *Sigillariostrobus*, Schimper, as we are unable at present to refer the cones to their parent stems.[2]

X. SIGILLARIOSTROBUS, Schimper, 1870.

1870. *Sigillariostrobus*, Schimper. *Traité d. paléont. végét.*, Vol. II., p. 105.

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[1] Rept. Brit. Assoc. Dover, 1899, p. 926. 1900.

[2] See also Renault, *Cours d. botan. foss.*, 1881, p. 138; Renault, *Structure comparée de quelques tiges de la Flore Carbonifère*, p. 225. 1879. (Thèses pres. a la Faculté de Sciences d. Paris.) Renault, *Bassin Houiller et Permien d'Autun et d'Épinac. Flore foss.* Deux. part, p. 184. 1896. Grand 'Eury, *Geologie et Paléontologie du Bassin Houilier du Gard*, pp. 196-197, p. 238 *et seq* 1890. I wish to take this opportunity for correcting an erroneous statement made in my second paper "On the Fossil Flora of the Yorkshire Coal Field" (*Trans. Roy. Soc. Edin.*, Vol. XXXIX., Part i., No. 5, 1897). On page 39 I say, quoting from Mons. Grand 'Eury, *l.c.*, p. 258—"For me, in any case, there is not a doubt that the celebrated silicified *Sigillaria elegans* from Autun, which is the *Sigillaria Brardii* with the structure of a Dicotyledonous gymnosperm, has *not* been reproduced by spores." The *not* in italics should be deleted.

1884. *Sigillariostrobus*, Zeiller. *Ann. d. Science Nat.*, 6e Sér. Bot., Vol. XIX., p. 256.

1888. *Sigillariostrobus*, Zeiller. *Flore foss. Bassin houil. d. Valenciennes*, p. 391.

1897. *Sigillariostrobus*, Kidston. *Trans. Roy. Soc. Edin.*, Vol. XXXIX, Part i., p. 49.

Cones sessile or borne on deciduous peduncles with few leaves, or the leaves reduced to bract-like structures, cylindrical, composed of a ligneous axis bearing spirally arranged sporophylls. Bracts entire or ciliate at margin, rhomboidal acute, or lanceolate, with an expanded rhomboidal base, caducous. Sporangia contained in the hollow inflated base of the sporophyll. Macrospores 0·75 mm. to 2·00 mm. in diameter, surface smooth or covered with small apiculi. Under surface marked with three ridges which radiate from the centre. Microsporangia probably present.

Remarks.—Goldenberg was the first to refer to *Sigillaria* certain cones as their fructification.[1] That figured on his Pl. X., fig. 1, he thought might be referable to *Sigillaria tessellata*, and that at fig. 2 of the same plate to *Sigillaria intermedia*. Some other figures of portions of cones are also given by the same author.[2] For these fructifications Schimper founded the genus *Sigillariostrobus*.

The reference of these cones to *Sigillaria* was suggested chiefly on the evidence of their association with stems of that genus—evidence of a very inconclusive nature; and it was not till the discovery by Mons. Zeiller thirty years later of a similar cone attached to a pedicel bearing Sigillarian leaf-scars that Goldenberg's cones could be accepted as undoubtedly the fructification of *Sigillaria*.[3]

This discovery not only proved the accuracy of Goldenberg's conclusions as to the position he assigned to his fossils, but also proved that *Sigillaria* is Lycopodiaceous, an opinion by no means universally accepted. Goldenburg further stated his belief that

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[1] Goldenberg, *Flora sarœp. foss.* Heft. I. (1855); Heft. II. (1857).

[2] Goldenberg, *l. c.*, Pl. B., figs. 18-25; Pl. IV., fig. 3; Heft. II., p. 1.

[3] Zeiller, *Sur des cônes de fructification de Sigillaires. Comptes rendus*, 30th June, 1884. *Cônes de fructification de Sigillaires. Ann. d. Scienc. Nat.*, 6e Sér. Bot., Vol. XIX., pp. 256-280, Pls. XI-XII., 1884. *Flore foss. Bassin houil. d. Valenciennes*, pp. 591-608, Pls. LXXXIX-XC., 1886-88.

the *Sigillariæ* were an arborescent form of *Isoëtes*.[1] This opinion is fully borne out by subsequent discovery, for a small specimen of *Sigillariostrobus ciliatus*, Kidston, collected at Woolley Colliery, Darton, near Barnsley, from the Barnsley thick coal,[2] by Mr. W. Hemingway (No. 2144), shows the sporangia (in this case macrosporangia) to be included within the inflated base of the sporophyll, which clearly unites the *Sigillaria* with the *Isoëtes*, as their nearest living ally.[3] The sporangia are here seen to be placed in the hollow basal portion of the sporophyll, whose surrounding walls unite again in front of the sporanginno to form the upward rising sporophyll blade.

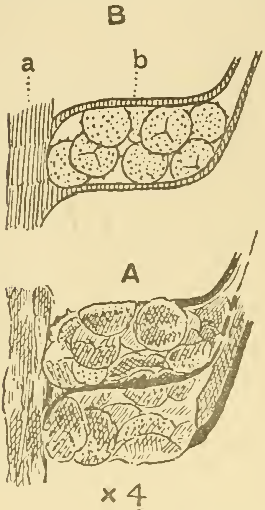

Fig. 18.—*Sigilliariostrobus ciliatus*, Kidston. A, two sporangia containing *macrospores* (×4). B, restoration of sporangium—*a*, axis; *b*, wall of sporangium.

Zeiller has suggested that perhaps some Sigillarian cones bore macrospores, and others the microspores, because in the case of his *Sigillariostrobus nobilis*[4] no spores were observable between the bracts, and had macrospores been present they would almost certainly have been seen, therefore, he suggests, that this cone may have borne microspores. But the absence of spores in this case may be equally well explained by supposing that the cone had reached maturity, and the spores shed before fossilization took place.

Though it is not, therefore, yet satisfactorily determined whether the cones of *Sigillaria* were *heterosporous* or *isosporous*, I incline to the former view, and the evidence on which I have formed this opinion is derived from a specimen collected by Mr.

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[1] *l. c.*, Heft. I., p. 25.

[2] Middle Coal Measures.

[3] Kidston, "On the Fossil Flora of the Yorkshire Coal Field," 2nd paper, *Trans. Roy. Soc. Edin.*, Vol. XXXIX., Part i., p. 54, Pl. II., figs. 3 and 3*a*.

[4] Zeiller, *Ann. d. Science Nat.*, 6e Sér. Bot., Vol. XIX., p. 267, Pl. XII., figs. 1, 2, and 2*a*.

John Rorrison at No. 3 Pit, Springhill, Crosshouse, Ayrshire, from the major coal belonging to the Lower Coal Measures (No. 1573).

This fragment shows a small portion of a Sigillarian cone which has apparently been split longitudinally. The upper parts of the bracts are imbedded in the matrix, and their basal extremities only are exposed on the surface of the rock and show their upper surface.

The basal portions of the lower sporophylls are about 3 mm. wide, and lying on their surface are numerous small, smooth macrospores about 0·75 mm. in diameter. The upper sporophylls have larger bases, measuring about 6 mm. across, and are in a fine state of preservation. When the upper surface of their exposed base is examined under the microscope it is found to be distinctly granular. These granular roughnesses measure about 0·20 mm., and are covered by a thin cellular envelope, the size of the cells forming this layer being such that from 3 to 4 cells equal the size of the individual roughnesses.[1]

On the exposed surface of some of the bases of these larger upper sporophylls is a sub-rhomboidal mark with a central point, and below it the indication of a semi-circular area. This may represent the point of attachment of the sporophyll to the axis of the cone, but of this I am not certain, as it might perhaps represent the part where dehiscence took place.

It is from the examination of this specimen that I have been led to believe that the cones of Sigillaria are hetorosporous, for on the lower sporophylls the macrospores are very clearly seen, while the bases of the upper sporophylls are much larger and distinctly different in size from the lower, and it seems difficult to give any other explanation of their granular appearance than by supposing it to have been caused by contained bodies, presumably microspores. I do not regard this specimen as determining conclusively the heterosporous condition of the cones of Sigillaria, but it points strongly in that direction.

The majority of Sigillaria appear to have had pedicellate cones, as indicated by the scars on the stems, but in *Sigillaria discophora*, König sp., and *Sigillaria Taylori*, Carr. sp., they were sessile, and arranged in two opposite vertical rows.

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[1] Kidston, *Trans. Roy. Soc. Edin.*, Vol. XXXIX., Part i. (No. 5), Pl. II., figs. 1, 1*a*, and 1*b*.

In the pedicellate cones the distinction between the cone and the pedicel is not so abruptly defined as in *Lepidostrobus*. In *Sigillariostrobus* the upper portion of the pedicel bears a number of barren, generally linear or setaceous bracts, which become more numerous immediately below the cone, and which gradually assume the form of sporophylls.[1]

In all the *Sigillariæ* the cones seem to have been produced on stems more or less advanced in age, and in this respect they differ from the *Lepidodendra*, where (with the exception of one or two *Ulodendroid-Lepidodendra*), the cones are borne at the terminations of the branchlets.

In addition to the various Sigillarian cones to which reference has already been made, several other examples have been figured and referred to *Sigillariostrobus*, but these specimens I do not think should be included in that genus. As reference to these will be found in my second paper "On the Fossil Flora of the Yorkshire Coal Field," where some Sigillarian cones are described, it is not necessary to further mention them here.[2]

XI. Stigmaria, Brongt. See p. 66.

XII. Stigmariopsis, Grand 'Eury, 1877.

1877. *Stigmariopsis*, Grand 'Eury. *Flore Carbonifère du Départ. de la Loire et du centre de la France*, p. 171.

1894. *Stigmariopsis*, Solms-Laubach. *Dames u. Kayser. Palæont. Abhandl*, New Series, Vol. II., Part 5, p. 223 (*Ueber Stigmariopsis Grand 'Eury*).

Stigmaria-like rhizomes, but proportionately shorter and thicker, springing from the hollow cup-like base of the *Sigillarian* stem in four primary arms, which again bifurcate—probably several times. From the lower surface of the four primary divisions, immediately at the base of the trunk, spring downward directed conical growths (the "tap-roots" of R. Brown). Surface

[1] See Zeiller—*Ann. d. Scienc. Nat.*, 6e Sér. Bot., Vol. XIX., Pl. I., figs. 1-4; Pl. II., figs. 2 and 5. Zeiller, *Flore foss. Bassin houil. d. Valenciennes*, Pl. LXXXIX., figs. 1-3; Pl. XC., fig. 1. Kidston, *Trans. Roy. Soc. Edin.*, Vol. XXXIX. (No. 5), Pl. I., figs. 1, 2, and 4; Pl. II., fig. 4.

[2] *Trans. Roy. Soc. Edin.*, Vol. XXXIX., p. 33.

of rhizomes and tap-root like growths bear quincuncially arranged rootlet scars, similar in structure to those of *Stigmaria.* Cast of pith cavity ribbed (like the internal cast of a calamite, but without joints).

Remarks.—Although *Stigmariopsis* was founded by Grand 'Eury, it is to Solms-Laubach we are indebted for pointing out the characters by which it can be distinguished from *Stigmaria.*

Fig. 19.—*Stigmariopsis anglica,* Kidston. Monckton Main Colliery, Barnsley, Yorkshire. *Hor.* Barnsley Thick Coal, Middle Coal Measures. (No. 2342.)

When dealing with *Stigmaria, Stigmariopsis* has been so often referred to in its supposed connection with *Stigmaria* that I need only say here that I accept the genus *Stigmariopsis* as possessing an autonomous existence, and not in any way connected with *Stigmaria*, except in its close affinity to that genus. In other words, *Stigmariopsis* is not the root and *Stigmaria* the rhizome of the same plant. *Stigmaria* is the rhizome of several genera of arborescent lycopods, including *Sigillaria*, while *Stigmariopsis*, as far as one can judge at present, seems to be restricted to certain *Sigillariæ*.

Stigmaria and *Stigmariopsis* are of equal position morphologically and physiologically. They represent the same structure and perform the same functions in the economy of the plants to which they respectively belong. If, therefore, *Stigmaria* is a rhizome, such must also *Stigmariopsis* be. Even the little known of the structure of *Stigmariopsis* as described by Solms-Laubach seems to me to make it impossible to regard *Stigmaria* and *Stigmariopsis* as different portions of one organism.

In 1889, through the kindness of Grand 'Eury, Solms-Laubach was enabled to examine *in situ* at St. Étienne a stem of *Sigillaria* with the rhizomes attached, to which Grand 'Eury had given the name of *Stigmariopsis.* The results of these investigations he has published in his valuable paper, "Uber Stigmariopsis Grand 'Eury." This contains the first concise account of *Stigmariopsis* with which I am acquainted, and the first to give any definite characters which warrant our regarding it as a distinct genus, in so far as one can apply the word genus to fossils which we know are only the subterranean portion of an individual whose trunk possesses another name.

The trunk examined by Solms-Laubach divided into four arms at the base in a similar manner to that which occurs in *Stigmaria.* Owing to unfavourable preservation it was impossible to further trace the four primary divisions.

From the under-surface of one of these four arms, and close to the base of the stem, spring two downward-directed thick conical growths, which are evidently the "tap-roots" described by Richard Brown as occurring on his example from the Island of Cape Breton.[1] The surface of the rhizomes, as well as that of the "tap-roots," is marked with Stigmarian scars, and the bark between them is ornamented with flexuous lines forming an irregular net-like reticulation.

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[1] *Quart. Journ. Geol. Soc.*, Vol. V., p. 354.

Both rhizome and "tap-roots" have a central core, whose cast is ribbed something like a calamite stem, but without any joints. The ribbing differs, however, from that found on calamites. On the casts of the pith cavity of *Stigmariopsis* the ribs are separated by square-based furrows which are rather wider than the ribs. These furrows are finely but strongly striated longitudinally. The ribs when well preserved are also longitudinally striated.

The cores discovered in the specimen examined by Solms-Laubach were covered with a layer of structureless bright coal, from 1 to 1·5 mm. thick. The outer surface of this coaly envelope bears linear club-shaped depressions placed in upright rows, which are connected in vertical series by a shallow tail-like extension of the depression. In addition to the upright series, these depressions show oblique spiral arrangements in their lateral position to each other. The space between these depressions is finely striated with slightly wavy lines.

Fig. 20.—*Stigmariopsis.* Cast of the pith cavity, from a specimen communicated by Graf Solms-Laubach from one of the examples described in his paper, "Uber Stigmariopsis. (No. 2601.)

The calamite-like cast is the impression of the pith cavity, and the coaly envelope represents the xylem portion of the bundle. The remainder and much larger portion of the rhizome is composed of cortex.

So much for our knowledge of the structure of *Stigmariopsis* —very imperfect, it is true—but it is sufficient to distinguish it clearly from *Stigmaria.*

Solms-Laubach has also thrown out the suggestion that the plant whose structure has been described by Renault, under the name of *Stigmaria flexuosa* may be a *Stigmariopsis.*[1]

If any doubt remains as to *Stigmaria flexuosa,* Renault, being a *Stigmariopsis,* I think there can be little doubt that the

[1] *Uber Stigmariopsis,* Grand 'Eury, p. 15.

Stigmaria Brardi, Renault, from Dracy-Saint-Loup is referable to *Stigmariopsis*.[1]

In *Stigmaria Brardi* there is the very fortunate circumstance of the preservation of the outer surface of the bark, which possesses all the character of *Stigmariopsis*. The rootlet scars are arranged in quincuncial order, and between them the bark shows the elongated mesh-like reticulation. The axis consists of a medullary cavity from which the tissue has disappeared. This is surrounded by a circle of centripetally developed bundles composed of irregularly placed vessels, which eventually unite laterally, their apices remaining free, and projecting into the pith cavity, where they form a prominent corona. The core of such a cavity, would form a cast similar to those described by Solms-Laubach in the stem examined by him at St. Étienne. The primary zone of xylem is surrounded by a secondary exogenously developed zone whose elements are radially arranged. This secondary zone seen in tangential section shows numerous large, primary medullary ray openings, similar to those occurring in *Stigmaria*, and through which the rootlet bundles pass from the primary zone of xylem, and thus go outwards to the rootlets.

The rootlet bundles show a group of primary vessels, arranged without order, to whose outer surface a fan-shaped secondary xylem of radially arranged elements is added.

The subepidermal layer shown at Pl. XXXVIII., fig. 9, is apparently similar to the structure given on Pl. XXXIX., fig. 12 (though only named *Stigmaria*), of which tangential sections are given enlarged on Pl. XXXIX., figs. 13 and 14. These show a number of longitudinal flexuous bands of fusiform cells with reticulated walls, which uniting among themselves form a net-like structure, the meshes of which are filled with smooth walled parenchyma. It is this dictyoxyloid structure which impresses upon the outer surface of the rhizome the net-like reticulation which appears to be one of the distinguishing characters of *Stigmariopsis*.

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[1] Renault, *Bassin houiller et permien d'Autun el d'Épinac*, Fasc. IV. *Flore fossile*, Deux part, p. 231. Atlas, Pl. XXXVIII., figs. 5-9; Pl. XXXIX., figs. 1-10, 1893. Also probably *Stigmaria, ibid.*, Pl. XXXIX., figs. 12-14.

From the study of *Stigmaria* (*Stigmariopsis*?) *Brardi*, Renault, it would appear that the coaly layer which surrounded the calamite-like cast of the specimen of *Stigmariopsis* described by Solms-Laubach represented both the primary and the secondary xylem, and that the elongated depressions seen on its outer surface were the openings of the primary medullary rays.

If I am correct in referring these specimens to *Stigmariopsis*, it differs from *Stigmaria* in possessing a centripetal zone of xylem, succeeded by a centrifugal secondary zone. In *Stigmaria* the primary centripetal zone is absent, and the cast of the pith cavity shows on its outer surface the impression of the netted cylinder which has been so well figured by Williamson.[1]

Solms-Laubach has thrown out the suggestion that *Stigmaria ficoides* is the deep-water rhizome of the *Sigillariæ* generally, and that *Stigmariopsis* is peculiar to the *Clathraria-Leiodermaria* group. If this be so, it would explain the comparative rarity of *Stigmariopsis* in Britain, where the *Clathraria-Leiodermaria* group of *Sigillaria* is not common. But, strangely enough, the example which Solms-Laubach investigated, and which he gives on Plate I., fig. 1, in illustration of his paper, "*Uber Stigmariopsis*," appears to show a *Syringodendron* condition of a member of the *Rhytidolepis*, or ribbed section of *Sigillaria*, and to the same group clearly belong his figures 3 and 5 of Plate III.

I only know of two "species" of *Stigmariopsis* from British carboniferous rocks. One is similar in all characters to that described by Goldenberg under the name of *Stigmaria rimosa*,[2] from the Hirschbach mine, near Dutweiler.

I have seen specimens of *Stigmariopsis rimosa*, Goldenberg sp., from the Lower and Middle Coal Measures, and also from the Carboniferous Limestone Series of Scotland, but among these there must be the rhizomes of different species, as we know of no Lycopod in Britain which passes from the Lower to the Upper Carboniferous.

The same difficulty occurs with *Stigmaria*, which is known to be the rhizome, not only of many species, but of, at least, two genera—*Lepidodendron* and *Sigillaria*—as hitherto no characters

[1] *Monog. Stigmaria*, Pl. XIV., fig. 69.

[2] Goldenberg, *Flora Sarœpontana foss.*, Heft. III., p. 15, Pl. XII., figs. 3-6, named on Plate *Stigmaria abbreviata*.

have been discovered by which the specimens can be referred to their respective parent genera.

One of my specimens (No. 2547) is a termination very similar in size and character to that figured by Goldenberg on his Pl. XII., fig. 3 (*Stigmaria rimosa*, Goldenberg). It was collected at Woodyett Pit, Denny, Stirlingshire (*Hor.* Carboniferous Limestone Series).

The other British species, which I have named *Stigmariopsis anglica*, is a smaller form than *Stigmariopsis rimosa*, Goldenberg sp., and all my specimens of it have been collected at Monckton Main Colliery, Barnsley, Yorkshire, from the Barnsley Thick Coal (Middle Coal Measures), by Mr. W. Hemingway, to whom I have been so often indebted for much kind assistance in my study of the Carboniferous Flora.

The Monckton Main specimens have their outer surface ornamented in a similar manner to that figured by Solms-Laubach,[1] but the rootlet scars are generally more closely placed on the Yorkshire examples, though their distance apart varies much according to the age of the specimens. On a small example, evidently near the growing point of the rhizome, the rootlet scars are very small, about 1 mm. in diameter and 2 mm. distant from each other (No. 2337); in another specimen, portion of a much larger example, the rootlet scars are 2 mm. in diameter, and 1·2 cm. apart (No. 2342). These forms are connected by a series of specimens showing intermediate sizes. Some of the specimens show a bifurcation, and one a termination with its attached rootlets (No. 2602). This latter, 6·5 cm. long and about 2·75 cm. across at its widest part, terminates in a blunt point. None of the attached rootlets appear to show their complete length. The longest is about 7 cm. long, and they are from 1 to 2 mm. broad, with a narrow central band, caused by the vascular strand. One rootlet, on the back of the specimen, shows a bifurcation. The rootlets are bent forward in the direction of the point, but do not close round it as they do on the *Stigmaria* termination described by Solms-Laubach.[2] Possibly the specimen may be one of the "tap-roots," and not a termination of one of

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[1] *Uber Stigmariopsis*, Pl. II., fig. 2.

[2] *Fossil Botany*, p. 269.

the main arms of the rhizome. On a larger specimen (No. 2340) the rootlets are 3 mm. wide.

When the epidermal layer is removed, the irregular flexuous wavy lines are especially prominent (No. 2335). They do not appear to be due to shrinkage, but to a dictyoxyloid structure in the sub-epidermal layer of the cortex, to which attention has already been called when referring to the structure of *Stigmaria* (*Stigmariopsis*) *Brardi*, Renault.

The specimen figured by Prof. Williamson[1] as a Stigmarian root, belonging to the Hutton collection in the Museum, Barras Bridge, Newcastle-on-Tyne, should also be referred to *Stigmariopsis,* and appears to have the same characters as the Monckton Main specimens.

XIII. Spencerites, Scott, 1898.

1898. *Spencerites,* Scott. *Proc. Roy. Soc.*, Vol. LXII., p. 166.

1898. *Spencerites,* Scott. On Spencerites, a new genus of Lycopodiaceous cones from the Coal Measures, founded on the *Lepidodendron Spenceri* of Williamson, *Phil. Trans.*, Vol. CLXXXIX., Ser. B., pp. 83-106, Pls. XII.-XV.

The genus contains two species—*Spencerites insignis,* Will. sp., and *Spencerites majusculus,* Scott—both from the Lower Coal Measures.

Spencerites differs from *Lepidostrobus* in several important characters, but especially in the attachment of the sporangia. The sporophylls are short, and formed of a sub-cylindrical pedicel which expands into a large peltate lamina. Sporangia solitary on each sporophyll and inserted by a narrow base on the upper surface of the lamina, but free from the pedicel.

In regard to the affinity of *Spencerites* Dr. Scott says:—"The distal insertion of the sporangium . . . . may perhaps be an indication that *Spencerites* represents a somewhat more archaic type of Lycopodiaceous strobilus than that of *Lepidostrobus.*[2]

[1] *Monog. Stigmaria,* Pl. XIII., fig. 71.

[2] *Phil. Trans.*, *l.c.*, p. 102. 1898.

This genus is only known from a few specimens showing structure which were found in the well-known "Coal-Balls." Of *Spencerites insignis* four examples seem to have been discovered, but of *Spencerites majusculus* only one is known to exist. The first-named species has been met with near Halifax and Huddersfield, the latter near Halifax.

SPHENOPHYLLALES.

SPHENOPHYLLUM, Brongniart, 1822 (1828).

1822. *Sphenophyllites*, Brongniart. *Class. d. végét. foss.*, pp. 9 and 34.

1823. *Rotularia*, Sternberg. *Essai flore monde prim.*, I., fasc. ii., pp. 34 and 37; fasc. iv., p. 32.

1828. *Sphenophyllum*, Brongniart. Prodrome, p. 68.

1864. *Sphenophyllum*, Coemans and Kicks. *Monographie des Sphenophyllum d'Europe. Bull. de l'Acad. Roy. des Sciences, Brussels*, Vol. XVIII., 2e Sér., pp. 134-160. Pls. I.-II.

1893. *Sphenophyllum*, Zeiller. *Étude sur la constitution de l'appareil fructificateur des Sphenophyllum. Mèm Soc. Géol. de France*, Vol. IV., No. 11, pp. 1-39, Pls. III.-V.

1895. *Sphenophyllum*, Williamson and Scott. Further Observations on the Organization of the Fossil Plants of the Coal Measures. *Phil. Trans.*, Vol. CLXXXV., pp. 919-946, Pls. LXXV., LXXVI., LXXXIII., LXXXIV., LXXXV.

Plants with slender stems, apparently not attaining to large dimensions. Branches irregularly given off at considerable intervals, and not more than one from a node. Stems ribbed with tumid or swollen nodes, ribs not alternating at the nodes, but continuing in the same line. Internodes varying in length. Leaves polymorphic, rarely narrow lanceolate, generally cuneiform in outline, entire or much divided into segments, segments wedge-shaped to filiform, veins radiating from the base, dichotomously divided. Fructification in the form of cones, terminal, often on short lateral branches, formed of more or less modified leaves, whose lower portions unite to form a saucer-like collar round the axis, distal portion free, erect. Sporangia varying in number according to the species, sessile or pedicellate; in the pedicellate forms the pedicels spring from the saucer-like collar.

Internal structure of axis.—Stem consisting of a solid axis, composed of primary (centripetal) and secondary (centrifugal) xylem, surrounded by a stout cortex.

The young stem of *Sphenophyllum* contains a solid primary triarch or hexarch central bundle in the form of a three-rayed star, composed in great part of large pitted or scaliform tracheides, though smaller scalariform tracheides occur towards the ends of the arms. The original protoxylem elements situated at the extreme limit of the arms of the star contain small spiral vessels.

When the primary xylem is fully developed it assumes the form of a triangle with concave sides and truncated angles. In due course this is surrounded by a secondary exogenous zone of xylem and bast developed from a cambium layer. The secondary xylem is developed with great regularity in radial series, but a marked difference in the size of the tracheæ is very observable at definite points. Those filling the concave sides have larger openings than those developed from the truncated angles, which latter form curved radiating series of tracheides that are easily distinguished from those formed on the sides of the triangular stele. Professor Williamson and Dr. Scott have designated the former *interfascicular* and the latter *fascicular* wood.[1] The leaf traces spring from the apices of the triangle of the primary bundle. The whole was surrounded by a thick bark. The bark of the older stems contained several layers of phyllogen, or cork cambium, situated at different levels in the cortex, which gave it a scaley structure.

Such is the general organization of the stem of *Sphenophyllum*, but minor differences occur in the various species.

In the two British species whose internal structure is known, *Sphenophyllum insigne*, Will. sp. (= *Asterophyllites insignis*,

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[1] *Phil. Trans.*, Vol. CLXXXV, (B.), p. 924. 1895.

Will.[1]), and *Sphenophyllum plurifoliatum*, Will. and Scott, the primary bundle is triarch, but in some French specimens of *Sphenophyllum*, one of which is figured by Williamson and Scott, the primary bundle is hexarch.[2]

In *Sphenophyllum plurifoliatum* the secondary tracheides have pitted walls, and in the angles formed between the corners of the tracheides, parenchymatous cells occur. In the fascicular wood medullary rays exist from the first; in the interfascicular wood they are absent at first, or only occur irregularly.

In *Sphenophyllum insigne* there is a canal at each angle of the primary triarch xylem, the tracheides are scalariform, and medullary rays are a constant character in both fascicular and interfascicular xylem.

Sphenophyllum plurifoliatum occurs in the Coal Measures, and *Sphenophyllum insigne* in the Calciferous Sandstone series.

The root of *Sphenophyllum* has been described and figured by Renault in several of his writings.[3] It consists of a small diarch primary bundle surrounded by a secondary xylem zone formed of pitted tracheides. The specimen does not, however, appear to have been very well preserved.[4] [5]

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[1] Williamson, *Asterophyllites*, Mem. V., p. 49. *Phil. Trans.*, 1874. Williamson, *Asterophyllites insignis*, "General Morphological and Histological Index," &c., Part i.; *Mem. and Proc. Manchester Lit. and Phil. Soc.*, 1891, p. 13. Williamson, *Asterophyllites sphenophylloides*, *ibid.*, *Mem. and Proc. Manchester Lit. and Phil. Soc.*, 1891, p. 12. Williamson and Scott, "Further Observations on the Organization of the Fossil Plants of the Coal Measures," *Phil. Trans.*, Vol. CLXXXV., p. 920, 1895.

[2] Williamson and Scott, "Further Observations on the Organization of the Fossil Plants of the Coal Measures," I., *Phil. Trans.*, Vol. CLXXXV., Pl. LXXVI., fig. 24. 1895.

[3] Renault, *Recherches sur la struct. et les affin. botan. d. végét. silicifiés*, 1878, p. 189, Pl. XXIX., figs. 5, 6; *Nouv. rech. sur la struct. d. Sphenophyllum*, p. 23, Pl. VIII., figs. 5, 6, 1876; *Cours d. botan. foss.*, Vol. IV., 1885, p. 31, Pl. B., fig. 2; *Bassin houiller et permien d'Autun et d'Épinac; Flore foss.*, Part 2, p. 155, Pl. LXIV., fig. 11. 1896.

[4] See Seward, Fossil Plants, Vol. I., p. 399. 1898.

[5] For a detailed description of the structure of the stem of *Sphenophyllum* see further :—

Renault, *Recherches sur la structure et les affinités botanique des végêtaux silicifiés recueilles aux environs d'Autun et de St. Étienne*, p. 158, plates. Autun, 1878; *Cours d. botanique fossile*, Vol. II., 1882, p. 81; *ibid.*, Vol.

Remarks.—*Sphenophyllum* early attracted the notice of geologists, and an English specimen is figured by Scheuchzer in 1709 in the first edition of his *Herbarium Diluvianum*, Pl. IV., fig. 1, one of the earliest works in which figures of fossil plants appear.[1]

In 1822 Brongniart instituted the genus *Sphenophyllites* for these plants, but altered the name to *Sphenophyllum* in 1828.

The genus contains several species, and is of common occurrence, but only recently has its internal structure, and especially that of the cones, been elucidated. Specimens with the internal organization preserved occur in England, Scotland, France, and Westphalia, and have been the subject of several memoirs by Williamson, Scott, Renault, and others.

Suggestions as to the affinities of *Sphenophyllum* have been very varied, and till recently the genus had been generally classed with the Lycopodiales, but extended knowledge of its anatomy and fructification have necessitated its removal from that group, and it is now placed in a special class, the *Sphenophyllales*, a class which stands alone in several important points from any other family, recent or fossil. This subject will be referred to later when we have more fully considered the characteristics of the Family. *Sphenophyllum* does not appear to have attained to a great size, probably not reaching a greater height than

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IV., 1885, p. 26; *ibid.*, *Nouv. recher. sur la structure des Sphenophyllum et sur leur affinitiés botanique; Ann. d. Science Nat. Bot.*, 6e *Sér.*, Vol. IV., pp. 277-311, plates, 1876; *Bassin houiller et permien d'Autun et d'Epinac; Flore fossile, deux part*, p. 146, plates, 1896.

Felix, *Untersuchungen über den inneren Bau Westfälischen Carbon Pflanzen. Abhandl. d. König Geol. Landesanstalt*, Vol. VII., Heft. 3, 1886, p. 153, Pl. VI.

Solms-Laubach, *Ueber die seinerzeit von Unger beschriebenen strukturbietenden Pflanzenreste des Unterculm von Saalfeld in Thüringen; Abhandl. d. König Preussischen Geol. Landesanstalt, Neue Folge*, Heft. 23, Berlin, 1896, p. 80, Pl. V., figs. 3-4; Fossil Botany, p. 343, 1891 (English edition).

Potonié, *Lehrbuch der Pflanzenpalæontologie*, p. 175, Berlin, 1899; *Ueber der Stellung der Sphenophyllaceen. im System. Bericht. d. Deut. Bot. Gesell. Jahrgang*, 1894, Vol. XII., Heft. 4, p. 97; Newberry, "The Genus Sphenophyllum," *Journ. Cincinnati Soc. Nat. Hist.*, Vol. XIII., p. 212, 1891.

[1] The second edition, enlarged, appeared in 1723. Though G. F. Mylius, *Memorabilium Saxoniæ Subterraneæ* also bears the date 1709, it is quoted by Scheuchzer, so must have appeared earlier in the same year.

a few feet. The stems are generally of small diameter, and seem to have been incapable of supporting themselves in an upright position without some external aid. This they possibly obtained by scrambling amongst other vegetation, and as *Sphenophyllum* is unprovided with any means of clasping or twining round outer stems, the support it received must have consisted of a system of "propping up."

The thickest stem I have seen is 1 cm. broad, and belongs to *Sphenophyllum myriophyllum*, Crépin, but Zeiller figures a branch of the same species of a slightly larger diameter.[1]

The internodes vary considerably in length, in the thickest stems being little longer than broad; but they are on an average from 1 cm. to 1·50 cm. long. The nodes are distinctly swollen, having an acute ridge from which the leaves spring.

The ribbing of the stems is usually very distinct, and the ribs do not alternate at the nodes as in *Calamites*, but continue on without interruption.[2]

The ramification of the stem is very sparse, only one branch springs from a node,[3] and the branches are usually separated by a considerable number of internodes. In some cases the lateral branches decrease in size upwards, in other cases they increase considerably in diameter as they recede from the parent stem.[4] Interesting branching specimens of *Sphenophyllum* have been figured by Germar,[5] Renault,[6] Schenk,[7] and Zeiller.[8]

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[1] *Flore foss. Bassin houil. d. Valenciennes*, Pl. LXII., fig. 4.

[2] It must be remembered that the "ribbed" *Calamites* are generally, if not always, internal casts, whereas in ribbed *Sphenophyllum* we have the true outer surface of the stem.

[3] The specimen of *Sphenophyllum Schlotheimii* given by Germar, *Vers. d. Stenik. v. Wettin u. Löbejun*, fasc. ii., Pl. VI., fig. 1, seems to contradict this statement, but the exact origination of the branches on this specimen is not clearly seen. See also Schenk in "Richthofen's China," Pl. XLIV., fig. 1 (*S. emarginatum*). Here, however, the general rule seems to be maintained.

[4] Zeiller, *Flore foss. Bassin houil. d. Valenciennes*, Pl. LXII., fig. 4.

[5] Germar, *l.c.*, fasc. ii., Pl. IV., figs. 1 and 3 (*Sphenophyllum Schlotheimii*).

[6] Renault, *Flore foss. terr. houil. d. Comentry*, Pl. IV., figs. 6 and 7 (*Sphenophyllum angustifolium*).

[7] Schenk in "Richthofen's China," Pl. XXXVIII., fig. 1 (*Sphenophyllum Schlotheimii*).

[8] Zeiller, *l.c.*, Pl. LXII., figs. 1 and 4; Pl. LXIII., fig. 4 (*Sphen. cuneifolium, var. saxifragæfolium*).

The normal form of leaf is wedge-shaped entire-dentate (fig. 21A), bifid or dichotomously divided into narrow segments. In *Sphenophyllum trichomatosum* (fig. 21C) and *Sphenophyllum tenerrimum* the segments are filamentous. A single vein enters the base of the leaf, which by dichotomous division sends off a veinlet to each tooth of the leaf or to each of the segments (fig. 21B). On the majority of the species the leaves are heterophyllous, the entire and much divided forms occurring even on the same branch. This is well shown on a specimen of *Sphenophyllum Schlotheimii* figured by Germar.[1]

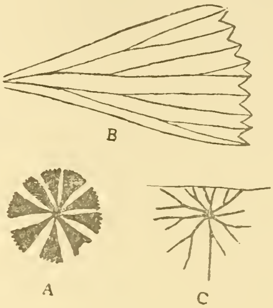

Fig. 21.—A and B, *Sphenophyllum cuneifolium*, Sternb. sp. A, Whorl of leaves, natural size (No. 2706). B, Leaf, enlarged to show teeth and nervation (No. 1566). C, *Sphenophyllum trichomatosum*, Stur, natural size (No. 1046).

In *Sphenophyllum cuneifolium*, the *var. saxifragæfolium*, with the much divided form of leaf, is almost invariably associated with the cone-bearing branches, though it also occurs on what are apparently barren branches. Probably in all the species, with perhaps the exception of *Sphenophyllum tenerrimum* and *Sphenophyllum trichomatosum*—which seem constantly to have filamentous segmented leaves—a heterophyllous condition of the leaf occurs. This heterophyllous condition gave rise to the opinion that *Sphenophyllum* was an aquatic plant, the submersed leaves being the much divided ones, the more or less entire leaves forming the aerial foliage. When, however, it is seen that the divided leaves are usually on the stems bearing the fructification, and as undoubtedly the cones were aerial, the presence of these divided leaves gives no support to the view that *Sphenophyllum* was aquatic; and further, both forms of leaves occur on the same branch, as on the specimen given by Germar.[2] The internal structure of the stem is also opposed to *Sphenophyllum* having been aquatic.

[1] *Vers. d. Stenk. v. Wettin u. Löbejun*, Pl. VI., fig. 3.
[2] Germar, *l.c.*, Pl. VI., fig. 3.

The number of leaves in a whorl varies considerably. This character is often difficult to determine owing to the compressed condition in which most of the specimens are found, but occasionally their number can be easily determined

The following table illustrates this point. The first column gives the number of leaves in a whorl as observed on specimens; the second column gives the numbers as shown on published figures:—

	I.	II.
Sphenophyllum verticillatum, Schl. sp. (= Sph. Schlotheimii, Brongt.), ...	—	... 6
,, emarginatum, Brongt., ...	6, 9	... 6
,, cuneifolium, Sternb. sp., ...	9	... 6, 7, 9
,, var. saxifragæfolium, Sternb. sp.,	10	... 6, 12
,, majus, Bronn sp., ...	6, 8	... —
,, oblongifolium, Germar and Kaulfuss,	—	... 6
,, myriophyllum, Crépin, ...	15	... —
,, tenerrimum Ettingshausen, ...	6 (?)	... 9, 12
,, trichomatosum, Stur, ...	9	... —
,, Thoni, Mahr,...	—	... 6

This table shows a considerable variation in the whorl number, a variation which is generally divisible by three.

In addition to these wedge-shaped leaves, whorls of narrow linear lanceolate leaves have been observed on some species of *Sphenophyllum*. Stur was the first to figure these, and, misled by their great similarity to the single-nerved narrow lanceolate leaves of *Calamocladus (Asterophyllites)*, treated *Sphenophyllum* as the foliage of a *Calamite*.[1] The fine specimen which Stur here unites with his *Calamites Sachsei*[2] is probably the *Sphenophyllum cuneifolium*, Sternb. sp., and shows beautifully the external aspect of the fructification. An equally good example of *Sphenophyllum*, exhibiting the dimorphic condition of the leaves, has been given by Seward.[3] Simple lanceolate leaves

[1] Stur, *Carbon Flora d. Schatzlarer Schichten*, Abth. II., *Die Calamarien der Carbon Flora d. Schatzlarer Schichten*, Pl. XI., fig. 2 (in *Abhandl. d. k. k. Geol. Reichsanstalt*, Vol. XI., Abth. II., 1877). See also *Verhandl. d. k. k. Geol. Reichsanstalt*, No. 15, p. 329, 1878.

[2] Stur, *Carbon Flora, l.c.*, p. 180.

[3] *Mem. and Proc. Manchester Lit. and Phil. Soc.*, 4th Ser., Vol. III., "*Sphenophyllum* as a branch of *Asterophyllites*," fig. 1. 1890.

have also been observed on *Sphenophyllum oblongifolium*, Germar and Kaulfuss.[1]

I have also received from Mr. Hemingway specimens of *Sphenophyllum cuneifolium*, Sternb. sp., showing a similar Asterophyllites-like form of foliage.

Notwithstanding the occurrence of the linear-leaved foliage on *Sphenophyllum*, the genus has probably no affinity with the *Calamites*, of which *Asterophyllites* is the foliage. *Sphenophyllum* differs from *Calamites* in the ribs not alternating, in the fructification and in the internal organization of the stem; in fact, there are almost no points in which the genera show any contact.

The species of which the fructification is most fully known are the following:—

SPHENOPHYLLUM TRICHOMATOSUM, Stur.

1887. *Sphenophyllum trichomatosum*, Stur. *Die Calamarien der Carbon Flora der Schatzlarer Schichten* (*Abhandl. d. k. k. Geol. Reichsanst.*, Vol. XI., part 2), p. 202, Pl. XV., figs. 1-4.

Sporangia oval, sessile, one (?) on each sporophyll. (Fig. 22.)

There is no observable presence of a pedicel or sporangiophore, and though the examples on which the observations have been made are preserved on shale, still the sporangia are well preserved, and would, I think, have shown the sporangiophores had they been present.[2]

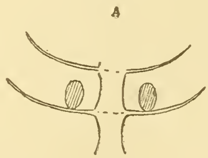

Fig. 22. — *Sphenophyllum trichomatosum*, Stur. Arrangement of sporangia (enlarged).

The irregularity in position of the sporangia to which Professor Williamson and Dr. Scott refer arises from the sporangia of a whole verticil being flattened on one another.[3] The attachment of the sporangia of *Sphenophyllum majus*, Bronn sp., described later (p. 128), gives

[1] Renault, *Flore foss. terr. houil. de Comentry*, part 2, p. 483, Pl. L., figs. 1-2. See also Newberry, "The Genus Sphenophyllum," *Journ. Cincinnati Soc. Nat. Hist.*, Vol. XIII., p. 213, Pl. XIX., fig. 4. 1891.

[2] Kidston, *Proc. Roy. Phys. Soc. Edin.*, Vol. XI., p. 59, Pl. I. 1891.

[3] *Phil. Trans.*, Vol. CLXXXV., p. 942. 1895.

support to the view that the sporangia of *Sphenophyllum trichomatosum* were sessile.

I have only met with this species in the Middle Coal Measures.

SPHENOPHYLLUM CUNEIFOLIUM, Sternb. sp.

1823. *Rotularia cuneifolia*, Sternberg. Vers. I., fasc. 2, p. 33, Pl. XXVI., figs. 4*a* and 4*b*.

1880. *Sphenophyllum cuneifolium*, Zeiller. *Végét. foss. du terr. houil. de la France*, p. 30, Pl. CLXI., figs. 1-2.

1831. *Sphenophyllum erosum*, L. and H. Fossil Flora, Vol. I., Pl. XIII.

1871. *Volkmannia Dawsoni*, Will. *Mem. Lit. and Phil. Soc. Manchester*, Ser. 3, Vol. V., p. 28.

1884. *Bowmanites Dawsoni*, Weiss. *Steinkohlen Calamarien II. (Abhand. z. geol. Specialkarte v. Preussen u. d. Thüringischen Staaten*, Vol. V., Heft. 2), pp. 201-202.

1893. *Sphenophyllum cuneifolium*, Zeiller. *Étude sur la constitution de l'appareil fructificateur des Sphenophyllum. Mém. de la Soc. Géol. de France. Paléont. Mém.*, No. 11, Vol. IV., pp. 1-39, Pl. I., Pl. II., figs. 1-3; Pl. III., figs. 1-2.

1895. *Sphenophyllum Dawsoni*, Williamson and Scott. *Phil. Trans.*, Vol. CLXXXV. (1894), B., p. 933.

1898. *Sphenophyllostachys Dawsoni*, Seward. Fossil Plants, Vol. I., p. 401.

Sporangia two to four, usually three, oval, attached to the extremities of the delicate pedicels or sporangiophores. Sporangiophores spring from the base of the upward rising saucer-like collar formed by the united bases of the bracts. Free portion of bracts linear lanceolate. The sporangiophores each spring from a point at an equal distance from the axis, and appear to be placed side by side at their point of origin, but they vary in length according to whether they bear the sporangia of the first, second, or third circle. The sporangiophores rise upwards and bend towards the axis, having suspended from their extremity a single sporangium, which thus hangs parallel to the axis.[1] (Fig. 23.)

Although the late Professor Williamson was the first to describe the internal structure of the cones of *Sphenophyllum*, they were described under the name of *Volkmannia*, and to Zeiller is due the credit of identifying the *Volkmannia Dawsoni*, Will., as the fructification of *Sphenophyllum*.[2] On this subject he published a preliminary note in 1892.[3] This was followed by his admirable memoir entitled, "*Étude sur la constitution de l'appareil fructificateur des Sphenophyllum*."

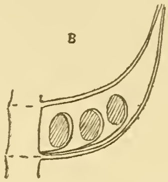

Fig. 23. — *Sphenophylium cuneifolium*, Sternb. sp. Arrangement of the sporangia.

In this memoir Zeiller describes a number of cones of *Sphenophyllum cuneifolium*, Sternb. sp., from the French and Belgian Coal Fields. The paper is accompanied by an excellent and most instructive series of figures taken from photographs of the specimens. M. Zeiller has clearly shown, it appears to me, that the *Volkmannia Dawsoni*, Williamson, is the fructification of *Sphenophyllum cuneifolium*, Sternb. sp., and, though there are some points awaiting further elucidation, the main structural features have been clearly demonstrated. There seems to have been generally three sporangia borne on each bract, which form a corresponding number of whorls of sporangia surrounding the axis. Two or four circles of sporangia seem to occur in some cases.

The sporangiophores or pedicels all spring from the saucer-like collar of the bracts, and, as seen in specimens showing the internal structure, their point of origin formed a circle round the axis; they were thus laterally placed to each other.

The sporangiophores, however, immediately become free, and their length varies according to whether the sporangiophore

[1] Williamson "On the Organisation of the Fossil Plants of the Coal Measures," *Memoir V., Phil. Trans.*, 1874, p. 41, *seq.* Under name of *Volkmannia Dawsoni*, *ibid.*, Vol. CLXXXII., p. 225, *seq.*, 1891, and references given above.

[2] Zeiller, *Étude sur la constitution*, &c., *l.c.*, pp. 20-21.

[3] *Sur la constitution des épis de fructification du Sphenophyllum cuneifolium*, *Comptes rendus*, July 11, 1892.

belongs to the sporangium of the first whorl, that nearest to the axis, or to that of the second or third whorl, and consequently more distant from the axis.

Each succeeding circle of sporangia was raised slightly above that lying inside of it or nearer the axis, on account of the upward slope of the bracts. Thus the second circle of sporangia holds a higher level than the first, and the third a higher level than the second circle. Hence in transverse sections of the cones the sporangia are cut through at different levels.

At the apex of the sporangium, where the sporangiophore merges into it, the cells are larger with thicker walls, and Zeiller points out that these have very much the structure and appearance of the cells forming the *annulus* on the sporangia of ferns.[1] It is probably through the agency of this somewhat oblique cap of larger cells that the sporangium was split at maturity.

In the specimens examined by Williamson and Scott the spores are all of one kind. Their outer surface is ornamented with spines connected by ridges, which give them a characteristic reticulate appearance. No specimens yet discovered give any support to the view that *Sphenophyllum* was heterosporous.[2]

The free portions of the bracts, into each of which runs a small vascular bundle, extend upwards past several internodes, hence in transverse sections of the cone it is usually surrounded by several circles of bracts, sometimes as many as six, cut at different levels. It would appear from the position of the various members of these bracts that the whorles alternate in the

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[1] Zeiller, *Constitution d. l'appareil fruct. Sphenophyllum*, p. 17, woodcut F. See also Williamson, *Phil. Trans.*, Vol. CLXXXII., Mem. XVIII., Pl. XXVIII., fig. 16, 1891; and Williamson and Scott, *Phil. Trans.*, Vol. CLXXXV., p. 939, 1895.

[2] Renault has figured a specimen which he refers to *Sphenophyllum*, in which is described *macrosporangia* and *microsporangia*, the latter attached directly to the limb of the bract. The specimen is a good deal broken up, and does not appear to give any support to the opinion that *Sphenophyllum* was heterosporous. Renault, *Ann. de Science Nat.*, 6e *Sér. Bot.*, Vol. IV., pp. 303-304, Pl. IX., figs. 9, 10, 11, 1876. ("*Nouvelles rech. sur la structure des Sphenophyllum et sur leur affinitiés botaniques.*") Renault, *Cours. d. botan. foss.*, Vol., II., pp. 102-103, Pl. XV., figs. 7-8; Pl. XVI., fig. 3, 1882. Renault, *Flore foss. Études sur le terr. houil. de Comentry*, pp. 481-482, 1890.

cone, though the leaf whorls are superposed.[1] According to the investigations of Williamson and Scott, the sporangiophores are most probably modified segments of the bract, and not independent outgrowths of the axis. They possess a small vascular bundle.[2]

The axis of the cone contains a solid hexarch vascular cylinder, bluntly triangular, with concave sides.[3] The peripheral scalariform tracheides are smaller than the central tracheides, with pitted walls.

SPHENOPHYLLUM EMARGINATUM, Brongniart.

1822. *Sphenophyllites emarginatus*, Brongt. *Class d. végét. foss.*, pp. 34 and 89, Pl. II., figs. 8*a* and 8*b*.

1828. *Sphenophyllum emarginatum*, Brongt. Prodrome, p. 68.

The structure of the cone of this species appears to be similar to that of *Sphenophyllum cuneifolium.* The specimen described by Zeiller was somewhat imperfectly preserved, but the sporangia seem to be arranged in three or several concentric circles, and from their position seem also to have been attached to sporangiophores.[4, 5]

SPHENOPHYLLUM RÖMERI, Solms-Laubach sp.

1895. *Bowmanites Römeri*, Solms-Laubach. *Jahrb. d. k. k. geol. Reichsanstalt*, Vol. XLV., Heft. 2, p. 225, Pls. IX.-X.

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[1] Williamson and Scott, *Phil. Trans.*, 1894, p. 934.

[2] Williamson and Scott, *Mem. I.*, *Phil. Trans.*, Vol. CLXXXV., pp. 937 and 943. 1895.

[3] Scott, *Phil. Trans.*, Vol. CLXXXIX. (B.), p. 25, 1897.

[4] Zeiller, *Constitution d. appareil fruct. d. Sphenophyllum*, p. 24, Pl. II., fig. 4.

[5] M. Zeiller reviews other species of *Sphenophyllum* of which more or less perfect cones have been discovered, but none of these afford very clear evidence as to the number or mode of attachment of the sporangia. The specimens mentioned are :—*Sphenophyllum gracile*, Crépin; *Sphenophyllum oblongifolium*, Germar and Kaulfuss; *Sphenophyllum verticillatum*, Schl. sp. (=*Sphenophyllum Schlotheimii*, Brongt.); *Sphenophyllum angustifolium*, Germar; *Sphenophyllum tenerrimum*, Ett.; *Sphenophyllum Sachsei*, Stur.; and *Sphenophyllum costatum*, Stur. The last-mentioned species, and also most probably *Sphenophyllum Sachsei*, should be referred to *Sphenophyllum cuneifolium*, Sternb. sp.

(*Bowmanites Römeri, eine neue Sphenophyllum Fructification.*)

1898. *Sphenophyllostachys Römeri*, Seward. Fossil Plants, Vol. I., p. 405.

This species is founded on two small specimens from Niedzielisko, near Jaworzne, having portion of their structure preserved.

The general arrangement of the sporangia appears to be similar to that which is found in *Sphenophyllum cuneifolium*, Sternb. sp. (= *Sphenophyllum Dawsoni*, Will. sp.). As in that species, the sporangia were arranged certainly in two, but probably in three, concentric circles. There is, however, this important difference in *Sphenophyllum Römeri*, that the sporangiophores expand at their distal extremity into a narrow elongate peltate shield, from each of which are suspended two sporangia. (Fig. 24.)

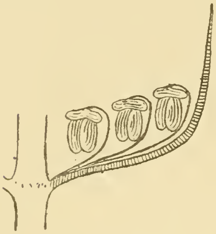

Fig. 24.—*Sphenophyllum Römeri*, Solms-Laubach. Diagramatic sketch of the arrangement of the sporangia.

SPHENOPHYLLUM MAJUS, Bronn sp.

1828. *Rotularia major*, Bronn in Bischoff. *Die Kryptogam Gewäches*, p. 139, Pl. XIII., fig. 2.

1835. *Sphenophyllum majus*, Bronn. *Lethæa Geol.*, Vol. I., p. 32, Pl. VIII., 9*a-b*.

Cone little modified in form from the ordinary foliage branch. Basal portion of bracts united into a narrow sheath which surrounds the axis, limb divided into two bifid forks. Sporangia pyriform, united in groups of four, and sessile on the free portion of the bract below the bifurcations.

Fruiting specimens of this species have been collected by Mr. Hemingway at Woolley Colliery, Darton, near Barnsley, from the shale over the Barnsley Thick Coal (Middle Coal Measures, No. 2172, &c.).

The cones of *Sphenophyllum majus* differ in some respects from those of the other species whose structure is known. The internodes are not shortened, and the bracts not more reduced in the limb than is seen in the segmented leaves of the ordinary foliage branches. Nor do they seem to have a "knee" where the distal portion usually uprises, but, as far as one can judge, the bracts stood out from the axis like the ordinary foliage leaves. They are, however, united at the base into a narrow collar or sheath which surrounds the axis.

The sporangia are usually more or less displaced, and it is very difficult to ascertain their true position on the bracts, or how many circles they formed. I am inclined to think they have been placed in two concentric circles, though on the specimen from which the figure was taken only one group was present.

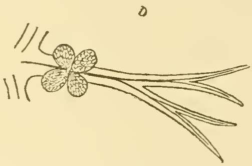

Fig. 25.—*Sphenophyllum majus*, Bronn. Bract showing four sporangia—sessile and united to each other by their bases.

The pyriform sporangia are united by their bases into groups of four; on this point there cannot possibly be any doubt; and that this is so is shown by the fact that when they are removed from the bracts they generally occur in the shale, still united in groups of four.[1] I can find no trace of a sporangiophore or pedicel, and if such a structure is present it must be reduced to a very short point where the four sporangia unite.

Several authors have proposed the union of *Trizygia*, Royle.[2] The fructification of *Trizygia* appears to be unknown, and it is therefore only the foliage branches that are available for comparison. In *Trizygia* each node bears a whorl of six cuneate leaves, but the two lateral pairs are larger than the anterior pair. On the inequality of the size of the leaves in *Trizygia* lies the chief difference between it and *Sphenophyllum*.

The discovery of some specimens by M. de Bosniaski in the Palæozoic rocks of Monte-Pisano, apparently belonging to *Trizygia*, led M. Zeiller to communicate an interesting paper,

[1] Sometimes six sporangia appear to form a group.

[2] Royle, "Illustrations of the Botany and other Branches of the Natural History of the Himalayan Mountains and of the Flora of Cashmere," p. 431. 1839.

"*Sur la valeur du genre Trizygia*," to the *Soc. Géol. de France*,[1] in which he advocates the union of *Trizygia* and *Sphenophyllum*. He cites several cases where well-known species of *Sphenophyllum* have been known to show an inequality in the size of the leaves forming the whorl, and simulating in this respect the characteristics of *Trizygia*.[2]

It must be noted, however, that in *Trizygia* the inequality in the size of the leaves in the whorl is a constant character, but in *Sphenophyllum* it is an accidental occurrence.

Seward in his *Fossil Plants* unites these two genera,[3] but this course I do not feel inclined to adopt, and prefer to leave the question open for the present.

Sphenophyllum, not only in the structure of its stem, but also in that of its cones, exhibits so many peculiarities that it is impossible to class it with any other group of plants. With the *Calamites* it has a certain superficial resemblance in the ribbed stem and whorled leaves, but the solid axis, the non-alternating ribs of *Sphenophyllum*, its dichotomous division of the segments and veins of the leaves, and also the structure of its cone, differ so much from those of the *Calamites* that any systematic relationship is entirely precluded. With *Archæocalamites (Bornia)* it has a greater resemblance in the ribs of *Archæocalamites* not alternating at the nodes and in the leaves being dichotomously divided, but it differs here also in its solid axis[4] and in the structure of the cone (presuming that *Pothocites* is the fructification of *Archæocalamites*).[5]

With the *Lycopodiaceæ* also, *Sphenophyllum* seems to have no close connection. When describing the fructification of *Sphenophyllum trichomatosum*, Stur, in 1891, my belief was that

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[1] *Bull.*, *3e Sér.*, Vol. XIX., p. 673. 1891.

[2] For reference to these figures, see Zeiller's paper, *l.c.*

[3] Seward, *Fossil Plants*, Vol. I., p. 411.

[4] For structure of *Archæocalamites Gopperti*, see Solms-Laubach, *Uber die in den Kalksteinen des culm von Glatzisch Falkenberg in Schlesien erhaltenen structur bietenden Pflanzenreste. Botanisches Zeitung*, 1897, Heft. XII., p. 219, Pl. VII.

[5] Kidston, "On the Affinities of the genus *Pothocites*," Paterson. *Ann. and Mag. Nat. Hist.*, Ser. 5, Vol. XI., p. 297, Pls. IX., X., XI., figs. 9-10; XII., figs. 13-16, 1883; *ibid.*, *Proc. Roy. Phys. Soc. Edin.*, Vol. XVI., Pls. I., II., III., figs. 9-10; IV., figs. 13-17

Sphenophyllum embraced "a peculiar group of plants which, though standing close to the Lycopods, cannot be included within them, but must be placed in a class by themselves—the *Sphenophylleæ*."[1] Since that sentence was written much light has been thrown on the structure of *Sphenophyllum*, especially in regard to its fructification, and although the complete morphology of the cone is not positively determined, still the evidence points to the sporangium being a ventral lobe of the leaf. If this be the true explanation, its morphology is quite different from that of the sporangia of *Lepidodendron*, *Sigillaria*, or any of the *Lycopodiaceæ*.

Until the morphology of the fructification of *Sphenophyllum* is definitely determined, it is, of course, impossible to fix the systematic position of the genus, but, as far as one can judge at present, it possesses a peculiar type of structure which stands out free from all other groups, recent or fossil, with which we are acquainted.

To compare it with recent genera is not less difficult, nor is there any clear data to proceed upon. The question has been very fully gone into by the late Professor Williamson and Dr. Scott,[2] and after a critical analysis of all the evidence available for a comparison of *Sphenophyllum* with existing genera, the conclusion they arrive at is—"We must be content for the present to leave this remarkable genus in its isolated position, in the hope that the extensive knowledge of its organization which we possess may in the future afford an adequate basis for comparison when additional forms of Palæozoic Cryptogams have been brought to light."[3] They further say—"In fact, *Sphenophyllum* affords yet another example of a Carboniferous Cryptogam, which, so far from representing a primitive type, is in many ways more elaborately modified than any recent forms;"[4] and

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[1] *Proc. Roy. Phys. Soc. Edin.*, Vol. XI., p. 61, Pl. I. 1891.

[2] Williamson and Scott, "Further Observations on the Organisation of the Fossil Plants of the Coal Measures—I.," *Phil. Trans.*, Vol. CLXXXV. (B.), p. 940, 1895; Scott, "On the Structure and Affinities of Fossil Plants from the Palæozoic Rocks," "On Cheirostrobus," *Phil. Trans.*, Vol. CLXXXIX. (B.), p. 23, *seq.*, 1897.

[3] Williamson and Scott, *Phil. Trans.*, Vol. CLXXXV., p. 946. 1895.

[4] Williamson and Scott, *l.c.*, p. 944.

here, I am afraid, the matter must rest for the present. To repeat the arguments which led to the above conclusions is unnecessary, as the original memoirs are most accessible to all students.[1]

Genera of Uncertain Position.

I. Cheirostrobus, Scott, 1897.

1897. *Cheirostrobus*, Scott. *Proc. Roy. Soc. London*, Vol. LX., p. 422.

1897. *Cheirostrobus*, Scott. On Cheirostrobus, a new type of Fossil Cone from the Lower Carboniferous Strata (Calciferous Sandstone Series), *Phil. Trans.*, Vol. CLXXXIX., Series B, pp. 1-34, Pls. I.-VI.

The single species of this genus, *Cheirostrobus Pettycurensis*, Scott, is founded on a portion of a peduncle and a cone, the only two specimens of the plant known to exist.

The cone represents a very complex structure, and any short description which could be included here, unless very fully illustrated, would be of little practical utility.

In regard to the affinities of *Cheriostrobus* Dr. Scott says:— "Taking all the characters collectively, it seems clear that *Cheirostrobus* has more in common with *Sphenophyllum* than with any other known group, recent or fossil, and that *Sphenophyllum* is thus no longer left perfectly isolated in the vegetable kingdom."[2]

I scarcely feel inclined to place *Cheirostrobus* in the *Sphenophyllales;* the differences are such that it appears to me to demand a position equal in value to *Sphenophyllum* itself, and that it is really the type of a distinct group.

The cone was discovered by Mr. James Bennie, Edinburgh, at Pettycur, Fife, and the peduncle from the same locality is in the Williamson Collection, British Museum.

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[1] See also Potonié, *Ueber die Stellung der Sphenophyllaceen im System. Bericht d. Deut. Bot. Gesell.*, Vol. XII., Heft. 4, 1894, p. 97. Potonié, *Lehrb. d. Pflanzenpalæontologie*, 1899, p. 180.

[2] Scott, *Phil. Trans.*, Vol. CLXXXIX., p. 25. 1897.

II. Psilotites, Goldenberg, 1855.[1]

1855. *Psilotites*, Goldenberg (not Münster). *Flora Sarœp. foss.*, Heft. I., p. 13.

Stem bifurcating. Leaves rudimentary, Sporangium three-chambered, and sitting in the axil of the leaf.

The specimen placed by Goldenberg in his genus, *Psilotites lithanthracis*, from the Saarbrück basin, does not seem to possess all the characters mentioned in the generic definition.[2]

The example which I referred to this genus under the name of *Psilotites unilateralis*,[3] and which was presented to the Hunterian Museum, Glasgow University, by Mr. Walter Burns, is equally problematical in its affinities. It consists of three slender striated stems each having on one side a longitudinally arranged row of curious small rounded knobs.

Till some distinct knowledge of the fruit of these obscure fossils is obtained, their systematic position must remain very doubtful.

The Scotch specimen came from the Lower Coal Measures, Baillieston, Lanarkshire.

III. Traquairia, Carruthers, 1872.

1872. *Traquairia*, Carruthers. *Rept. Brit. Assoc.*, p. 126.

1880. *Traquairia*, Williamson. On the Organization of the Fossil Plants of the Coal Measures, Mem. X., *Phil. Trans.*, 1880, Part II., pp. 511-532; Pl. XVIII., figs. 41, 42, 45, 46, 47; Pl. XIX., figs. 40, 43, 44, 48, 49, 50; Pl. XXI., figs. (?)82, (?)83, (?)84, 85 (in part), 86, 87, 88.

1880. *Lepidostrobus Traquairia*, Williamson, Mem. X., *l.c.*, p. 537.

The curious little fossils that have been named *Traquairia* are spherical organisms, with a thin structureless wall which is produced into long warty, branching spines.

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[1] The genus *Psilotites* was first employed by Münster (*Beitr. z. Petrefact-enkunde*, Heft. V., p. 188, 1839-44). The plant, however, which formed his type is now supposed to have been a macerated specimen of a conifer (*Schenk. Die Fossilen Pflanzen.*, p. 57, 1888). The genus is now employed under Goldenberg's definition.

[2] Goldenberg, *l.c.*, Pl. II., fig. 7.

[3] *Annals Mag. Nat. Hist.*, June, 1886, p. 494, "On a new species of *Psilotites* from the Lanarkshire Coal Field."

Traquairia was supposed by Mr. Carruthers to be a Radiolarian Rhizopod. Prof. Williamson having obtained specimens suggested that they were spores, and the subject is dealt with in his Mem. X. *Traquairia* occurs in a scattered and uncertain manner in the coal balls, and, from the discovery of some examples in a crushed cone, Prof. Williamson came to the conclusion that *Traquairiæ* were the macrospores of a Lycopodiaceous plant.[1] It is extremely probable that the association of *Traquairia* with the crushed *Lepidostrobus* was merely an accidental occurrence. Some authors have suggested that the affinities of *Traquairia* may be with *Azolla*.[2] There is, however, very little to support this view.

Although Prof. Hæckel, the greatest authority on the Radiolarians, has rejected *Traquairia* from that group, still there is not much evidence for claiming them as vegetable remains, for it can scarcely be accepted as certain that the specimens found in the crushed cone by Williamson really belong to it, as they also occur with other broken up vegetable remains. I am, therefore, inclined to regard *Traquairia* as an organism whose true nature, vegetable or animal, has yet to be determined. They are found in the coal balls of the Yorkshire Lower Coal Measures.

APPENDIX.

Omphalophloios, White. 1898.

1898. White, *Bull. Geol. Soc. Amer.*, Vol. IX., p. 340.

Since my communication was read before the Society, I have received a copy of a paper by Mr. David White, containing a description of a new genus which he names *Omphalophloios*.[3]

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[1] *l.c.*, Mem. X., p. 532.

[2] Solms-Laubach, *Fossil Botany*, English edition, p. 183 (1887), 1891. *Schenk. Die Fossilen Pflanzen.*, p. 52, 1888. *Potonié Lehrbuch d. Pflanzenpalæontologie*, p. 174, 1899.

[3] "*Omphalophloios*, a New Lepidodendroid Type." *Bull. Geol. Soc. of America*, Vol. IX., pp. 329-342, Pls. XX.-XXIII. Rochester, May 24, 1898.

The type of his genus is the *Lepidodendron cyclostigma*, Lesqx.,[1] of which additional specimens have come into the possession of the United States Natural History Museum. These later examples, along with the specimens originally described by Lesquereux, form the subject of Mr. White's memoir. Although several of his specimens show the epidermis, none of them seem to have clearly shown the structure of the scar left by the fallen organ.

I believe that the plant described by Mr. White under the name of *Omphalophloios cyclostigma*, Lesqx. sp., is the *Lepidodendron anglicum*, Sternb.,[2] from Paulton, Somerset.[3] I have several good examples of the Somerset plant from the same beds as those from which the type specimen was derived, and have figured portions of some of these in my paper on "The Fossil Flora of the Radstock Series of the Somerset and Bristol Coal Field."[4]

Brongniart, in his Prodrome,[5] places *Lepidodendron anglicum* in *Stigmaria* under the name of *Stigmaria reticulata*, and in my paper, to which reference has already been made, it is also placed in *Stigmaria*, but under the name of *Stigmaria anglica*, Sternb. sp. A comparison of the figures given in the *Trans. Roy. Soc. Edin.*, Vol. XXXIII., Plate XXVIII., with those published by Mr. David White, will, I think, show the identity of the American examples with Sternberg's plant, especially if my fig. 9 be compared with Mr. White's fig. 3, Pl. XXI.

Omphalophloios anglicus, Sternb. sp., I believe to be a rhizome comparable to *Stigmaria*, with which it appears to be closely related. The imperfect preservation of the American specimens has, I am afraid, obscured the structure of the scars.

Different portions of a specimen from Somerset (No. 426), measuring about $9\frac{1}{2}$ inches long, are shown at fig. 26, A, B, C, D, and E. Between the smaller scars at the upper end and those at the basal end of the fossil are certain differences which merit

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[1] *Coal Flora*, II., p. 394, Pl. LXII., fig. 5. 1880.

[2] Vers. I., fasc. iv., p. xi., Pl. XXIX., fig. 4. 1826.

[3] From the Radstock Series of the Upper Coal Measures.

[4] *Trans. Roy. Soc. Edin.*, Vol. XXXIII., Part II., p. 401, Pl. XXVIII., figs. 9. 9*a*, 10, 10*a*, 10*b*.

[5] page 87. 1828.

consideration. At fig. 26, A, a few of the rhomboidal "fields" are shown natural size, with their subcordate prominent cushion, considerably upraised, and containing faint traces of an almost central scar, within which is a slightly elongate vascular cicatrice placed near its lower margin. Immediately below this upraised cushion, and attached as it were to its outer side, is a triangular ridge-like elevation containing a small pit. That this small pit is situated on the lower margin of the raised cushion is proved by the fact that the rhomboidal areas and scars increase in size as we recede from this end of the specimen. At B is given an enlarged drawing of one of these areas to show the parts more clearly. The "field" is indicated by the *a*, the prominent cushion with slightly raised-up border at *b*, and its contained scar at *c*, whose vascular cicatrice is placed slightly below the centre. At *d* is the small pit-like cicatricule. Fig. C gives a few of the

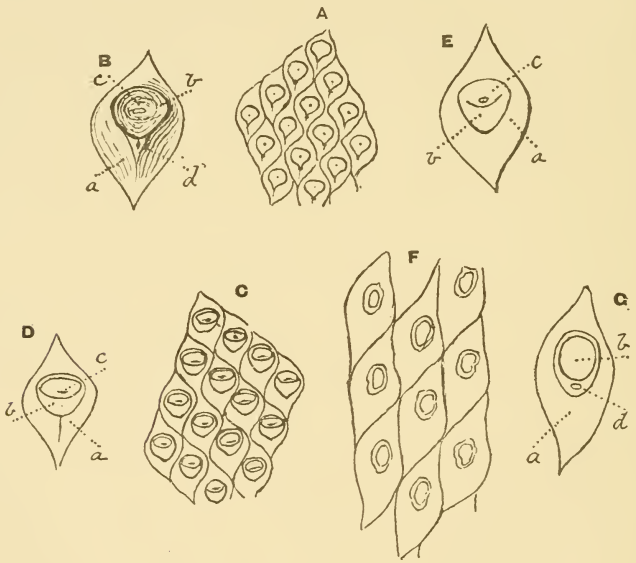

Fig. 26.—*Omphalophloios anglicus*, Sternb. sp. A to E, from different portions of the same specimen (No. 426); F and G, portions of another example (No. 433); A, C, and F, natural size; B, D, E, G, enlarged—all from Camerton, Somerset. For explanation of lettering see text.

rhomboidal areas, natural size, from about the middle of the same specimen, and D gives a single cushion, enlarged. The scar left by the shed organ is seen at *c*, where it is more clearly defined than at *c*, fig. B. Figs. A and B are from a portion of the specimen showing the outer surface of the fossil; C, D, and E are taken from the impression of portion of the same specimen left in the matrix from which the stem has fallen out. The rhomboidal area E is from the basal end of the specimen, and here the scar *c* is becoming effaced, though the vascular cicatrice is clearly seen. On D and E the small cicatricule or pit, shown at *d* on B, is not visible, probably through imperfect preservation.

Fig. 26, F, shows a portion of another and older specimen, drawn natural size, and G gives one of the rhomboidal areas enlarged. A great difference is seen in the form of the central cushion *b*. Here the elevation of the cushion, so prominent in A and C, has entirely disappeared, and with it all trace of the scar *c* and its vascular cicatrice, and the space is now occupied by a hollow, surrounded by a raised ring bearing on its outer and lower face the little cicatricule *d*.

Mr. White suggests that perhaps his fig. 1, Pl. XXII., represents a dichotomy of the fossil. This is most probable, as Mr. George West, Camerton, showed me an example which divided into two equal forks.

Awaiting the discovery of better preserved specimens which would show clearly the various parts of the scar, Mr. White deferred giving a definite diagnosis of his genus *Omphalophloios*, but believing that the Somerset examples afford all the necessary characters, I venture to give the following generic description :—

OMPHALOPHLOIOS, White. 1898.

1898. *Omphalophloios*, White, *Bull. Geol. Soc. Amer.*, Vol. IX., p. 340.

Cortex divided into clearly defined rhomboidal areas, within which, and a short distance above its centre, is an elevated subcordate or oval cushion with a slightly raised ring-like margin, containing, a little above its centre, an oval scar with a single vascular cicatrice.

Remarks.—The genus *Omphalophloios* differs from *Stigmaria* in the cortex exhibiting clearly defined and slightly raised rhomboidal areas placed in spiral series, and in the elevated cushion on which is situated the scar of the organ it has borne. It is true that in *Stigmaria* there is a slight circular cushion which bears an inner circular ring containing the central single vascular cicatricule, but the raised cushion in *Omphalophloios* is much more pronounced, and the oval scar of the fallen organ, with its transversely elongated vascular cicatricule is placed above the centre of the cushion on which it sits. In the older condition of *Omphalophloios*, as that shown at fig. 26, F and G, these characters are in part effaced with age, but it is to the more active growing parts that we must look for the true structure of the cushion and scar.

It also differs from *Stigmaria* in the presence of the small cicatricule on the lower margin of the raised central cushion. This structure is seen both in the young and old conditions of the fossil (Fig, 26, B *d*, G *d*), though it is not always discernible, possibly through imperfect preservation. In position it agrees with a similar structure seen on the cushions of some species of *Lepidophloios*, and which from its position can scarcely be compared with the so-called ligule scar of *Lepidodendron* and *Sigillaria*.

I believe *Omphalophloios* is a *rhizome* whose general structure approaches closely to that of *Stigmaria*, but the differences, to which reference has already been made, are such as to demand its removal from *Stigmaria*, in which genus I have always felt it did not find a suitable place.

It should be mentioned, however, that in some forms of *Stigmaria* the scar is surrounded by a more or less distinctly-defined rhomboidal area, as in *Stigmaria areolata*, Dawson,[1] of which I have a similar form from the Lower Carboniferous of Northumberland (No. 2558), but in these cases the rootlet scar is of the normal *Stigmaria* type, and such specimens are probably from that portion of the stem of *Lepidodendron* when the transition between stem and rhizome takes place.

If my views on the identity of the English and American plants are correct, then the genus is restricted to a single species.

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[1] *Foss. Plants, Devon. and Upper. Silur. Form*, p. 23, Pl. III., fig. 33. 1871.

OMPHALOPHLOIOS ANGLICUS, Sternb. sp. (Fig. 26.)

1826. *Lepidodendron anglicum*, Sternb. Vers. I., fasc. iv., p. xi., Pl. XXIX., fig. 3.

1828. *Stigmaria reticulata*, Brongt. *Prodrome*, p. 87.

1838. *Aspidiaria anglica*, Presl in Sternb. Vers. II., p. 181 (? Pl. LXVIII., fig. 11).

1880. *Lepidodendron cyclostigma*, Lesqx. *Coal Flora*, Vol. II., p. 394, Pl. LXII., fig. 5.

1888. *Stigmaria anglica*, Kidston. *Trans. Roy. Soc. Edin.*, Vol. XXX., Part II., p. 401, Pl. XXVIII., figs. 9, 9*a*, 10, 10*a*, 10*b*.

1897. *Omphalophloios cyclostigma*, White. *Bull. Geol. Soc. Amer.*, Vol. IX., p. 340, Pls. XX.-XXIII.

Description.—Cortex divided into smooth rhomboidal areas, whose lateral angles are somewhat rounded. Within this rhomboidal area or "field," and slightly above the centre, is an elevated subcordate or subcircular cushion, with slightly raised margin, containing, generally towards its upper half, an oval scar with an oblong vascular cicatrice placed near its lower margin. Immediately below this cushion, and attached to the side of the elevated rim, is a small triangular ridge with a pit-like cicatricule. In the older condition the scar is effaced, and the central area of the cushion becomes depressed, and is surrounded by an elevated ring, which frequently shows the small pit-like cicatricule on its lower margin.

British specimens—

Hor. Radstock Series of the Upper Coal Measures.
Locs. Paulton; Radstock; and Camerton; Somerset.

American specimens—

Hor. Lower Coal Measures, or Des Moines Series.
Locs. Clinton Coal, Missouri (Lesquereux).
Pitcher's Coal Mine, Henry County (White).

[*The figures contained in brackets show the Registration number of the specimens referred to in the Author's Collection.*]

INDEX.

(Synonyms are printed in italics.)

Meteorological Notes and Remarks upon the Weather during the Year 1899, with its General Effects upon Vegetation.

By James Whitton, Superintendent of Parks, Glasgow.

[Read 24th April, 1900.]

In prefacing these notes it is but needful to state that the figures quoted are from the records kept at Queen's Park, Glasgow.

January.—The year was ushered in by moist and mild weather, suggesting anything but mid-winter. The opening days were dull and wet, with gales from the south-west about the 13th, when the barometer fell to 28·30 inches. On the 12th a change took place in the temperature, and the rain, which had been falling incessantly for the previous day or two, gave place to snow and sleet. Frost set in on the 16th, and culminated in a heavy snowfall on the 18th, when it lay to a depth of between three and four inches. Cold frosty weather continued till the 29th, when a gradual thaw begun. On the mornings of the 25th and 27th the thermometer fell to 19°—being 13° of frost. The 27th was a day of dense fog in the city, necessitating the lighting of the street lamps.

The atmospheric pressure for the month was wide and erratic, ranging from 28·30 inches on the 13th to 30·38 on the 26th.

Frost was registered on 12 days, and amounted to 94° in all. The lowest reading was taken on the 25th and 27th, when 13° of frost were recorded. On three occasions, viz., the 25th, 28th, and 29th, the temperature never rose above freezing point (32°) The average maximum temperature for the month was 40°, and the average minimum 32°, as compared with 47° and 39° respectively in the preceding January.

The month's rainfall was exceptionally heavy, 5·61 inches being measured, which, however, included a quantity of melted snow. The greatest daily rainfall was 1·20 inches on the 19th.

The mildness of the beginning of the month caused the sap to rise in trees, and buds began to swell, but their prematurity was checked by the frost towards the close of the month.

February.—The threatened thaw at the close of the previous month was succeeded at the opening of February by a renewal of hard frosty weather, which, however, was bright and bracing. Skating and curling were general in all the ponds around the city, including those in the public parks. Snow began to fall in the early hours of the 6th, and continued till mid-day, when it measured 3 inches in depth. On the 7th a thaw set in, and by the 8th the frost and snow had entirely disappeared, and in their place a return to mild weather, accompanied by rain. These conditions prevailed till the 20th, when keen frost again made its appearance, and lasted till the close of the month. A dense fog was experienced on the 27th.

Frost totalling 83° was registered on 14 days during the month, while the average maximum temperature was 43°, and the average minimum 32°. During the month there were 20 dry days, and the total rainfall for the month was 1·84.

The barometer was low for the first half of the month, but from 28·70 inches on the 14th it rose steadily till, on the 20th, it touched 30·25 inches, and thereafter continued steady.

Snowdrops were in full bloom by the middle of the month, and in sheltered places crocuses were also in flower.

March.—After the severe frosty weather which characterised the latter part of February, the bright and open weather which obtained during the first part of this month was pleasant and enjoyable, though showery. Until the 16th the weather continued mild and clear, but on this date fog was again experienced, and increased until the afternoon of the following day, when it cleared, and was followed by intensely cold and frosty weather. This somewhat unseasonable cold snap continued till the 25th, when snow fell to a depth of 4 inches, and was almost immediately followed by thaw and rain. The weather until the close of the month was milder, with a heavy rainfall (1·20 inches) on the 28th.

The atmospheric pressure was irregular and low, falling to 28·70 inches on the 9th, then rising rapidly to over 30·00 inches on the 11th, and remaining higher for a week.

The rainfall for the month was 3·18 inches.

The amount of frost recorded was 72° for nine days, and the lowest reading of the thermometer was 17° on the 24th, thus showing 15° of frost. The total frost for the same month of 1898 was 45° for ten days. The average maximum and minimum temperatures were 46° and 35° respectively, against 46° and 34° in the previous year.

The anticipations of an early season, fostered by the comparatively mild weather of the beginning of the year, began to lessen with the severe weather of the latter part of March, and fears were entertained that the Spring would be late.

Notwithstanding the unpropitious weather several species of plants came into bloom during the month, notably daphne, heath, and *Rhododendron nobleanum.*

April.—With a prevalence of northerly and easterly winds, this month continued cold and unseasonable. Though there was abundance of rain the weather was cold, and there was scarcely a warm day during the month. The opening days were cold and showery, with dull and cloudy skies, and on the 12th a sharp attack of frost occurred, and lasted intermittently till the 19th. Towards the close of the month the weather became milder, till on the last day of the month, when several degrees of frost were again registered.

The barometer throughout the month was low and irregular, never reaching higher than 30·00 inches, and lowest on the 13th at 28·85 inches.

The rainfall for the month was 3·18 inches, and there were 21 dry days.

The amount of frost registered during the month was 24° on seven mornings. The average maximum temperature was 52°, and average minimum 37°, compared with 6° of frost for one day and average maximum and minimum temperatures 55° and 41° for the preceding April.

Consequent on the cold, ungenial weather, the hyacinths and tulips which bloomed this month only lasted a short time, and vegetation generally made little progress, being at least three weeks later than the previous year. The trees noted in leaf in the parks were hawthorn, on the 15th, and birch, on the 20th.

May.—The milder weather experienced in the closing days of April did not last long, as the 1st of May came in cold, and, instead of the dews expected in the morning, there was a fall of snow and sleet, followed by a cold rain. On the 3rd, however, with a rising barometer, the weather became dry and brighter, though still cold, with the wind from the east and north-east. Frost to the extent of 4° and 3° was registered on the 4th and 5th respectively. On the wind changing to the south-west, a thunder storm was experienced on the 15th, accompanied with a strong wind and heavy rain. Dull and showery weather continued till the last week of the month, when it became much warmer and brighter. The Children's Day in the City Parks, held on the last Saturday, was a day of bright sunshine, which added greatly to the success of the undertaking.

The rainfall for the month was heavy (4·45 inches), though there were 18 dry days, two days having over one inch each, viz., 1·50 inches on the 19th, and 1·05 inches on the 20th.

Frost occurred on two days to the amount of 7°, and the highest temperatures recorded were on the last two days of the month, when 67° were registered.

The progress of vegetation was much impeded by the cold, searching east winds, the first grass being cut in the parks on the 24th, as compared with the first cut on 25th April, 1898.

June.—The first three weeks of June were like the last week of May—warm and sunny days and cold nights, with scarcely any rain. The only rain registered during this period was 0·05 inches and 0·09 inches on the 4th and 19th. With the last ten days of the month came refreshing showers of rain, and the atmosphere was more temperate. On thirteen occasions during the month the thermometer rose above 70°, the highest being 77° on the 11th, and the average maximum temperature was 69°, while that of the preceding June was 65°. The rainfall was only 1·55 inches, and there were 22 dry days.

As a result of the high temperature and soft south-west winds, vegetation made up some of the leeway of the last two months—the flowering trees and shrubs in the parks getting into full bloom. Especially may be noted the fine show made by the weigela, red flowering chestnuts, thorn, laburnum, &c.

July.—The opening day of the month was cold and wet, with light south-east wind. From the 4th to the 10th the weather was finer, but on the 11th rain fell all day, and for the twenty-four hours measured 1·22 inches. For the succeeding fortnight the weather was dull and sultry, with frequent showers. Towards the close of the month it became warmer and brighter.

The barometer on the 1st indicated the pressure at 29·20 inches, rising sharply to 30·00 inches on the 5th, and thereafter remained high without much variation during the month.

Rain fell during the month to the extent of 3·69 inches, and there were 16 dry days. The average maximum temperature was 68°, one degree higher than in 1898, while the average minimum was 53°, and in 1898 49°. During the month the thermometer was at or above 70° on nine occasions.

The refreshing rain of the month gave an added impulse to vegetation, while the plants bedded out in the parks made excellent growth, and presented a bright and pleasing display. The various crops, which were almost stationary owing to the drought, made rapid headway.

August.—August was a month of great heat and little rain, being the hottest and driest month of the year. It opened with very warm weather, but from the 7th to 13th there was a spell of cooler days and somewhat cold nights. Towards the end of the month the heat was semi-tropical, with a regular succession of fine days.

The highest reading of the year was taken on the 24th, when the thermometer touched 80°, which is the highest temperature since 1893, when it reached the same figure. On 13 other occasions the thermometer was at or above 70°, and the average maximum temperature was 69° and the minimum 53°, being higher than the previous August by 4° and 2° respectively. The rainfall was only 1·38 inches, which is the lowest recorded for this month for a number of years, August of 1898 having a total of 4·77 inches. There were 23 dry days in the month.

The great heat and drought experienced during the month ripened the leaves of most deciduous trees, and some defoliated rapidly, notably limes, sycamore, elms, and beech. The great heat experienced during the month materially helped the development and maturation of the cereals, which were in a somewhat backward condition on cold heavy soils, and harvesting was begun earlier than was generally anticipated.

September.—This month was showery and unsettled, with some thunderstorms about the 26th, when the barometer fell to 28·86 inches. There were only 5 dry days in the month, and the total rainfall was 3·71 inches. Although no frost was registered, the nights towards the close of the month were cold, the thermometer on the grass falling below freezing point on several occasions.

The average temperatures for the month were—maximum 59° and minimum 46°.

The barometer was steady between 29·00 inches and 30·00 inches till the thunderstorm and heavy rain of the 26th, when it fell half-an-inch in twenty-four hours.

The unsettled atmospheric conditions which obtained during the month militated very considerably against harvesting operations, and many farmers had considerable difficulty in getting these operations satisfactorily performed.

October.—For the first half of this month there was a continuation of the mild showery weather which prevailed during September. On the 13th, with a rising barometer, the weather became bright and cold, and on the 14th the first frost of the season was experienced, when 3° were registered at Queen's Park. This bright clear weather continued till the 24th, and the remaining days of the month were dull and showery.

The rainfall was rather above the average, the amount registered being 3·57 inches. There were 15 dry days.

The readings of the barometer show some striking changes—from 30·10 on the 8th, the pressure decreased to 29·16 on the 12th, rising again to 30·17 on the 21st, and ending at 29·47 on the 31st.

The average maximum temperature was 54° and the average minimum 40°, the maximum being the same and the minimum 6° less than in the corresponding month of last year.

Frost was registered on two mornings to the extent of 6°.

The frost of the middle of the month brought the show of outdoor flowers to a close, and trees became rapidly divested of their leaves, assuming their wintry appearance. The showery weather delayed the later harvesting operations.

November.—November was remarkable for its mildness, indeed it is one of the warmest Novembers on record. With a prevalence of south-west winds the weather for the first two weeks was wet and unsettled. On the 3rd heavy rain fell, accompanied by a strong south-west wind, and for the twenty-four hours ending 9 a.m. on the morning of the 4th it measured 1·45 inches, which is the heaviest rainfall for one day for the year. Again on the 8th the rainfall measured 1·01 inches. This indicated the general character of the weather for the month—dull and wet, with occasional heavy fogs.

The rainfall is the greatest monthly total of the year, 5·64 inches. There were only 10 dry days. The barometer was low and very irregular during the first fortnight ranging as low as 28·70 on the 8th, but from the 14th it gradually rose till, on the 17th, it touched 30·42, the highest reading of the year.

The almost entire absence of frost during the month was remarkable, 1° only occurring on the 18th, a most unusual experience for this season of the year. The average temperatures were—maximum 51° and minimum 42°, while in 1898 these were 46° and 37°.

December.—The severe weather of this month amply made up for the previous mildness of the season. After the first week, which was mild like November, severe frosty weather set in on the 8th, and on the 12th a heavy snowstorm was experienced in the city, snow lying to a depth of 3 inches. Cold bracing weather continued till about the 19th, when, for a few days, the atmospheric conditions were less severe, but dull and unpleasant. Frost again occurred on the 22nd, and held more or less keen till the end of the year.

The frost recorded this month—128° for 17 days—is the highest monthly record for the year, and the lowest reading of the thermometer was taken on the 15th, when it fell to 15°, showing 17° of frost.

The average maximum and minimum thermometers were 39° and 30° respectively, as compared with 48° and 40° for December, 1898.

The rainfall for the month was moderate, at 2·94 inches, and there were 16 dry days.

The barometer readings show that the atmospheric pressure during the month was of a very variable nature. Until the 21st it varied from 29·30 to 30·10, thereafter falling steadily to 29·30 on the 28th, and very sharply to 28·26 on the 30th. This was the lowest reading of the year.

Comparing the records with those of previous years, we find that the rainfall—41·67 inches—is the heaviest recorded within the last ten years, the next being 41·48 inches in 1894. The month in which the highest rainfall was recorded was December, with 5·64 inches, January coming very close with 5·61 inches. The wettest day of the year was the 18th May, when 1·50 inches was recorded. Other notable days of rain were January 19th, 1·20 inches; March 29th, 1·20 inches; and November 4th and 8th, which had 1·45 and 1·01 inches respectively. The driest month of the year was August, and in 1898 the driest month was July. The number of dry days was 193, compared with 212 in 1898.

The following table shows the amount of rain registered in the various parks, &c., where gauges are placed, in comparison with Queen's Park, on which record these observations are based. Allowance must be made for the difference in altitude and other local conditions :—

RAINFALL DURING 1899 IN THE PUBLIC PARKS.

	QUEEN'S.	MAX-WELL.	KELVIN-GROVE.	SPRING-BURN.	ALEX-ANDRA.	GLASGOW GREEN.	BELLA-HOUSTON.	TOLL-CROSS.	GEORGE SQUARE.
Height of Gauge above Sea-level.	145 ft.	69·1 ft.	48·3 ft.	361 ft.	141·4ft.	34·7 ft.	160 ft.	85 ft.	40 ft.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January, -	5·61	6·20	5·83	5·31	6·47	6·54	6·73	6·03	6·88
February, -	1·84	3·90	1·92	1·96	1·80	1·74	1·91	1·71	2·05
March, - -	3·18	3·29	3·14	2·78	2·92	3·61	3·36	3·35	2·84
April, - -	4·11	3·49	3·56	3·33	3·36	3·34	3·32	3·66	3·55
May, - - -	4·45	4·17	4·55	3·61	4·20	4·61	4·14	4·29	5·25
June, - - -	1·55	1·82	1·76	1·61	1·86	1·52	1·67	1·95	1·96
July, - - -	3·69	3·93	3·80	4·11	3·67	3·95	3·65	3·69	4·19
August. - -	1·38	1·43	1·25	1·36	1·00	1·30	1·25	1·22	1·45
September, -	3·71	3·99	3·55	3·47	3·84	3·68	3·42	3·90	3·54
October, - -	3·57	3·43	3·08	3·41	2·66	3·53	2·46	3·28	3·34
November, -	5·64	6·41	4·66	4·76	4·39	5·33	4·04	5·21	5·42
December, -	2·94	3·31	3·44	3·15	3·39	2·80	2·97	3·48	3·66
Totals, -	41·67	45·37	40·54	38·86	39·56	41·95	38·92	41·77	44·13

As regards the temperature of the year, there was a greater range in the thermometer than has been the case for some years. The highest reading of the thermometer was 80° on the 24th August, being 2° higher than that of the previous year, when 78° was registered on 7th September. The maximum thermometer was at or above 70° on 13 days in June, 9 days in July, and 13 days in August, or 35 times in all, whereas in 1898 the total was 20 times, and occurring in the same months.

The amount of frost registered was 415°, occurring on 64 occasions, against 192° on 42 occasions in 1898. The coldest month of the year was December, when 128° of frost was recorded on 17 mornings, and the coldest day was on the 15th of that month, when 17° of frost was registered. In 1898 the coldest month was February, with 67° of frost, and the coldest day 29th November, when the thermometer touched 18°, or 14° of frost.

Comparison of the records for the different parks, &c., will be found of interest, allowance being made, as before, for difference in situation :—

1899.	Queen's Park.	Maxwell Park.	Kelvingrove Park.	Springburn Park.	Alexandra Park.	Glasgow Green.	Bella-houston Park.	Tollcross Park.	George Square.
Thermometer (in shade, 4 feet above ground level).									
Highest reading of year, ...	80°, 24th Aug.	86°, 10th and 12th June and 2nd Aug.	85°, 24th Aug.	87°, 13th June	80°, 24th Aug.	84°, 11th June and 2nd Aug.	85°, 24th Aug.	83°, 2nd Aug.	86°, 25th Aug.
Lowest do. do.,	15°, 15th Dec.	8°, 14th Dec.	19°, 14th Dec.	20°, 28th Dec.	10°, 28th Dec.	9°, 29th Dec.	15°, 28th Dec.	11°, 15th Dec.	20°, 28th and 29th Dec.
Number of days on which thermometer fell to freezing point (32°), ...	74 days	144 days	69 days	64 days	122 days	125 days	88 days	95 days	41 days
Number of days on which thermometer did not rise above freezing point (32°),	9 days	12 days	13 days	5 days	14 days	21 days	8 days	9 days	6 days
Degrees of Frost registered—									
January, ...	94° on 12 days	195° on 23 days	68° on 14 days	70° on 14 days	151° on 21 days	153° on 23 days	88° on 16 days	105° on 18 days	27° on 6 days
February, ...	83 " 14 "	169 " 20 "	48 " 13 "	42 " 13 "	133 " 20 "	136 " 18 "	80 " 15 "	104 " 16 "	17 " 4 "
March, ...	72 " 9 "	138 " 17 "	55 " 9 "	29 " 8 "	104 " 16 "	126 " 16 "	72 " 12 "	73 " 10 "	42 " 6 "
April, ...	24 " 7 "	81 " 11 "	24 " 7 "	4 " 3 "	58 " 11 "	54 " 11 "	33 " 9 "	42 " 9 "	3 " 2 "
May, ...	7 " 2 "	42 " 8 "	1 " 1 day	...	38 " 9 "	19 " 7 "	8 " 5 "	18 " 7 "	...
June, ...	...	...	...	...	...	...	...	...	...
July, ...	...	...	...	...	...	...	...	...	...
August, ...	...	...	...	...	...	...	...	...	...
September, ...	...	12° on 2 days	...	...	9° on 2 days	7° on 2 days	1° on 1 day	4° on 2 days	...
October, ...	6° on 2 days	63 " 13 "	5° on 2 days	7° on 2 days	37 " 8 "	23 " 6 "	9 " 3 days	24 " 6 "	...
November, ...	1 " 1 day	22 " 7 "	2 " 1 day	4 " 1 day	19 " 4 "	13 " 3 "	2 " 2 "	14 " 3 "	...
December, ...	128 " 17 days	225 " 21 "	96 " 15 days	85 " 16 days	211 " 20 "	215 " 22 "	151 " 19 "	172 " 18 "	74° on 12 days
Total Frost registered,	415° on 64 days	947° on 122 days	299° or 62 days	241° on 57 days	760° on 111 days	746° on 108 days	444° on 82 days	556° on 89 days	163° on 30 days

The barometric readings show a greater range of pressure than in the preceding year. In this year the pressure was 82 times above 30·00 inches, 259 times between 29·00 and 30·00 inches, and 24 times below 29·00 inches. The highest reading was taken on the 17th November, when the pressure was at 30·42 inches, and the lowest reading was 28·26 inches on the 30th December; in 1898 the highest was 30·30 inches on 23rd January, and the lowest 28·30 inches on 28th December.

The prevailing wind of the year, as is usual in Glasgow, was the South-west, blowing from that direction on 189 days. The number of days for the other directions were as follows:—From the West, 53; North-west, 13; North-east, 35; East, 41; South, 7; and South-east, 26. Excluding the direct North and South, the Western group shows 255 and the Eastern group 102 days. In 1898 the Western had 283 and the Eastern 59 days.

From the foregoing notes it will be seen that the weather of 1899 was, in many respects, of a totally different character from that of the previous year. For instance, the year 1899 was notable for the violent storms experienced during the first two months, with the severe frosts of January, February, and March, while in 1898 these months were comparatively mild and open. August was much warmer and drier than in the preceding year, and November was almost entirely free from frost. One remarkable feature is that of the rainfall, which, as already stated, is the highest for 10 years, despite the drought experienced during the summer months. This district did not suffer so much from the want of rain as many others in the kingdom, and, on the whole, the season was fairly favourable for vegetation. Agricultural crops, with perhaps the exception of hay and turnips, were quite up to the average, and of excellent quality. The cold, hard, frosty winds in May did serious damage to the fruit trees when in bloom, consequently the crops were very light. A very satisfactory growth was made by nearly all classes of trees and shrubs, and the prospects of a bright display in park and woodland are very satisfactory, as almost all species of trees are well set with flower buds. The open weather of the later months has induced a too free growth on such shrubs as laurels, aucubas, and the tissues are so surcharged with sap that they are in a bad condition to withstand with impunity any severe frosts which may occur in the earlier months of the year.

Notwithstanding the excessive rainfall of certain months, the weather of the past year was favourable, on the whole, for our locality. The great heat experienced in the summer suited the heavy soil of the district for vegetation, and the bright sunshine happening during the holiday season fitted our urban community, and we can only hope that the weather of the ensuing season will be no worse than its predecessor.

Subjoined is the meteorological records for the last three years as kept at Queen's Park, and the average for the last twelve years.

COPY OF METEOROLOGICAL RECORD KEPT AT QUEEN'S PARK, GLASGOW.

Rain Gauge 145 Feet above Sea Level.

Months.	1897. Rainfall. Inches.	1897. Thermometer. Average. Max.	1897. Thermometer. Average. Min.	1897. Dry Days.	1898. Rainfall. Inches.	1898. Thermometer. Average. Max.	1898. Thermometer. Average. Min.	1898. Dry Days.	1899. Rainfall. Inches.	1899. Thermometer. Average. Max.	1899. Thermometer. Average. Min.	1899. Dry Days.	Averages for the Last 12 Years. Years.	Rainfall. Inches.	Mean Temperature.	Dry Days.	Number of Days on which 1° or more of Frost was registered.	Degrees of Frost registered.
January,	1·22	38	29	23	2·42	47	39	18	5·61	40	32	13	1888	32·33	46	190	81	232
February,	2·85	44	35	14	3·52	44	32	11	1·84	43	32	20	1889	26·18	47	194	59	250
March, ...	4·05	47	36	11	1·65	46	34	19	3·18	46	35	21	1890	38·04	47	170	74	273
April, ...	2·01	50	35	19	1·65	55	41	21	4·11	52	37	14	1891	36·09	46	184	85	371
May, ...	2·66	57	40	20	2·04	58	40	22	4·45	54	40	18	1892	33·84	45	194	101	798
June, ...	5·67	62	49	15	1·98	64	48	18	1·55	69	50	22	1893	33·05	47	186	56	306
July, ...	2·22	67	50	21	1·46	67	49	24	3·69	68	53	16	1894	41·48	46	169	55	256
August,...	5·51	67	52	13	4·77	65	51	15	1·38	69	53	23	1895	27·57	45	202	99	823
September,	3·39	58	44	16	3·99	63	48	15	3·71	59	46	5	1896	33·90	47	209	63	331
October,	1·71	53	39	23	3·97	54	46	20	3·57	54	40	15	1897	40·22	46	205	61	347
November,	3·37	49	40	17	4·67	46	37	18	5·64	51	42	10	1898	38·44	48	212	42	190
December,	5·56	43	33	13	6·32	48	40	11	2·94	39	30	16	1899	41·67	47	193	64	415
	40·22			205	38·44			212	41·67			193	Averages.	35·23	46°	192	70	383°

Notes on a Cruise in Clyde Waters in June, 1900.

By John Paterson.

[Read 28th August, 1900.]

To Mr. Andrew Bain, a small party, consisting of Dr. Gilmour, Messrs. John Fleming, John Robertson, John Renwick, Hugh Boyd Watt, and the writer, has again been greatly indebted for a pleasant cruise in Clyde waters in the present summer. We joined the "Romany" on the 7th of June, at Gourock, and proceeded down the Firth. Terns were very numerous until the Lady Isle was reached, and we noticed that the common Guillemot greatly exceeded the Razorbill in numbers. The Lady Isle, off Troon, is well known as a resort of the Common Seal (*Phoca vitulina*), but we were scarcely prepared to see there a herd of over thirty individuals, which, as they took the water, presented a remarkable appearance. The Lady Isle is a low island, and from this fact and its exposed situation its surface is surf-swept, and vegetation is confined to a patch in its centre. Its general aspect is smooth, probably owing to glaciation in the first instance, the rocks everywhere being well rounded. Rabbits have long been in possession, and we saw several. The Rock-pipit abounded, two or three pairs of Oyster-catchers were observed, and Mr. Watt was fortunate in seeing three Turnstones (*Strepsilas interpres*, Linn.). *Helix aspersa*, Müll. (approaching var. *minor*, Moq.), was collected, also *H. nemoralis*, L. (one approaching var. *castanea*, Moq., the other approaching var. *rubella*, Moq.). Plants, including *Ligusticum scoticum*, L., grow luxuriantly in the small verdant patch mentioned before. After a leisurely survey we rejoined the "Romany," and proceeded southwards, as we wished to trace the nesting of the Cormorant and Shag on the cliffs at the southern extremity of Ayrshire. They had long since been reported to nestle in this region by the late Mr. Robert Gray, and statements in confirmation have reached me in recent years from the Rev. Mr. J. D. W. Gibson and Mr. Trevor Eyton. We localised what we thought would be the site of one of their colonies, and we visited it from Glenapp the same evening. The Shag (*Phalacrocorax graculus*, Linn.) was found to be the characteristic species at the place visited, and several nests with eggs and young could be seen. The nests, however, could not be reached safely from above, as, although the cliffs were formed of a gritty sandstone, each step in the cliff shelved towards the sea. It was rather curious that we got no evidence of the nesting of the Common Cormorant here. We lay at the "Wig." in Loch Ryan, that night, and on the following morning returned to the Shag's nesting colony, on this occasion from the sea. Mr. Robertson was landed to visit the nesting colony, and Messrs. Fleming and Watt to photograph the cliffs. Mr. Robertson reported that the eggs in the nests seemed well incubated, while young in down and squabs were also to be seen. The previous evening we had seen several Black Guillemots (*Uria grylle*, Linn.)—perhaps three pairs—and this species was seen to leave the rocks in the neighbourhood of the Shag's nesting-place. They were again seen passing out and in at the same place on our last visit to the place. Mr. Gray says (*Birds of Ayrshire, &c.*) that he has seen it, "in summer, near the entrance to Loch Ryan," and that it is "probably a native," an opinion with which one must agree after our experience this summer. It is a very hard matter to get irrefragable proof of the nesting of a bird of such habits on such a coast as that at the entrance to Loch Ryan. Large and beautiful clumps of Rose-root (*Sedum rhodiola*, DC.), and Orpine (*Sedum telephium*, Linn.) relieved the cliffs here.

Crossing the entrance to the Firth, from Loch Ryan to Sanda, we saw many Ailsa birds, and on two occasions what were taken to be Manx Shearwaters (*Puffinus anglorum*, Temm.). We anchored in the roads at Sanda, after a delightful sail in clear and beautiful weather, and after lunch proceeded to investigate Sheep Island, which is of considerable size, though less than Sanda. It is covered with grass, brake-fern, and wood-hyacinth chiefly, and has a somewhat bold appearance on a near approach, owing to the cliffs on its eastern face. On its north side is a fine natural arch, which was photographed by Mr. Fleming. The most interesting feature on the island to the ornithologist is the colony of Herring Gulls (*Larus argentatus*, Gmel.), of which species there will be about twenty pairs or so—a modest estimate, I believe. Other birds seen, which were probably natives, were the Wheatear, Blackbird, Wren, Jackdaw, Carrion Crow, Rock-pipit, Oyster-catcher, Herring Gull, Ringed Plover, and Starling. Rabbits were seen, and Mr. Thomson, of the Lighthouse on Sanda, informs Mr. Watt that the Brown Rat is common here. The following land molluscs were gathered:—*Hyalinia alliaria* (Miller), *H. nitidula* (Drap.), *Pupa cylindracea* (Da Costa). Two common wood-lice (*Oniscus asellus*, Linné., and *Porcellio scaber*, Latreille) were obtained on this island, and sent to Mr. Thomas Scott, F.L.S., who named them as above.

The following plants were obtained on Sheep Island:—*Ranunculus ficaria*, Linn.; *Cochlearia officinalis*, Linn.; *Polygala vulgaris*, Linn.; *Silene maritima*, With.; *Lychnis dioica*, Linn.; *Cerastium triviale*, Link.; *Sagina procumbens*, Linn.; *Montia fontana*, Linn.; *Erodium cicutarium*, L'Hérit.; *Trifolium procumbens*, Linn.; *Lotus corniculatus*, Linn.; *Potentilla sylvestris*, Neck.; *P. anserina*, Linn; *Cotyledon umbilicus*, Linn.; *Sedum anglicum*, Huds.; *Heracleum sphondylium*, Linn.; *Hedera helix*, Linn.; *Galium saxatile*, Linn.; *Bellis perennis*, Linn.; *Matricaria inodora*, Linn.; *Cnicus lanceolatus*, Willd.; *Vaccinium myrtillus*, Linn.; *Erica cinerea*, Linn.; *Armeria maritima*, Willd.; *Primula acaulis*, Linn; *Veronica serpyllifolia*, Linn.; *V. chamædrys*, Linn.; *Euphrasia officinalis*, Linn.; *Scutellaria galericulata*, Linn.; *Teucrium scorodonia*, Linn.; *Plantago lanceolata*, Linn.; *P. coronopus*, Linn.; *Atriplex babingtonii*, Woods; *Rumex crispus*, Linn,; *R. acetosa*, Linn.; *Urtica dioica*, Linn.; *Salix aurita*, Linn.; *Empetrum nigrum*, Linn.; *Scilla festalis*, Salisb.; *Juncus squarrosus*, Linn.; *Luzula vernalis*, DC.; *L. maxima*, DC.; *L. campestris*, DC.; *L. erecta*, Desv.; *Eriophorum angustifolium*, Roth.; *Schœnus nigricans*, Linn.; *Carex goodenowii*, J. Gay; *C. pilulifera*, Linn.; *C. binervis*, Sm.; *Anthoxanthum odoratum*, Linn.; *Deschampsia flexuosa*, Trin.; *Nardus stricta*, Linn.; *Pteris aquilina*, Linn.; *Lomaria spicant*, Desv.; *Asplenium adiantum-nigrum*, Linn.; *A. marinum*, Linn.; *Lastrœa dilatata*, Presl.; *Polypodium vulgare*, Linn.; *Beta maritima*, Linn.

From Sheep Island we proceeded by the Scart Rocks, which appear to be perches only, not breeding places, of the Cormorant and Shag, to Glunimore. A Shag left as we approached, and the first incident in our visit, after clambering over the huge rocks here, was the finding of a nest of this species by Dr. Gilmour. It contained three eggs. A Great Black-backed Gull's (*Larus marinus*, Linn.) nest with three eggs was also found. Herring Gulls' nests were common. Two pairs of Black Guillemots were seen, and Mr. Robertson succeeded in finding two nests. The nest I saw was about three feet in a crevice, the eggs being laid on a cluster of little pebbles. A Brown Rat (*Mus decumanus*, Pall.) was found dead on this islet. This species is common here, according to Mr. Thomson, the Sanda Light-keeper.

We next proceeded to Sanda, but had only time for a brief visit. Since our last visit Mr. Watt has received from Mr. Robert Thomson, of the Lighthouse, some further information regarding the mammals occurring there. Otters (*Lutra vulgaris*, Erxl.) are often seen, and in January, 1899, one frequented the little port near the Lighthouse gardens. In the same month two half-grown seals (*Phoca vitulina*) were killed on the north side of the island. Mr. Alexander Gray, Curator of the Millport Marine Biological Station, informed Mr. Watt that up to twenty-five years ago two Grey Seals (*Halichœrus grypus* (Fabr.)) were regular frequenters of the port near the tenant-farmer's house, and that they disappeared without any known reason, say about 1874. The Common Rat (*Mus decumanus*, Pall.) is very plentiful on Sanda, according to Mr. Thomson. Land shells as follows were collected on Sanda:—*Hyalinia cellaria* (Müll.); *Helix rotundata*, Müll.; *H. aspersa*, Müll. (fairly typical examples); *H. nemoralis*, L., 00045; *H. hispida*, L. (the darkest (most red) may be var. *sub-rufa*, Moq.); *Pupa cylindracea* (Da Costa); *Clausilia perversa* (Pult.); *Cochlicopa* (*Zua*) *lubrica* (Müll.).

The following plants observed on this visit are not in the list published in the account of our first visit to Sanda (*Trans. N. H. Socy. Glas.*, V. (N.S.), pp. 203, 4):—*Nasturtium officinale*, R. Br.; *Brassica sinapistrum; Vicia angustifolia*, Linn.; *Spirea ulmaria*, Linn.; *Sedum acre*, Linn.; *Conium maculatum*, Linn.; *Anthriscus sylvestris*, Hoffm.; *Achillea millefolium*, Linn.; *Ver-*

zonica eccabunga, Linn.; *Lamium purpureum*, Linn.; *Euphorbia helioscopia*, Linn.; *Dactylis glomerata*, Linn.

There are now neither trees nor shrubs lending variety to the surface of the island, but Mr. Watt has drawn my attention to a statement by Dr. John Walker, in his *Economical History of the Hebrides and Highlands* (1812), II., p. 278, that Sanda "is still [1760-86] covered with dispersed coppice, as also with tutsan (*Hypericum androsæmum*, Linn.), and the great hairy woodrush (*Juncus umbratilis*, *J. sylvaticus*, Huds.), which are plants whose natural situation is under the shade of trees."

We proceeded to Campbeltown in the evening, and intended to visit Ailsa next day, but the weather was unfavourable, and we returned by the Sound of Kilbrannan and the Kyles of Bute and Loch Striven to Gourock. Off Arran several Dolphins (sp. ?) appeared, cutting our bows in characteristic fashion, but they did not come out of the water.

To Dr. Gilmour and Mr. John Renwick I am chiefly indebted for the lists of plants, especially the long list from Sheep Island. The mollusca were chiefly collected by Mr. Watt, who acknowledges valuable assistance received from the Rev. G. A. Frank Knight, M.A., in naming them, and states that the names have been confirmed by Mr. Robert Standen, of Owens' College Museum, Manchester.

Reports on Excursions.

KEPPEL PIER, CUMBRAE, 9th September, 1899.—This excursion was organised in two detachments. A first contingent proceeded to Keppel by an early steamer, and had a couple of hours' dredging by the use of the boat belonging to the Biological Station. The day, though fine, was furiously windy, and the successive hauls in 20, 25, and then 10 fathoms were taken with difficulty, and in the end were very unproductive. The following molluscs were procured:—*Mya truncata*, L.; *Tectura virginea* (Müll.); *Rissoa punctura* (Mont.); *R. inconspicua*, Ald.; *R.*

striata (Ad.); *Odostomia turrita*, Han.; *O. scalaris* var. *rufescens* (Forb.); *Pleurotoma costata* (Don.). The second party, which arrived about four o'clock, inspected the Museum of the Station, the large collection of marine objects being exhibited and described by Mr. Alexander Gray, Curator of the Robertson Museum. Thereafter Mrs. Robertson very kindly conveyed the whole party in omnibuses to her residence, Fernbank, and entertained the members to a very hearty tea. On the motion of the Rev. G. A. F. Knight, who acted as conductor of the excursion, a very hearty vote of thanks was awarded to Mrs. Robertson for her most kind hospitality.

GLAMIS, FORFARSHIRE, 25th September, 1899 (Glasgow Autumn Holiday).—Upwards of twenty members visited Glamis Castle, expecting to spend a day in the extensive grounds in tree-measuring and photographing; the pitiless rainfall, however, effectually spoiled such a programme. Everything was done, nevertheless, to render the visit an enjoyable one. The party was met by Mr. Wilson, Chief of the Castle Gardens, who hospitably entertained the members to breakfast in his house. Thereafter the party proceeded direct to the Castle, where the Earl of Strathmore, in a few kindly words, welcomed his guests, and directed them to be shown over the buildings. Glamis Castle is one of the most famous and historic seats in Scotland, and at every turn the visitors were reminded that they were in a mansion which has played a conspicuous part in the annals of this country. Many were the interesting relics of the ages of chivalry and romance, and the members were charmed equally with the older and with the more modern portions of the Castle. After partaking of an elegant luncheon, provided by the kindness of the Earl in the great dining-room, the party examined the celebrated ancient sun-dial on one of the lawns. The sun-dial is fully 20 feet high, and shows the gnomon on 84 face dials. The glass-houses were next inspected, and were found to be full of plants of great interest. A yellow-flowered form of *Clerodendron fallax*, Lindl., attracted attention, as it had originated in a neighbouring garden from amongst seed saved from the normal plant, which has scarlet flowers. After a visit to the fruit-houses and flower-garden, the party crossed the river by an elegant modern bridge, and entered the Pinetum. Splendid representatives of the genera Abies and Pinus were here seen, and regret was felt that so many of the finest trees on the estate have been attacked and ruined by the silver-fir bug. The collection of coniferous trees is indeed very wonderful, species having been introduced from many parts of the world, until the Glamis Castle Pinetum has become famous. The different species of Pines, Firs, Cypresses, Cedars, Larches, &c., were all carefully inspected, but the finest of all the Larches—called the "Pride of Strathmore"—is now represented only by a fragment of the old stump, and by a plate giving the dimensions of the tree, which was blown down in the great storm of November 11th, 1893. A visit to "King Malcolm's Stone," a monolith, 7 feet in height and 4 feet wide, carved with a runic cross and hunting figures in relief, was hastily carried out, and thereafter the party found its way back to Glasgow. The conductor was Mr. James Whitton.

Girvan Valley, 16th April, 1900.—This was a joint-excursion with the Geological Society of Glasgow, the date being the Spring Holiday. The conductor was Mr. John Smith. The route was from Dailly Station, by Drummochreen, to Roughneuk. The coniferous trees of the neighbourhood, which are very numerous, were observed to be much covered with lichens; the Larches especially had their trunks invested with a hairy-looking integument. This is probably from their being destitute of leaves during winter, which consequently allows a greater quantity of rain and light to fall on the stems than is the case with the conifers. The season as to spring flowers was noted to be late. Nothing deserving of any special mention was observed, but the following tree measurements at Bargany were taken by Mr. Renwick :—

Largest Oak yet recorded in Ayrshire—girth, 15 feet 2 inches at 3 feet; spread of branches, 101 feet 9 inches.

Largest Noble Silver Fir in Ayrshire, *Picea nobilis*, Doug.—girth, 7 feet 11½ inches at 4 feet; height, 66 feet.

Largest Scots Fir in Ayrshire—girth, 11 feet 6 inches at 5 feet; bole, 24 feet; height of tree, 61 feet; spread of branches, 78 feet 9 inches.

The following were measured at Dalquharran :—

One of the largest Beech trees in the county—girth, 17 feet 1 inch at 6 feet 5 inches; bole, 26 feet.

Very fine Silver Fir at altitude of 500 feet above sea level—girth, 13 feet 8½ inches at 7 feet 3 inches, rising to a height of about 100 feet.

Very handsome Sequoia—girth, 13 feet 4 inches at 1 foot; height, 62½ feet.

DOUGALSTON AND "THE AULD WIVES' LIFTS," 5th May, 1900. —A party numbering twelve travelled to Milngavie Station, and proceeded thence to Dougalston, under the leadership of Mr. John Cairns, Jun. Entering by the South Lodge, the handsome Beeches on the north and south sides of the avenue are worthy of note. On the occasion of a former visit of the Society, on 23rd March, 1893, a number of the larger trees were measured, and it is of interest to compare these records with the measurements made on the present occasion :—

Beech, near Lodge, on south side of avenue—
Girth—25th March, 1893, 13 ft. 5 ins. at 4 ft. 10 ins. on E.
12 ft. 8 ins. at 7 ft. on E.
5th May, 1900, 13 ft. 9½ ins. at 4 ft. 10 ins. on E.
13 ft. at 7 ft. on E.

Beech, near Lodge, on north side of avenue—
Girth—25th March, 1893, 13 ft. 5 ins. at 4 ft. 8 ins. on N.
12 ft. 4 ins. at 7 ft. 3 ins. on N.
5th May, 1900, 13 ft. 9½ ins. at 4 ft. 8 ins. on N.
12 ft. 7½ ins. at 7 ft. 3 ins. on N.

Beech, in field, near House—
Girth—25th March, 1893, 15 ft. 6 ins. at 6 ft. 8 ins. on S.
16 ft. 11 ins. at 4 ft. on S.
5th May, 1900, 15 ft. 11 ins. at 6 ft. 8 ins. on S.
17 ft. 4 ins. at 4 ft. on S.

Birch, near Loch, on south side of avenue—
Girth—25th March, 1893, 6 ft. 3 ins. at 2 ft. 7 ins.
5th May, 1900, 6 ft. 6 ins. at 2 ft. 7 ins. on W.

Sweet Chestnut, to north of House—
Girth—25th March, 1893, 11 ft. 10½ ins. at 6 ft. 3 ins. on S.W.
5th May, 1900, 12 ft. 2½ ins. at 6 ft. 3 ins. on S.W.

Yew (female), to east of House—
Girth—25th March, 1893, 11 ft. 8 ins. at ground.
5th May, 1900, 11 ft. $10\frac{1}{2}$ ins. at ground on S.W.

Yew (male), to north of House—
Girth—25th March, 1893, 6 ft. $8\frac{1}{2}$ ins. at 1 ft. 3 ins. on S.W.
6 ft. $2\frac{1}{2}$ ins. at 3 ft. 6 ins. on S.W.
5th May, 1900, 7 ft. at 1 ft. 3 ins. on S.W.
6 ft. $5\frac{1}{2}$ ins. at 3 ft. 6 ins. on S.W.

Oak, to south of House—
Girth—5th May, 1900, 11 ft. 9 ins. at 3 ft. 6 ins. on S.W.

Beech, to north of House—
Girth—5th May, 1900, 14 ft. 5 ins. at 4 ft. 2 ins. on S.W.

The party was conducted through the gardens and greenhouses by Mr. Fraser, the Head Gardener.

Leaving Dougalston, the road was taken to the Parish Church of Baldernock, in the graveyard of which are two fine Wych Elms. The one in the south-west corner had a girth in January, 1899, of 13 feet 5 inches at 4 feet 10 inches on south-west and a height of 82 feet; the other on the east side had a girth of 12 feet $8\frac{1}{2}$ inches at 3 feet 6 inches on north, 12 feet $1\frac{1}{4}$ inches at 6 feet, height 83 feet.

The "Auld Wives' Lifts" were then visited, situated as they are in a slight depression on the open moor. The three great stones in the form of a massive trilith have been the occasion of much controversy, opinion being much divided as to whether they represent (1) the artificial burial cairn of an ancient chief, (2) the altar of sacrifice for a tribe, or (3) are simply the product of geological denudation. The members had an opportunity of testing all these hypotheses on the spot, but were not able to cast any further light on a problem which seems destined to remain for ever in obscurity. Opinion tended, however, to reject the supposition that the blocks were artificially placed in their present position, seeing that the topmost stone weighs upwards of 100 tons; and the geological members of the party rather inclined to see in this striking monument an illustration of the working out of natural causes. (For a discussion of the question, see further Ure's *History of Rutherglen and East Kilbride*, who maintains the Druidical altar theory; and Wilson's *Prehistoric Annals of Scotland*, page 66, who, while advocating the "cromlech" theory, erroneously calls "the huge capstone a block of basalt.")

AILSA CRAIG was visited on the Queen's Birthday, 24th May, in conjunction with the Andersonian Naturalists' Society; CUMBERNAULD GLEN, on 2nd June, along with the Airdrie Natural History Society; POLLOK, on 5th June; HOWIETOUN HATCHERY, Stirling, on 9th June, in company with the Edinburgh Field Naturalists' and Microscopical Society; CASTLEMILK, Rutherglen, on 12th June; GLENFALLOCH, in conjunction with the Geological Society, on 16th June; TOLLCROSS PARK, on 26th June; but nothing of special interest falls to be recorded of these excursions.

BEN LOMOND, 30th June, 1900.—This was a joint-excursion with the Geological Society and the Edinburgh Field Naturalists' and Microscopical Society. The following plants were observed:—*Habenaria conopsea*, Benth.; *Myrica gale*, L.; *Listera cordata*, L., at 600 feet; *Thalictrum alpinum*, L., 1,000-2,900 feet; *Rubus chamæmorus*, L., 1,900-2,100 feet; *Gnaphalium supinum*, L.; *Potentilla sibbaldi*, Hall.; *Armeria maritima*, Willd., 2,300-2,900 feet; *Silene acaulis*, L., 2,700 feet, in fine flower; and on the summit, 3,192 feet, *Saxifraga nivalis*, L., in flower; *Luzula spiceta*, L.; *Cochlearia alpina*, Wats.; *Saxifraga rhodiola*, D.C.; *S. hypnoides*, L., all from 2,800 feet; *S. stellaris*, L., from 1,900 feet to the summit; *Phyopteris dryopteris*, Fée, in flower at 3,900 feet; *P. polypodioides*, Fée, very large at 600 feet; *Polygonum viviparum*, L., at 2,700 feet, in flower; one plant of *Juncus triglunus*, L.

ROSS PRIORY, 4th August, 1900.—This excursion was undertaken in conjunction with the Andersonian Naturalists' Society, the conductor being Mr. George Herriot. After visiting the family burial-ground, the party was conducted over the estate by the proprietor, Sir George H. Leith Buchanan. The following trees were measured:—

Oak, second in avenue, north side, 14 ft. 8¾ ins. at 5 ft. south-east, bole about 15 ft.

Gean, in avenue, north side, 9 ft. 7¼ ins. at 5 ft. west, bole about 10 ft.

Beech, in avenue, north side, 14 ft. 1¼ ins. at 5 ft. north by west, bole about 30 ft.

Oak, in avenue, north side, 13 ft. 8¼ ins. at 5 ft. south-west, bole about 20 ft.

Plane (Oriental?), in front of House, 7 ft. 8¼ ins. at 5 ft. 5 ins., bole about 8 ft.

Beech, south-west of House, 17 ft. 3¾ ins. at 5 ft. south-west, bole about 19 ft.

Walnut, north side of House, 9 ft. 11¾ ins. at 5 ft., bole about 12 ft.

Walnut, north side of House, 8 ft. 11½ ins. at 5 ft., bole about 16 ft.

Oak, on side of Loch, half-mile from House, 16 ft. 4 ins. at 5 ft. 3 ins. north, bole about 16 ft.

GALLINGAD GLEN, Caldarvan, 18th August, 1900.—This is a remarkable glen in many respects, in regard to the features of its rocky basin and the distribution of its waterfalls. The vegetation was found to be very abundant. Mr. L. Watt, who acted as conductor, noted the following plants among others:—*Pyrola secunda*, L., in fruit, at an elevation of 500 feet; *Asplenium viride*, Huds.; *Polystichum lobatum*, Presl.; *P. aculeatum*, Syme; *Phegopteris dryopteris*, Fée; *P. polypodioides*, Fée; *Vicia sylvatica*, L.

GLEN WATER, Darvel, 18th August, 1900.—A party, led by Mr. A. Gilchrist, went up the valley of the Glen Water to its junction with the Mucks Water, and then up the latter valley. Among the plants observed were the following:—*Hypericum quadratum*, Stokes; *Prunus spinosa*, L.; *P. avium*, L.; *P. padus;* *Agrimonia eupatoria*, L.; *Saxifraga hypnoides*, L.; *Senecio aquaticus*, L.; *Campanula latifolia*, L.; *Cystopteris fragilis*, Bernh.; *Phegopteris dryopteris*, Fée; *P. polypodioides*, Fée.

Proceedings of the Society.

SESSION 1899-1900.

26th September, 1899.

Mr. Robert Kidston, F.R.S.E., F.G.S., President, in the chair.

The Rev. G. A. F. Knight, M.A., reported on the Society's excursion to Millport (see page 158).

Mr. A. Adie Dalglish sent for exhibition *Crambus latistrius*, How., a moth rare in Clydesdale, which had recently been taken by him at Irvine.

Mr. Chas. Kirk exhibited a specimen of a white Song-thrush (*Turdus musicus*, L.), which was shot by Col. R. C. Mackenzie at East Kilbowie, in the parish of Old Kilpatrick, on the 8th inst. In his description Mr. Kirk pointed out that the bird could not properly be regarded as a pure albino, as the eyes were of the usual hazel colour, and the feathers of the breast showed incipient dark spots. Miss Zamorska exhibited fruits of *Platanus orientalis*, L., the eastern plane tree, from Smyrna.

The Rev. G. A. F. Knight, M.A., read a paper entitled "The Marine Mollusca of Port-Stewart, North Ireland: Notes taken during a recent visit," in which a comparison was instituted between the molluscan fauna of the North of Ireland and that of the Firth of Clyde (see page 1).

27th October, 1899.

Mr. Robert Kidston, F.R.S.E., F.G.S., President, in the chair.

Mr. James Whitton read a report of an excursion of the Society to Glamis, Forfarshire (see page 159).

Mr. James F. Gemmill, M.A., M.B., C.M., the Society's delegate to the meeting of the British Association, read a report of the meetings of the Association, held this year in Dover.

Report of the Council (1898-99).

Membership.—The present Membership of the Society is as follows :—

Honorary Members, - - - - -		13
Corresponding Members. - - - -		37
Ordinary Members (Life), - - -	31	
Annual Subscriptions, - - - -	233	
		264
Total, - - - - - -		314

Associates.—One Associate was added during the session. The number on the roll stands at 22.

Obituary.—The death of Mr. Geo. W. Ord is the only one brought under the notice of the Society. (See *Trans.*, Vol. V., N.S., Part III., p. 319.)

Meetings.—Twelve were held, at all of which business was transacted, the attendance, with one or two exceptions, being satisfactory.

Excursions.—Eight ordinary excursions and two evening excursions were arranged, at all of which there was an average attendance. On the Spring Holiday the Society was joined by the Geological Society in an excursion to Callander; and on the 6th May by the Edinburgh Field Naturalists' and Microscopical Society in an excursion to the Edinburgh Botanic Gardens and the Mushroom Tunnel.

British Association.—Mr. James F. Gemmell, M.A., M.B., C.M., represented the Society as its delegate at the meeting held at Dover.

Finance.—The Hon. Treasurer (Mr. John Renwick), submitted his Annual Statement of Accounts, duly audited. From this it appeared that the income for the year had been £117 10s. 5d., and the expenditure £142 11s. 9½d. There was a credit balance in the Society's Ordinary Fund of £50 3s. 1d., and in the Life Members' Fund of £147. The expenditure has been increased, extraordinarily, by the publication of a new Library Catalogue.

Library.—The Hon. Librarian (Mr. James Mitchell) reported that 332 volumes and journals had been issued during the Session—the largest number ever issued in any year. Eight volumes had been presented to the Society, and 12 volumes had been acquired by purchase. The privilege of consulting or borrowing books during the hours when the Rooms are open is much taken advantage of. The books in the Library are all in good condition, and the *Transactions* and Magazines received in exchange are nearly all bound up to date. The Society now exchanges *Transactions* with nearly all the publishing Scottish societies.

Transactions.—The Hon. Editor (Mr. John Paterson) reported that Part II. of Vol. V. of the *Transactions*, for Session 1897-98, was issued in December of 1898, and the material relating to the following Session was being dealt with. He thanked all who had contributed to the Illustration Fund, the result of the appeal to the Members having enabled the Publishing Committee to meet the cost of producing seven full page plates, and over thirty smaller illustrations, without encroaching on the general funds of the Society.

The Reports were all unanimously approved of and adopted.

Vacancies in the Council were filled up as follows:—Mr. Alex. Somerville, B.Sc., F.L.S., as President; Mr. Robert Brown, M.D., as Vice-President; Mr. J. J. Robertson, as Hon. Secretary; Mr. John Renwick, as Hon. Treasurer; Mr. James Mitchell, as Hon. Librarian; Mr. John Paterson, as Hon. Editor; Messrs. John Cairns, Jun.; James F. Gemmell, M.A., M.B., C.M.; Robert Kidston, F.R.S.E., F.G.S.; Johnstone Macfie, M.D.; and Wm. Stewart, as Members of Council. Messrs. James Jack and William Leighton were appointed Auditors.

Mr. Geo. Paxton exhibited a nest of the Common Wren, *Troglodytes parvulus*, Koch, which had been built in *debris* collected at the end of a branch of a rowan tree which overhung the Water of Ayr.

Mr. James F. Gemmell, M.A., M.B., C.M., exhibited under microscopes various horizontal sections of "Double Embryos of Trout."

Mr. R. D. Wilkie exhibited two specimens of the Natter-jack Toad, *Bufo calamita*, Laurenti, from the shores of the Solway Firth, a species of infrequent occurrence.

Mr. Wm. Stewart read a paper entitled "Notes on the Occurrence of *Trichomanes radicans*, Sw., in Scotland," and exhibited fronds collected in two out of the four recorded habitats. (See page 18.)

Mr. Robert Brown, M.D., read a paper "Botanizing among the Dolomites," and exhibited many interesting specimens of the flora of that district. He described the extraordinary appearance of the mountains, with their predominantly grey colour, but with, here and there, broad stretches of red, green, and blue tints. These mountains are extremely friable, and are constantly changing their outline. Botanizing on the higher slopes is not very easy, owing to the amount of loose detritus. *Phyteuma comosum*, Linn., was obtained, rooted in cracks in the dry face of a rock, its peculiar whitish-blue and dark dilated head of flowers projecting right out of the stone. *Potentilla nitida*, Linn., an extremely beautiful Alpine plant, was observed growing in clumps on ledges of bare rock. *Artemisia nana*, Gand, a rare wormwood, with small capitula, and *Dianthus alpestris*, Hoppe, a strictly local species, were obtained, along with *Swertia perennis*, Linn., in this district very rare and purely local.

28TH NOVEMBER, 1899.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. W. K. Hutton, M.A., M.B., C.M., 12 Granby Terrace, Hillhead; Mr. James Watson Reoch, 22 Montgomerie Street, Kelvinside; and Mr. Arthur Shepherd, Free Church Manse, Cambuslang, were elected as Ordinary Members.

Mr Robert Kidston, F.R.S.E., F.G.S., retiring President of the Society, read as a closing presidential address a paper on "The Carboniferous Lycopods and Sphenophylls." (See page 25.) The lecture was delivered in the large hall of the Philosophical Society's Rooms, and was fully illustrated by lantern views. Members of the Philosophical Society, the Geological Society, and the Andersonian Naturalists' Society, were present by invitation, and the attendance was large. Professor F. O. Bower, M.A., D.Sc., F.R.S., &c., moved a vote of thanks to the lecturer, which was seconded by Mr. Robert Brown, M.D.

26TH DECEMBER, 1899.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. Thomas H. Bryce, M.B., C.M., F.R.S.E., Queen Margaret's

College; Mr. D. T. Gwynne-Vaughan, M.A. (Cantab.), 16 Lawrence Street, Hillhead; Mr. James Hunter, Braehead House, Cathcart, were elected as Ordinary Members.

Mr. John Renwick made suitable reference to the death of Mr. W. Craibe Angus, the well-known authority on art, who had been a Member of the Society for 31 years. His particular branch of study had been the British avifauna, and on this subject he had contributed papers of much interest.

The President then delivered a short address. After thanking the Members of the Society for the honour they had done him in electing him to the office he now filled, he proceeded to make special reference to the Society itself, and to the position which it occupies in virtue of its nearly fifty years of existence, its volumes of *Transactions* published throughout that period, its valuable library, and its roll of 250 Members. He referred to the variety of departments in nature study open to the student, and pled for systematic work so that the meetings and excursions might be as profitable as possible. It was to the Society's credit that, in connection with the coming of the British Association to Glasgow in 1901, the services of so many of its Members had been laid under requisition in the preparation of the lists of the plants and animals of the Clyde valley and estuary. Allusion was made to the connection existing between the Society and the Millport Marine Biological Station, the chairman and the executive of which were all Members of the Society. The address closed with an appeal for additional Members, in order that, with an increased income, the special expenses of the Society's approaching jubilee year, 1901, might be the more easily met.

Mr. C. Sherry exhibited a specimen of a Blue Moss, believed to be a species of *Climacium*, received direct from Japan, where the sender stated it to be locally plentiful. The colour of the plant was declared to be due to no artificial cause.

On behalf of Dr. T. F. Gilmour there was exhibited a specimen of the Death's Head Moth, *Acherontia atropos*, L., obtained in August last near Port-Ellen, Islay. According to Mr. Chas. G. Barrett, F.E.S., author of the magnificent work on the British Lepidoptera now being issued, this is a first record of the occurrence of the insect in the Hebrides.

Mr. Robert Brown, M.D., laid on the table an interesting series of plants gathered by him this year in Switzerland and the Tyrol. The most important among them were *Rhododendron chamæcistus*, L., the prettiest, and also the rarest, of the family; *R. ferrugineum*, L.; *R. hirsutum*, L.; *Phyteuma comosum*, L.; *Tofieldia calyculata*, var. *capitata*, Koch.

Mr. Thos. H. Bryce, M.A., M.B., C.M., F.R.S.E., showed his fine set of lantern slides in illustration of the early development of *Echinus esculentus*, L. The slides were prepared from micro-photographs of actual specimens, and form an excellent series by means of which the phenomena of cell-division and segmentation can be demonstrated.

30TH JANUARY, 1900.

Mr. Alex. Somerville, B.Sc., F.L.S., in the chair.

Mr. J. Leiper Gemmill, Parklea, Dumbreck, and Mr. John H. Teacher, M.A., M.B., C.M., Physiological Laboratory, Glasgow University, were elected Ordinary Members.

The following were elected Corresponding Members of the Society, viz.:—Rev. Edward F. Linton, M.A., Crymlyn, Bournemouth, who, by the request of the Kew authorities, has now under preparation a new edition of *The Student's Flora*; Mr. James Groves, F.L.S., 58 Jeffreys Road, Clapham Rise, London, S.W., engaged in bringing out a new edition of Babington's *Manual of British Botany*; Rev. Edward S. Marshall, M.A., F.L.S., joint-author of the *Flora of Kent*; Mr. William P. Hiern, M.A., F.L.S., Castle House, Barnstaple, Devonshire, who has been engaged for several years, at the request of the British Museum authorities, in preparing a catalogue of the Welwitsch collection of West African plants; Mr. R. Lloyd Praeger, B.E., B.A., M.R.I.A., National Library of Ireland, Dublin, joint-editor of the *Irish Naturalist*, and now at work in the preparation of a Topographical Botany of Ireland.

On behalf of Professor G. F. Scott Elliot, M.A., B.Sc., F.L.S., F.R.G.S., there was exhibited by Mr. J. Wylie, a collection of sixty-four species of *Mycetozoa*—presented to Professor Elliot by Mr. Arthur Lister, F.R.S. Mr. Wylie read a paper treating fully of the group, and especially of those which had been obtained from the Clyde district, which were as follows:—*Physarum nutans*, Lister, on an old stump in Darnley Wood;

Craterium pedunculatum, Trent, on dead leaves, chiefly oak and grasses, near Muirhouse, Kilmalcolm (400-500 feet altitude); *Lycogala miniata*, Grev., on tree-bark from Nitshill and Darnley; *Stemonitis fusca*, Roth., *S. gemina*, from Cathkin Braes, found by Mr. Wylie; *Reticularia lycoperdon* (Lister) from a wood near St. Germains Loch, Bearsden; *Arcyria punicea* (Lister) on dead leaves, Cathkin Braes Park; *Trichia babrytis*, from fir plantation near Gryfe, and from Darnley; *Trichia affinis*, from Falls of Clyde and from Dalmellington, in deciduous woods, on various mosses on the ground.

Mr. Chas. Kirk exhibited the Common Buzzard, *Buteo vulgaris*, Leach, from the Crieff district. This large hawk, which has all the appearance of a miniature eagle, was at one time common throughout Scotland, but has for so long been trapped and shot that it is now scarce.

Mr. Kirk, on behalf of Mr. Adam Wood, Troon, also brought forward an unusually large-sized skull of a polar bear, *Ursus maritimus*, Desm., shot near Hamilton Gulf, Greenland. Dr. J. F. Gemmill, M.A., indicated the chief characteristics of the skulls of carnivores in general, and of bears in particular, and pointed out that the specimen on view showed some remarkable individual peculiarities, the result, in all probability, rather of an early and severe injury, than of a congenital malformation.

Mr. James Mitchell, who had recently visited the Cape, exhibited a remarkably fine series of horns of South African antelopes, including those of the Eland (*Oreas canna*, Gray); the Koodoo (*Strepsiceros kudu*, Gray); the Gemsbok (*Oryx gazella*, Gray); the Sable Antelope (*Ægocerus niger*, Gray = *Hippotragus niger*, Buckley); the Roan Antelope (*Æ. niger*, Gray = *H. equinus*, Buckley); and the Springbok (*Antidorcas euchora*, Gray). Mr. Mitchell read a paper describing the three animals first mentioned above:—The Eland, the largest of living antelopes, standing six feet at the shoulders, and having a prominent fringed dewlap, is now only to be found in the parched and pathless recesses of the Kalahari desert. The Colonial Government has passed laws for its preservation, but it is difficult to get the natives to understand or observe these laws where they are most needed. In Natal, Government has set apart a tract of land where the rarer antelopes are preserved. The Koodoo is without a superior in South Africa in shape, beauty, and size of horn. Thanks to its secluded habits, and to living in the bush and forest, it continues fairly abundant in most districts. Its corkscrew-like horns are of great weight, and attain to 4 feet in a straight line, or 5 feet 3 inches over the curve. The Gemsbok is now almost confined to the Kalahari desert; seemingly independent of water, it loves the arid regions of the South-west. The Gemsbok alone, with hardly an exception among the fully twenty-five species of African antelopes, will face the lion, and the carcases of the lion and Gemsbok are occasionally found rotting together on the veldt, the lion having been impaled in its spring, and firmly fixed on the sharp horns of its quarry.

27th February, 1900.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

There was so large an attendance that the meeting had to adjourn from the small to the large hall downstairs.

Mr. Claud A. Allan, 163 West George Street, was elected a Life Member; and Mr. James Williamson, 12 Dover Street, and Dr. J. Wallace Anderson, were elected Ordinary Members of the Society.

The Chairman then introduced the lecturer of the evening, Mr. William S. Bruce, F.R.S.G.S., as one well qualified to speak upon his subject, "Life in the Polar Regions." In his introductory remarks the lecturer outlined what his Polar voyages had been, stating that his information had been derived from one voyage to the Antarctic in the "Balaena," from two voyages to the Arctic regions with the Prince of Monaco in his splendid yacht the "Princesse Alice," from one voyage with the Jackson-Harmsworth Expedition on the "Windward," and from two voyages with Mr. Andrew Coats, of Paisley, in the latter's yacht "Blencathra" (now "Pandora"). The series of magnificent lantern slides which were thrown on the screen showed aspects of Spitzbergen and Novaia Zemlya very different from what one usually associates with Polar conditions of life. Instead of stormy seas, the waters were seen to be calm, and in place of absolutely snow-covered and sterile land, there were beautifully-outlined rocky hills carpeted with a low vegetation, and even up to the height of 3,000 feet possessing a plentiful insect fauna. Views of a number of the fresh-water lakes of these islands, some still unnamed, were shown, most of them swarming with crustacean life, as well as with salmon. The abundant flora of the islands was shown by a series of slides and some very clever snapshots of the varied avifauna. One view of the eider-duck, with its nest, called forth the remark that there was a gradual destruction of these valuable birds of commerce now in progress, and steps should be taken to secure their preservation. The remains of the early Dutch settlements, whose almost sole relic is a series of graves dug 200 or 300 years ago, were contrasted with the present fully-equipped Swedish station on Spitzbergen, from the members of which the explorers received much kindness, particularly when on one occasion the "Princesse Alice" discovered the presence of a submarine rock by running aground on it. The whole routine work of an exploring ship was explained by the use of the screen—the dredging, trawling, sounding, temperature-finding, &c., and the difficulties attending such investigations in Arctic waters were vividly shown by views of iceberg and icefield. Again and again the traps set overnight, and buoyed up to secure deep-water and pelagic fauna, were torn away by ice, and the labour was in vain. The geological phenomena of the islands were not passed unnoticed, the extraordinary terraces of Carboniferous strata having been well shown, as also the series of raised beaches, which prove that Spitzbergen is slowly being elevated. On the motion of the Rev. G. A. F. Knight, M.A., Vice-President, a hearty vote of thanks was accorded to the lecturer.

27th March, 1900.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

The Chairman intimated the death, on the 13th instant, of Mr. John Young, LL.D., F.G.S., Keeper of the Hunterian Museum in the University, who had long been a Member of the Society; and a Memorial Notice was read by Mr. John Renwick.

Mr. Walter W. Blackie, B.Sc., 17 Stanhope Street, was elected an Ordinary Member.

Mr. John Paterson, Honorary Editor of *Transactions*, then placed on the table the *Transactions* for last Session (Vol. V.

(N.S.), Part III.). In doing so he took the opportunity of thanking the members of his Committee for their able assistance, and especially Mr. Richard M'Kay, who had carried out the preparation of the exhaustive indices with which the volume was furnished.

Mr. Paterson then exhibited, on behalf of Mr. Charles Kirk, a series of lantern slides illustrative of "Bird Life on Ailsa Craig." The slides were exceedingly beautiful, and reflected great credit on Mr. Kirk, who had himself taken the photographs. They included photographs of collective groups, of individual birds, of birds on their nests, of birds on the wing, of birds in their younger stages, and of eggs. How and from where the photographs were taken is yet the wonder of many who were present!

24th April, 1900.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

The Chairman drew the attention of the meeting to the death of two distinguished Members since last meeting:—His Grace the Duke of Argyll and Sir W. Renny Watson, both of whom became Members in 1889.

A report of the excursion to the Girvan Water on the Spring Holiday was read by Mr. John Renwick (see p. 160).

Messrs. A. B. Motherwell, Rosemount, Airdrie, and Robert M'Lean, M.A., 289 New City Road, were elected Ordinary Members.

Mr. L. Watt exhibited the following Lichens from Dumbartonshire:—

Cladonia cervicornis, Schaer, among moss on Kilpatrick Hills, from 800 to 1,100 feet; not very plentiful.

C. pyxidata, Fr., common, on roots of trees and shady rocks on Kilpatrick Hills, from 400 to 1,100 feet.

Cladina rangiferina, Hoffm., from 500 feet upwards, especially on rocky ground with a slight peaty covering, Kilpatrick Hills.

C. uncialis, Hoffm., on peaty ground, Kilpatrick Hills, from 600 feet upwards; fairly common.

Evernia furfuracea, Mann, on sandstone and conglomerate rocks and on trees; an early species which soon disappears. Found by Mr. Watt on Duncomb last year, 1,100 feet up.

Cetraria aculeata, Fr., on sandstone dyke, along with *Evernia*, at Edinbarnet; not so common.

Platysma glaucum, L., another early species; common on the sandstone and conglomerate rocks, at east end of Kilpatrick Hills. The thallus curls up with the sun and thus gets blown away.

Parmelia physodes, L., on wall tops from Clyde side to near the top of Duncomb, 1,300 feet.

P. saxatilis, L., common on walls and rocks on the Kilpatrick Hills, from 400 to 1,200 feet; easily recognised by the rugose thallus.

In his opening remarks, Mr. Watt said that although records of Lichens from every other county in Scotland had been published, nowhere could he find any recorded from Dumbartonshire. Not that Lichens are by any means rarer in that county than in any other, but as a class they had been neglected.

A paper, "Meteorological Notes and Remarks upon the Weather during the year 1899," by Mr. James Whitton, Superintendent of Parks, was held as read (see p. 141).

29TH MAY, 1900.

Mr. Robert Brown, M.D., Vice-President, in the chair.

The Chairman intimated the death, since last meeting, of Colonel Stirling of Gargunnock, who had been a Member of the Society since 1880.

Mr. John Cairns, Jun., read report of an excursion, held on 5th May, to Dougalston and the Auld Wives' Lifts (see p. 161). Photographs of the larger trees and of the "Lifts," taken by Mr. James Mitchell, were exhibited.

Messrs. Frank E. Cardwell, 240 Darnley Street; James Jack, 24 Chapelside Place, Airdrie; David Bruce, 18 Carrington Street; and Robert Duncan, Whitefield, Govan, were elected Ordinary Members.

Mr. James Mitchell exhibited skins of the Aard Wolf (*Sroteles cristatus*, Gray) and the Cape Ratel (*Mellirora ratel*) from the Orange River Colony. The Aard Wolf resembles the striped hyena of Northern Africa. In height it stands about 19 inches. This Maanhaar, the name by which it is most commonly known, may be found over all the Orange River Colony and the Transvaal, but in Cape Colony and Natal it is rare. It is nocturnal in its habits. Its food consists of insects and reptiles, as well as small animals and birds. It has been a matter of discussion recently whether or not it attacked sheep, but its molar teeth are so small and irregular, that the idea of its being able to chew bones, like the common Red Ratel, may be set aside. There is, however, a strong presumption that, in some parts of the country, it has recently acquired the habit of killing lambs with the same object as have the baboons, which are known in certain localities to destroy lambs for the sake of the curdled milk found in their stomachs. The Cape Ratel is fairly common on the Vaal. Although well known to naturalists, comparatively little is known of its habits. This probably arises from the fact that it is extremely dangerous, and is shunned by both natives and Boers. It burrows in holes among tree roots, and hides itself in hollow trees. It lives on insects, small birds, and reptiles.

Dr. Johnstone M'Fie exhibited a mounted specimen of the Wild Cat, trapped some time ago in Morven, Argyllshire. The animal is now becoming very rare, being destroyed by gamekeepers whenever it is met with.

Mr. Hugh Boyd Watt read a paper entitled "A Census of Glasgow Rookeries" (see page 21).

The Rev. G. A. Frank Knight, M.A., Vice-President, read "A Narrative of a Scientific Cruise on the Fishery Board steamer 'Garland'." Through the courtesy of the Fishery Board for Scotland, Mr. Knight, with three other Members of the Society (Profesor Malcolm Laurie, D.Sc., F.R.S.E., Dr. Rankin, and Dr. Gemmill), had the opportunity of somewhat extended marine research. In view of the work of compiling lists of the Clyde fauna in connection with the forthcoming visit of the British Association to Glasgow, there was a desire to investigate certain parts of the estuary which had been comparatively little dredged. The party accordingly spent a number of days trawling and dredging in the Clyde waters, principally between Cumbrae and Arran, from Pladda to Turnberry, round Ailsa

Craig, off Sanda Island, and up the Kilbrannan Sound. The following rarer molluscs were obtained on this cruise, and were exhibited:—

Lepton clarkiae, Cl., not hitherto recorded from the Clyde; off Sanda, 26 fathoms.

Tellina pusilla, Phil., whose only previous record was "Clyde, 5-20 fathoms, dead," by Forbes, between 1850-60; off Sanda, in 26 fathoms.

Scissurella crispata, Flem., hitherto only recorded from Loch Fyne by Barlee many years ago; off Sanda, 26 fathoms.

Trochus zizyphinus, var. *lyonsii*, Leach, for which hitherto there had been no Clyde records whatsoever; off Sanda, 26 fathoms.

Phasianella pullus (L.), whose only record was "Clyde, 15 fathoms," by Forbes, more than half a century ago; off Sanda, 26 fathoms.

Lacuna divaricata, var. *quadrifasciata* (Mont.), not hitherto recorded from Clyde waters; Sanda to Carradale, 18-21 fathoms.

Rissoa striata, var. *distorta*, Marsh., new record; off Sanda, 26 fathoms.

R. proxima, Ald., very rare; off Sanda, 26 fathoms.

R. semistriata (Mont.), hitherto very scarcely attested; off Sanda, 26 fathoms.

Aclis ascaris (Turt.), only once before recorded for Clyde; entrance to Campbeltown Loch, 23 fathoms.

A. supranitida (S. Wood), only twice previously recorded; off Pirnmill, 73 fathoms; and six miles off Davaar, 23 fathoms.

Odostomia conoidea, var. *australis* (Jeff.), new record; six miles off Davaar, 23 fathoms.

O. interstincta, var. *intermixta*, Mtros., new record; off Pirnmill, 21 fathoms.

O. eximia, Jeff., new record; one mile S.E. of Ailsa, 27 fathoms.

O. ventricosa (Forb.), only once before recorded; nine miles N.W. of Corsewall Point, 60 fathoms.

Pleurotoma costata, var. *coarctata*, Forb., new record; off Davaar, 19 fathoms.

P. nebula, var. *elongata* (Jeff.), new record; Sanda to Carradale, 18-21 fathoms.

(The paper has since been published by the Millport Marine Biological Station. *Communications* I., Nov. 1900, p. 9.)

A paper "On Some Deep-sea Rhizopods found in the Clyde Area," by Mr. Fred. G. Pearcey, was read. The species new to science are—*Storthosphæra depressa*, *Bathysiphon minuta*, and *Hippocrepina oblonga*. Representatives of these genera have hitherto been found only in the deep waters of the North Atlantic, or in the abyssmal depths of the great ocean basins. The discovery of these deep-sea forms within the Clyde Area is not only of considerable interest from a geographical and physical point of view, but is also of importance in discussing the cause of the apparent isolation of other deep-water marine animals found in this area, and in various West Highland lochs. The organisms named build their tests of sand-grains, fine argillaceous matter, sponge spicules, and other foreign material, more or less embedded in a chitinous cement. They represent families hitherto considered extremely rare, and now recorded for the first time from the Clyde Area, where in certain localities they may be obtained living in fair abundance. (The whole paper has been published by the Millport Marine Biological Station. *Communications* I., Nov. 1900, p. 37.)

26th June, 1900.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. James Grant, Molendinar Cottage, Cathedral Square, was elected an Ordinary Member.

On behalf of Dr. W. W. Fullarton, Ballantrae, the President exhibited specimens of the following plants from the south of Ayrshire:—*Buda rupestris*, Lebel.; *Vicia lutea*, L.; *Scilla verna*, Huds.

Mr. C. Sherry exhibited a specimen of *Chrysanthemum lacustre*, Brot., with three flowers on a stem.

28TH AUGUST, 1900.

Mr. John Renwick in the chair.

The following reports of excursions were read :—

To Cumbernauld Glen, on 2nd June, by Mr. A. B. Motherwell (see p. 163).

To Ben Lomond, on 30th June, by Mr. L. Watt (see p. 163).

To Ross Priory, on 4th August, by Mr. Geo. Herriot (see p. 163).

To Glen Water, on 18th August, by Mr. John Renwick (see p. 164).

Mr. T. Alexander Cook, 10 Grafton Square, was elected an Ordinary Member.

Mr. John Paterson exhibited a specimen of *Agaricus* (*Amanita*) *muscarius*, L., from Gourock.

Mr. William Stewart exhibited *Polyporus varius*, Fr., and intimated that he had found *P. melanopus*, Fr., both from near Symington, and both being new records for this district. Mr. Stewart also recorded having found at Blackwaterfoot, Arran, *Scutellaria minor*, Huds., and *Gentiana campestris*, L.

Mr. John Paterson read a paper entitled "A Cruise in Clyde Waters, 1900." (See p. 154.)

ABSTRACT STATEMENT OF ACCOUNTS—SESSION 1899-1900.

1899.—Sept. 1.			
To Balance—Life Members' Fund,	£47 0 0		
Ordinary Fund, on loan, £40 0 0			
Do., in Bank, *less* due to Treasurer, 10 3 1			
	50 3 1		
		£97 3 1	
1900.—Aug. 31.			
To 1 Life Member's Subscription,		5 5 0	
,, 197 Members' Annual Subscriptions, @ 7s. 6d.,		73 17 6	
,, 4 Members' Arrears,		1 10 0	
,, 14 Associates' Subscriptions, @ 5s.,		3 10 0	
,, Interest,		7 2 10	
,, *Transactions*, &c., sold,		5 14 3	
,, Donation to Library,		0 2 6	
,, Donations to Illustration Fund,		7 5 6	
,, ,, towards purchase of Lantern,		14 5 0	
,, ,, for new Bookcases,		14 11 6	
		£230 7 2	

From Balance of £121 10s. 4½d. fall to be deducted cost of *Transactions* for 1898-99 and 1899-1900, of Circulars for 1900, and of Lantern.

1900.—Aug. 31.			
By Rent and Attendance,			£11 19 6
,, Postage, Stationery, &c.,			15 0 9
,, Printing Circulars (1899),			5 9 6
,, Illustrating *Transactions*,			1 19 5
,, Carriage on *Transactions*,			1 8 8
,, Lecture and Lantern Expenses,			2 16 10
,, Library—New Books,		£6 6 9½	
Insurance,		0 12 0	
Postage, Stationery, &c.,		0 9 10	
			7 8 7½
New Bookcases,			13 11 6
,, Donation to Millport Biological Station,			2 2 0
,, Balance, Life Members' Fund, on loan @ 4%,		*£47 0 0	
,, Balance, Ordinary Fund, on loan @ 4%,	*£40 0 0		
,, Balance, Ordinary Fund, in National Security Savings Bank, and in Treasurer's hand,	81 10 4½		
		121 10 4½	
			168 10 4½
			£230 7 2

* On Security of Guaranteed Railway Stock.

Life Members' Fund—	
Invested in 2½ per cent. Debentures of The Modern Permanent Building and Investment Society, Melbourne,	£100 0 0
On loan at 4 per cent.,	47 0 0
	£147 0 0

GLASGOW, 18*th October*, 1900.—We have audited above Accounts, compared same with relative Vouchers and Securities, and find them correct.

(Signed) WM. LEIGHTON, } *Auditors.*
JAMES JACK, }

TRANSACTIONS

OF THE

Natural History Society of Glasgow.

Extracts from an unpublished Ornithology of Glasgow.

By the late Dr. JOHN GRIEVE, with Notes by JOHN PATERSON.

[Read, in part, on 26th March, 1901.]

THROUGH the courtesy of Dr. G. Burnside Buchanan, there came into the possession of the Society recently a very interesting little work on the Birds of Glasgow, in manuscript, by the late Dr. John Grieve (regarding whom see an obituary notice in our *Transactions*, Vol. IV. (N.S.), p. 357). This little work, which has remained unpublished, bears a title page as follows:—

ORNITHOLOGIA MILLBURNENSIS:

THE ORNITHOLOGY OF GLASGOW;

COMPILED

FROM OBSERVATIONS MADE AT MILLBURN

DURING A SERIES OF YEARS,

BY JOHN GRIEVE.

GLASGOW:

1847.

With this there also came to the Society some loose sheets, evidently notes of an address on the same subject, but, unfortunately, incomplete in respect of a few pages at the beginning. I believe the part lost to have dealt with the Peregrine Falcon, Sparrow-Hawk, Kite, Hen-Harrier, Rook, and in part Jackdaw, being the first half-dozen species in the complete list.

The Birds of Glasgow is a work yet to be undertaken. In the meantime it may be said that local ornithologists owe some gratitude to Dr. Grieve's memory for the admirable example he has set to them in the work under notice.

The area of observation is thus described:—"The north-east boundary of Glasgow is formed by the Germiston Burn, from where it passes under the Garnkirk Railway, or what is now called Caledonian, it winds round under the Monkland Canal away east a small bit, and then due west to the High Church, where it turns southward as the Molendinar, and here ceases to be a boundary line. Before passing under the Monkland Canal it runs through the grounds of Millburn where the principal observations were made. It is surrounded by the gardens of the neighbouring gentlemen, and is within ten minutes walk of one of the principal thoroughfares of the city. The data from whence the following observations were made were duly registered there for a series of years, and though repeated excursions were made round the city to a distance of three miles or so outside the boundary, no other birds were discovered but what have been seen at some time or another at Millburn."

Though dated 1847, the work is based on a journal kept during the years 1843, 1844, and 1845. The birds enumerated number about 56 species, and are as follows:—Peregrine Falcon, Sparrow-Hawk, Kite, Hen-Harrier, Rook, Jackdaw, Magpie, Jay, Starling, Fieldfare, Song-Thrush, Redwing, Blackbird, Pied Flycatcher (marked?), Sedge-Warbler, Garden-Warbler (marked?), White-throat, Redbreast, Reed-Warbler (marked?), Lesser Pettychaps, Yellow Wren, Gold-crested Wren, Wren, Whinchat, Hedge-Sparrow, Pied Wagtail, Grey Wagtail, Yellow Wagtail, Tit-Lark, Sky-Lark, Wood-Lark (marked?), Greater Titmouse, Blue Titmouse, Yellow Bunting, Bullfinch, Green Linnet, Sparrow, Chaffinch, Brown Linnet, Canary, Red-headed Linnet, Goldfinch, Cuckoo, Chimney-Swallow, Sand-Martin, Martin, Swift, Ring-Dove, Partridge, Lapwing, Snipe, Corn-crake, *Larus* (various species), *Anas.*

Of the Peregrine Falcon, he says: "A bird called the Blue Hawk by gardeners is said to be seen here occasionally," but he was unable to satisfy himself about it. The Sparrow-Hawk "is the only bird of prey we can boast of as a residenter. It is frequently seen gliding leisurely over our fields. . . . I have never been able to find out their nests here, though I think it very probable that they build on some of the old trees at the top of the quarry at Craigpark."

Of the Kite, a species quite unknown in the Glasgow district at the present time, one is almost surprised to read that "it is not so common here as the preceding, still it is often enough seen flying over our fields. . . . I have never heard of any of their nests having been found near the city, though, as they build chiefly in trees, they may only have escaped observation." Within a decade or two of the years covered by Dr. Grieve's diary, this splendid bird must have vanished pretty completely from the Glasgow district. The Hen-Harrier he had seen only once. "It was in the August of '43, when walking along the Germiston Road, near Provan Mill, I observed one of these birds, within twenty yards of me, flying leisurely over a corn field, just about a foot above it, beating every corner of it with great assiduity. . . . ." Surprise is expressed at no owl coming under his observation, though he had looked and listened carefully at night for one. "The Cathedral might be a very fit place for a pair to take up their abode."

Of the Rook it is said that "they are not generally considered here to cause much destruction by turning up the grain. . . . This view being more generally held now, they are considered more welcome, and are allowed to breed, while formerly every attempt was made to cause their destruction. . . . This town, in former days, could boast of large rookeries. The only one that now exists is that in the College Green, reduced to a few dozen nests, though once the largest, and certainly a more favourable spot could not be had—besides the number of trees and full scope for their quarrels, being protected by the Laws of the University, by which any one was punishable for meddling with or annoying them. Notwithstanding, they were gradually becoming less numerous. One used to exist at the head of Queen Street, around the house of one of the M.P.'s for the city, who got nicknamed in consequence ['Craw Ewing'].* When his house was taken down to make room for the present terminus, the trees were felled likewise, but whether they formed an alliance with their University friends or took up a new abode cannot now be so easily determined. One pair built regularly on a tree in a back green of one of the houses on the south side of West George Street, but that being felled two years ago, they, too, have left the city. A few still build at Possil, and here and there several nests may be seen, probably exiled for some misdemeanour."

* See "Trans. Nat. Hist. Socy., Glasgow," Vol. IV., N.S., p. 276.

The Jackdaw "is by no means a common bird in this neighbourhood — numbers build out at Pollokshaws, and give us an occasional visit."

The Magpie in spring is generally seen in pairs, but "towards the end of September flocks of 6 or 8. . . ." "I have never seen their nests here, but am told that they build about Craigpark and some of the adjacent woods." The egging propensity of this species is much commented upon.

The Jay had only come under observation once, viz. :—" on the 14th December, 1844—during a time of hard frost—at the Burn."

The narrative given by Dr. Grieve, relating to the great encouragement given to the Starling at the time he is writing of, deserves to be quoted pretty fully, as an interesting contribution to the history of the increase of this now very common bird. "Few birds receive more encouragement to build than does this one. On the roofs of almost all the houses hereabouts boxes are placed for them to build in, and though the young brood are not infrequently taken away they continue to frequent them year after year. These boxes are made about 18 inches long and 10 broad at the back, while at the front it is reduced to 6. The door or hole for entrance is made very small, and no larger than will admit the bird. They are nailed up by the side of the chimneys, or in the fork of a tree, the former being considered the more agreeable by the birds, and probably so from the warmth of the chimney. . . . During winter they are to be seen in flocks, and do not generally resort to the boxes for sleeping quarters. The number of boxes appear to regulate the number of birds, as when they are taken down in winter and not put up till the birds have been seen looking for suitable nest places, they are seldom so numerous as when the boxes are left up. . . . There appears to be a slight mania in the starling box line among our neighbours, which will probably subside in a few years, and then the bird may become more rare. A few build about the Cathedral." The extent to which this guarded forecast of the "subsidence" of this species has been falsified, is a matter of common knowledge.

Under the heading Fieldfare, a narrative is given of its nesting at Millburn, but subsequently the confusion into which the author had fallen between this species and the Mistle-Thrush had been discovered, and the manuscript bears a pencil jotting in the margin to this effect.

The Song-Thrush is "very numerous here. . . ." "It generally begins to sing about the end of January (January 27), and continues on to the end of July (July 27), sometimes even to the 10th or 12th of August."

The Redwing "arrives here with the Fieldfares, about the middle of October, and remains to the middle of March."

The Blackbird "commences to sing about the beginning or middle of February, and continues on to the end of July or beginning of August—(February 17—July 27, August 10). . ."

The nicety of Dr. Grieve's observation is well illustrated in his description of the economy of the Spotted Flycatcher, regarding the identity of which he had had for some time a little difficulty, but, as he says, "the spotted appearance of the young bird can hardly be mistaken," which is a good point. A pair built for two successive years at Millburn "in one of our walled pear trees," and our author states further "I have found it among some of the pine woods in Bute. . . . It has a low, sweet song, which it generally utters on the extremity of a small spray, where it sits perched looking for flies, and then pouncing on them as they fly past. . . . I have generally heard it first about the beginning or middle of May, and seldom seen it after the middle of September. . . . They were seen first this year (1844) on May 24th, and not after September 19th. One of the young ones had three toes of the left foot wanting. . . . On 29th June, 1843, there were 4 eggs laid in the nest, one daily on the three preceeding days, and the nest occupied two days in building. July 12, has sat 12 days. July 21, young 10 days old—so that incubation lasted only about 12 days. . . . On the 24th they flew."

The Sedge-Warbler "is sometimes met with at the Mill dam on the Town Mills' Road. . . ."

The Garden-Warbler "arrives here about the end of April, though is seldom heard here before the middle of May, and leaves in August. I have heard it here on the first week of September. . . . I saw the bird here first on 5th of July, 1843, but, after a careful search, could not fall in with its nest. Next year, however, I found the nest in a currant bush about four feet from the ground, on the 14th June. On the 17th it contained four long-shaped eggs. . . . On the 28th the young were hatched, that is allowing 11 days for incubation. . . . On July 8th the birds flew after 10 days' nutrition."

Of the Common Whitethroat it is said that "they are pretty frequently seen here, and breed down at the burn. . . . They breed pretty early here, as I found three of them newly flown on 26th June, 1843."

The Redbreast "is quite common here all the year round. . . . It may be seen singing on the top of a stob or any exposed place during a heavy fall of snow, or hopping about and twittering with its wings flapping its sides. . . . I have heard the robin singing as it flew from bush to bush."

The Reed-Warbler is entered in the complete list with a mark of interrogation. It does not appear to rest upon his own observation, and its insertion is a mistake in any case.

The Lesser Pettychaps or Chiff-Chaff is "heard first about the middle of April, and rarely after the beginning of September. . . . It is one of our rarest summer visitants." One would have liked something fuller regarding the occurrence of the Chiff-Chaff, and it is a little disappointing that Dr. Grieve's acquaintance with the Willow-wren was limited to his having seen it "several successive years here, generally about the beginning of August." Has the Willow-wren become so abundant since 1845?

Of the Gold-crest, our author writes—"While out walking among the shrubbery at Millburn, before breakfast, on the 29th September, 1844, I fell in with this beautiful little songster. I had never seen it here previously, and willingly followed it from bush to bush till I had obtained several near sights of it, and was convinced that it was a veritable Gold-crested Wren. The song was very low, but broke out loud at the end, terminating very like that of the Chaffinch. . . ." A good description!

The Wren "is to be seen almost everywhere. . . ."

Of the Whinchat—"I have occasionally met with this bird among the whin bushes around the sand quarry." ["M'Ilquham's," according to the notes of an address, *ante*, p. 182], "on the other side of the Burn. . . . It is very common about Dunoon and Rothesay. . . . It arrives here about the end of April, and is seldom seen after September."

Of the Hedge-Chanter [Sparrow], "They are very numerous here, and are easily caught in the common brick trap. . . . I remember catching one which had a cataract in the left eye."

The Pied Wagtail "is common here all the year round. . . They keep up a most agreeable inward chatter when looking for food—and are generally more plentiful in the neighbourhood of those streams to which washerwomen resort, the insects being attracted by the soap suds—whence one of its common names [Washerwoman]."

The Grey Wagtail is "not near so common here as the preceding, in company with which it is sometimes seen. Its song is not so loud. . . ."

The Yellow Wagtail, "certainly the most elegant of the Wagtails—having the longest tail [a mistaken idea, this being the distinction of the Grey Wagtail]. . . . It is, however, the rarest, being only occasionally seen here. It is, however, very common in other parts of the country, from which it pays us a passing visit generally for a few days in August. . . ."

The Meadow-Pipit alone among its congeners is mentioned, but a perusal of Dr. Grieve's description of its habits proves that the Tree Pipit was also under his observation, although he failed to distinguish the one from the other. This is a common mistake in old writers, as Pennant, Gilbert White, &c.

In his account of the Sky-Lark, he gives a curious narrative of a wild brood he put in a cage on the outside of his window, where they were attended for several days by their parents.

As so often happens in old lists, the Wood-Lark appears, in this case upon the authority of "a lady," but, as the author properly says, "probably wrong."

The Great Titmouse and Blue Titmouse were very common. Of the former, it is said "it has a nice song which it commences early in February, sings through March and April, and resumes again for a short time in September."

The Yellow Hammer "generally commences to sing about the 20th or 23rd of February, and sings on to August 18th, or even 26th, and again from about September 20th to the end of the month. It is not uncommon on the fine clear sunny mornings of September to hear many of the young birds going through part of their song, as I said already of the young larks."

Of the Bullfinch little is said, it having been observed only once. The Green Linnet was "common everywhere."

A long account is given of the House-Sparrow, and of the behaviour of a pair which he reared in confinement. "By degrees the one which appeared to be the hen grew black, and after her first moulting became jet black, like any crow, with two white spots on the wing."

An interesting account of the Chaffinch follows that of the Sparrow, but our space will not allow of the quotations one is disposed to make.

The "Grey Linnet is seen here in large flocks during the winter months—numbers of them are caught then for the market, where they are sold at 4d. each or so."

The Canary, hens of which are "let away by unprincipled people or escape," calls for no notice here.

Of the Lesser Redpole, a few "are occasionally, though rarely, seen with the flocks of Grey Linnets during winter."

The Goldfinch, which is described as being "so common in many parts of the country, is rare here, as he only pays us an occasional visit after a winter storm, or the end of autumn when the thistle seeds are flying about in numbers."

Regarding the Cuckoo, nothing of importance is narrated.

The Swallow "arrives here from about April 17th to 25th, and remains with us to about September 26. . . . They have generally two broods in the year."

The House-Martin "arrives about the same time as the former, April 23rd, and remains to September 26th. . . . This bird is generally to be found with its nest in the window corners and eaves of houses, and generally to a northern exposure. The nests being thus protected from cracking by the sun's rays. and less exposed to destruction from heavy rains, which very easily undermine the fragile materials of which they are composed. . . . Their nests are to be found on almost every window fronting the Clyde." This species is described in the notes of an address before referred to (*ante*, p. 181), as "much more common" than the former. The statement is interesting in view of the opinions frequently expressed about the recent decrease of this species in numbers in various Scottish districts. A pair or two may be found nesting at the present time from a mile and a-half to two miles south of the river (for the north side I cannot speak), but this is a very different story from that told by Dr. Grieve.

The Sand-Martin, our author says, he has repeatedly watched "at the sand quarry on the other side of the Germiston Burn. . . . About half-a-dozen pairs build here annually. . . . They generally arrive here about the 17th of April, and are seldom seen after the 26th September."

The Swift is described as "seldom arriving before the beginning of June, and leaves about the 26th of August, . . ." but it is well known to recent observers in the neighbourhood to appear regularly a month earlier.

The Ring-Dove was an occasional visitor, and, " . . . one year a pair built on a tree at the Germiston Burn, just where it passes under the Garnkirk Railway."

The Partridge was occasionally "seen in flocks of from 6 to 12 during the month of September and the early months of spring, especially in pairing time—for this bird is one of those that pair early."

Of the Lapwing, "stragglers from Hogganfield and the neighbouring mosses not unfrequently pay us a visit, especially in wet and stormy weather, and during spring. . . ."

A Common Snipe, which was first seen "in one of our ditches" on the 14th December, 1844, was the only one that came under Dr. Grieve's notice.

The Corn-crake was seldom heard at Millburn before the beginning of June, but this would be a month at least after its arrival in the district generally.

The Gulls seen were not distinguished specifically. "Several species are seen here during spring and autumn on their migratory voyages. . . ." "A few come up to our harbour in stormy weather, but only for a day or two. . . ." The harbour of Glasgow, at the time of which Dr. Grieve writes, may not have presented the attraction of "fine confused feeding" that it does at present. The Black-headed Gull is abundant at all seasons now-a-days, while the Lesser Black-backed and Herring Gulls are summer and winter visitors respectively, and the Common Gull may be seen on a rare occasion.

Large flocks of Ducks were to be seen at Millburn towards the end of November, flying southwards, and returning north again about the beginning of February, but the species were not distinguished.

One puts aside this interesting work with feelings of regret. Written out at the age of twenty, and based on a journal kept between the author's sixteenth and eighteenth years, it is remarkable for the breadth of view attained. It is not usual to find naturalists at the age named already noting carefully all matters relating to seasonal movements, song-periods, autumn-songs, dates of nesting, and time occupied by different birds in incubation and nutrition, experiences gained in rearing wild birds in confinement, &c. And further, the work is quite individual in its character, as it does not appear that he had any associate on whom he could rely for assistance. The district to which it refers has been rudely shorn of its natural attractions in recent years, verily, "man marks the earth with ruin." The name persists certainly in Millburn Street, Millburn Public School, and Millburn Chemical Works, but that to the naturalist is a poor return for the furze and the sand quarry, the burn (now covered up), the currant bushes, and the walled pear tree where the Spotted Flycatcher nested. The house was demolished a year ago. It stood within the square now represented by Millburn, Holybank, Kilberry and Scarba Streets, with houses for the humblest class of worker. Elevation is indeed the only natural attraction left, and from the neighbourhood ample views are still obtainable.

The Seals, Whales, and Dolphins of the Clyde Sea Area.

By Hugh Boyd Watt.

[Read 28th May, 1901.]

N.B.—The numbers within brackets refer to the list at the end of the paper.

The Clyde Sea Area includes all the tidal waters contained within a straight line drawn from the Mull of Kintyre to Loch Ryan. In respect of its marine mammals, it may be regarded as an almost land-locked and small portion of the region which Dr. P. L. Sclater calls Arctatlantis, and of which the characteristic genera are *Halichœrus*, *Cystophora*, and *Hyperoodon* (11). In "Clyde" and adjacent waters *Cystophora* is unrecorded, but the other two are represented.

A considerable advance can be claimed in our knowledge since 1876, when the late Mr. E. R. Alston could only name three species of marine mammals from Clyde waters (1), a number which was not added to in his subsequent paper published by this Society (2). The following annotated list shows that we now have definite records of eight species, and, in addition to these, there are four further species named within square brackets, as confirmation of their occurrence is awanting. This will be forthcoming in the course of time, I feel convinced. Other records, which I believe to be erroneous, I have excluded. One such is the Greenland Whale (*Balæna mysticetus*, Linn.) (12), whose occurrence in British waters at any time is not admitted. Here it may also be said that no fewer than eight species of Cetaceans are named from "Clyde" in the two "Statistical Accounts of Scotland" (1791-7 and 1845), but only those otherwise confirmed are given below.

Not infrequently newspaper reports of "Whales" appear, and while no scientific reliability can attach to these statements, yet they are evidence that Cetaceans are not so uncommon in our Firth as is generally supposed. Unlike land mammals, marine mammals have uninterrupted means of passing from one region of the globe to another, the sea serving to them as a great highway forming a continuous zone of communication, and not as a dividing barrier. Consequently our number of species of Cetaceans, in proportion to the whole number of species known, is probably larger than that of any other group of mammals in our fauna.

ORDER : *Carnivora.*
FAMILY : *Phocidae.*

1. *Halichærus grypus* (Fabr.). Grey Seal.—I am indebted for what I know as to this species to Mr. Alexander Gray, Curator of the Millport Marine Biological Station. Its early occurrence is vouched for by a tooth which Mr. Gray found in a kitchen midden near Campbeltown, and which Dr. Joseph Anderson identified. Mr. Gray also has information that, up to about 1860, two grey seals were known to live, summer and winter, on Paterson's Rock, in the Sound of Sanda (6). They disappeared without any known reason.

When Mr. Gray was dredging off the Little Cumbrae, on 8th September, 1900, a grey seal rose leisurely to the surface within 30 yards from his boat. A good view was obtained of it, as it was seen three times altogether. Mr. Gray thinks it was three times the size of an ordinary seal, one of which he saw on the same day near the same place (5).

2. *Phoca vitulina*, Linn. Common Seal.—I have notes of the recent occurrence of this species all over our area from Sanda upwards. One was shot so far up as two miles above Port-Glasgow in 1890. Loch Fyne is apparently a breeding resort, and an old seal with two pups were seen near Largs in 1899. According to the new "Statistical Account" (V., 1845), a favourite haunt is a rock in the sea not far from Troon. This probably refers to the Lady Isle, which is still frequented. I was so fortunate as to see a herd of from 30 to 40 there in June, 1900. The probability is that this species is much more common than is generally supposed, although there is now no seal-fishing. This seems to have been pursued in "Clyde" about 1791 (13).

3. [*P. groelandica*, Fabr. Greenland or Harp Seal.—Mr. F. Gordon Pearcey informs me (*in lit.*, 30th October, 1899) that he

saw in June, 1899, two seals, probably this species, close to his ship, when trawling between Pladda and the Ayrshire coast. He hit one with a revolver shot, but it sank shortly after.]

Observation.—P. hispida, Schreber. Ringed or Marbled Seal. —Professor Sir William Turner gives particulars of frequent finds of remains of this species in Scottish glacial clays, and although none are from the Clyde, they have probably been overlooked (17).

ORDER : *Cetacea.*
FAMILY : *Balœnopteridae.*

4. [*Balœnoptera musculus* (Linn.). Common Rorqual or Razorback.—Dr. John Walker, in his "Essays" (1808), states that this species yearly frequents Loch Fyne during the herring season, and this statement is repeated by other writers. No captures are however known. Mr. Gray tells me that about the year 1889 the Sound of Kilbrannan was frequented by a whale, 50 to 60 feet long, followed by two calves; the three were well known to the fishermen, and often seen by him. Mr. F. Gordon Pearcey also saw a whale, probably this species, 3½ miles south of Davaar Island, on 10th October, 1899.]

Observation.—A post-tertiary deposit near the mouth of the River Irvine bears the name of the Irvine Whale Beds (16). Cetacean remains have been found there from 1790 onwards. A skull, obtained in 1863, and another one and some ribs and vertebræ, obtained in 1889, are in the Hunterian Museum. A broken cranium, found in 1892, was at one time in the Anatomical Museum, Edinburgh University, but is now in the Museum at Kilmarnock. Sir William Turner thinks this belongs to a *Balœnoptera*, but he cannot definitely state the species (*in lit.*, 17th July, 1900).

5. *B. rostrata*, Fabr. Lesser Rorqual or Pike Whale.—On 7th August, 1897, the small steam whaler "Thrasher," when on her trial trip, had the unusual experience, in such circumstances, of putting her whaling gear into actual use. She harpooned and killed a whale off Largs, and towed the carcase, which was about 30 feet long, up to Greenock. It was offered for sale at £5, and the lips found their way to Paisley Museum, where I saw them. Their resemblance to an illustration in Sir William

Turner's article on the Lesser Rorqual (18) struck me, and on sending a photo. of them to Mr. Oldfield Thomas, of the British Museum, he stated that they seemed to belong to this species. This is the first and only record of it in Clyde waters (21), but it has occurred in Islay (3).

Family: *Physeteridæ.*

6. *Hyperoodon rostratus*, Müller. Bottlenose.—This species is frequently reported, and is apparently not uncommon. Mr. Gray sees it every season off the Cumbrae shores. The old "Statistical Account" (1792), under Row, says:—"A species of whale, called Bottlenoses, have sometimes run aground during the ebb of tide, been taken, and oil extracted from them." In recent years I have the following definite records of its capture: —In 1863 one was taken in the Gareloch, and its cranium shown to this Society by Dr. Scouler (15); in October, 1883, a young male was stranded at Loch Ranza—the skull and some other bones are in the Anatomical Museum, Edinburgh University (19); in July, 1896, a small male was captured at Kingston Yard, Port-Glasgow (9); in January, 1898, one came ashore at Peaton, Loch Long—I found the carcase entombed in a lime-heap when I went to see it; and in September, 1899, I was more fortunate in seeing one which had stranded on the beach at the North Shore, Ayr (21). Without placing any weight on reports of this species having been merely seen, the foregoing is evidence that such reports may not be inaccurate.

Family: *Delphinidæ.*

7. *Phocæna communis*, Less. Common Porpoise.—This is our commonest Cetacean, and may be seen at all seasons of the year. One hundred years ago it came as far up the Clyde as the Broomielaw (14), and it still may be seen off Greenock. The mouths of Loch Long and the Holy Loch are favourite haunts, and I have notes of it from many places in our waters. Last month a small school of about half-a-dozen was playing at the head of Loch Long, and several times I saw leaps taken clean out of the water in the manner of the "Bucker" (Dolphin). When a school is playing, the individuals seem often actually to rub along, side touching side; thus, from some points of view, two dorsal

fins may have the appearance of belonging to one animal, and may cause bewilderment. Porpoises sometimes approach very close to the shore, apparently in the most confident manner. Last month I saw one moving slowly along shore at Kirn, only two or three yards from the beach. In August, 1825, a pure white porpoise was shot off Millport and brought ashore (8). I do not remember hearing of a white porpoise elsewhere.

8. [*Orca gladiator*, Gray. Killer or Grampus.—There seems little doubt but that this species has occurred in our waters, but as no capture is on record, it is here given within square brackets. Both the "Statistical Accounts" include it—the new one speaking of "the depredations of the porpus, grampus, and other destructive sea-fishes, particularly the grampus, which comes up nearly as far as the salt water reaches almost every tide at flood during certain seasons in pursuit of salmon, of which it devours great numbers."

Mr. Gray says that he knows it, *e.g.*, as occurring on the Ballantrae Banks in spring; and Mr. John Paterson saw two off Bute in June, 1898 (10). The old "Statistical Account" calls it the "Bucker," and as the name Grampus is given to the Pilot Whale by fishermen, there cannot but be uncertainty as to the correct species when a "Grampus" is heard of. It seems not unlikely that the Kilbrannan Sound "sea-serpent" story of the summer of 1899 may be founded on the appearance of an individual or individuals of this savage species.]

9. *Lagenorhynchus albirostris*, Gray. White-beaked Dolphin. —Next to the porpoise, this seems to be our commonest Cetacean, although it is only in recent years that it has been conclusively added to our Scottish fauna. The first authentic record in Scottish waters is that of an individual shot in Kilbrannan Sound in September, 1879, by Mr. J. Y. Buchanan. The skull is in the Anatomical Museum, Edinburgh Museum. Sir William Turner saw in these waters in August, 1887, what he believed to be a school of the White-beaked Dolphin (20).

The late Dr. James Dunlop said that they are to be seen daily in Kilbrannan Sound, and the four specimens (a stuffed example and three skeletons, one a fœtus) which were in the Kelvingrove Museum, were all captured in the Sound in 1894 and 1895 (4), and presented by Dr. Dunlop to the Museum. In November, 1899, Mr. John Robertson found cast up on the beach near St. Ninian's Bay, Bute, the carcase of a small Cetacean, the skull and sternum of which were subsequently recovered and sent to me. I made the species to be the one under discussion, an identification which was very kindly confirmed by Sir William Turner, with whom the skull was left to be placed in the Anatomical Museum, Edinburgh University (22). These occurrences seem to indicate that the animal so well known in the Firth of Clyde as the "Bucker," and in Loch Fyne as the "Stinker," is identical with this species. Fishermen and yachtsmen clearly distinguish it from the porpoise by its larger size, and by its conspicuous habit of leaping out of the water. By the Loch Fyne men this is said to be the "stinkers threshing." They make themselves a nuisance to the herring fishermen by following the boats, so much so that the men throw ballast stones at them to drive them away, not because of any danger, but because in coming to the surface the Dolphin causes such a glare of phosphorescence as to dazzle the eyesight. If one becomes entangled in the nets, it can leap out of, or over them, and escape. The leaping is frequently done in broad daylight, and I have seen a school of about a dozen in the shallow waters of Whiting Bay, playing and gambolling round the ferry-boat, throwing themselves well clear of the water and falling back with a resounding splash—a fine sight in the bright sunshine of a summer day (August, 1897). Seen at a distance, their bodies are in a beautiful curve when clear of the water, not unlike salmon leaping. They seem to possess a power of suspended motion, and sometimes bring their rapid actions suddenly under control, leaving their caudal extremities projecting above the surface for a short time before drawing them under. The impression given is that the animal stands on its head, as it were.

Other species of Dolphin have occurred in our waters, and the name "bucker" may apply to them all, but, so far as I know, the only statements with any specific value regarding our other Clyde Dolphins are the following:—

10. *L. acutus*, Gray. White-sided Dolphin.—An example of this rare British species is stated to have been seen lying on the pier, at Ardrishaig, by the Rev. N. Macpherson, of Newton, Inveraray (7). It would confirm the identification were it known that the skull had been examined by a competent authority.

11. [*Delphinus delphis*, Linn. Common Dolphin.—Mr. Pearcey informs me that in September, 1898, he saw a large school of what he took to be this species, between Ardlamont and Skipness Points. There is in Rothesay Museum a skull labelled "Porpoise, from Mr. A. M'Kirdy," which I believe to be this species, as the skull is about 24 inches in length and has about 190 teeth. It is certainly not the Common Porpoise.]

12. *Tursiops tursio*, Fabr. Common Tursio.—According to the new "Statistical Account" (1845), the Great Dolphin (*D. tursio*), from 12 to 15 feet in length and with a pointed muzzle or beak, frequents the coast of Saddell and Skipness during the herring-fishing season. There is more satisfactory evidence than this of the occurrence of this species in our waters, as Dr. D. Noel Paton shot one in August, 1879, in Loch Long, the skull and ear-bones of which are in the Anatomical Museum, Edinburgh University (22).

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Meteorological Notes, and Remarks upon the Weather during the Year 1900, with its General Effects upon Vegetation.

By JAMES WHITTON, Superintendent of Parks, Glasgow.

[Read 28th May, 1901.]

THESE notes are compiled, as in former years, from observations taken at Queen's Park, Glasgow, so that the continuity of the series is preserved.

January.—The cold frosty weather experienced towards the close of 1899 gave place at the opening of the year to mild and moist weather, and this was the general nature of the atmospheric conditions throughout the entire month. During the first week the weather was bright and pleasant, though with occasional showers of rain. On the 9th showers of sleet fell, followed by a period of showery and dull days. On the 19th the weather became boisterous, and throughout the day fitful gusts of wind and rain swept the streets. On the following day the wind increased, with rain, hail, and sleet at intervals, and continued until the 26th, when there was a slight thunderstorm. On the

27th and 28th slight showers of snow fell in the early morning, and the atmosphere became somewhat colder.

The barometer readings show a very irregular pressure throughout the month, with some sharp changes. From the 3rd the tendency was upwards, till on the 11th it read 30·10 inches, the highest reading of the month. During the succeeding three days it fell rapidly to 28·96 inches on the 15th; the pressure thereafter till the close of the month was steady.

Frost was registered on five mornings to the amount of 12°, while the total for the same month of the previous year was 94° for twelve days. The average maximum temperature for the month was 43° and the average minimum 35°, as against 40° and 32° respectively for January, 1899.

The amount of rain registered during the month was somewhat heavy, being 5·08 inches, part of which, however, was melted snow.

Owing to the comparative immunity from frost during the month, the grass was still green at the close. *Jasminium nudiflorum* was in full bloom, and narcissi were to be seen above the surface in open borders.

February.—With the advent of this month the weather conditions abruptly changed, and keen frosty weather set in. From the opening of the month till the 11th the frost increased in strength, and on the morning of that day the thermometer at Queen's Park registered 9°, or 23° of frost. Skating and curling were freely indulged in on all the ponds around the city, and the air was keen and bracing. On the 9th and 10th there were heavy falls of snow to a depth of six inches, and, unlike the usual experience in the city, it continued to lie on the ground till the 15th, when, after a further fall of snow, followed by rain, it rapidly disappeared. On the 22nd, after a succession of milder days, a heavy snowfall was again experienced. Thaw set in immediately after, and the closing days of the month were cold and wet.

The range of the barometer during the month was low, the highest reading being 29·75 inches, and twice it fell to 28·40 inches, viz., on 16th and 19th.

The total amount of frost registered was 189° for nineteen days, and on five days the thermometer did not rise above freezing point (32°). The average maximum and minimum temperatures were 38° and 26° respectively. In 1899 these figures were 43° and 32° respectively.

The rainfall of the month was 2·68 inches, and included a quantity of melted snow. There were 20 dry days.

The sharp frosts experienced during the month checked precocious vegetation, and had a most damaging effect upon those shrubs which made late growth, or whose tissues were surcharged with sap, consequent on the mild wet weather which prevailed during the greater part of the four preceding months. Such plants as *Aucuba japonica*, certain forms of *Rhododendron ponticum*, and the common laurel suffered severe injury in the young shoots. The foliage of the laurel especially, was browned to a greater degree than usual in the western and northern parks. In the case of *Olearia Haasti*, which, by the way, we find to be an excellent town plant, in several parks it was hardly injured, whilst in others it was killed to the ground.

March.—As in the previous month, the weather in March continued cold and frosty, with a period of fine clear days.

The opening days were bright and springlike, but on the 19th the atmosphere became colder, and snow fell to a depth of 2 inches. Thereafter the weather remained cold and dull, with a recurrence of snow on the 27th and 28th.

The atmospheric pressure was regular for the first fortnight, but on the 14th the barometer fell sharply from 30·38 inches to 29·10 inches on the 19th, the day on which the snowfall occurred. From this point it gradually rose until it reached 30·05 inches on the 31st.

The rainfall recorded this month was very moderate—the amount measured (0·28 inch) being little more than a quarter of an inch. There were 27 dry days during the month.

Frost to the extent of 83° was recorded for twenty days, and the lowest thermometer was 22° (10° of frost) on the 18th. For the same month of 1899 there were 72° of frost for nine days. The average maximum temperature for the month was 44° and the average minimum 31°, against 46° and 35° respectively for the corresponding month of last year.

Vegetation was held in check by the cold and frosty winds prevailing during the month, but towards the close, with a warmer sun, buds began to swell and the grass to make some growth. Snowdrops were in full bloom about the middle of the month, and towards the end crocuses came into flower.

April.—This month was bright and sunny, though there was a prevalenee of cold winds and considerable rain. From the 18th to the 25th the days were bright and sunny. There was a comparative absence of frost throughout the month, only 14° being recorded for six mornings, and the average maximum temperature was 55° and the average minimum 38°, as compared with 52° and 37° respectively for the preceding April.

The barometric record for the month was wide and erratic, ranging from 28·90 inches to 30·25 inches.

The rainfall was 2·14 inches, and there were 16 dry days.

Owing to the cold winds of the month vegetation did not make great progress, and trees and shrubs put forth their leaves but slowly. Grass, however, made some growth, stimulated by the frequent showers and spells of sunshine. Hyacinths and narcissi were in full bloom by the 26th, making a very good appearance, though the latter were not quite so floriferous as in the preceding year. The lateness in blooming of that early variety of hybrid rhododendron "Eugenie" indicated the tardiness of growth. Frequently it is in full bloom by the end of April, whereas this year it was past the middle of the month ere it began to open its flowers.

May.—The month opened well with two fine days, when the atmosphere was dry and warm, but on the 3rd and 4th the wind increased to a gale, and the weather became damp and raw. Till the 9th the atmospheric conditions continued dull and showery, but on this day the wind, which had been mainly from the south-west, changed to the east, and a period of dry and cold days were experienced. On the 18th the wind again turned to the south-west, and was followed by warmer and more seasonable weather, which lasted till the close of the month.

The barometric readings ranged, with no particularly rapid change, from 30·00 inches on the 13th to 29·10 inches on the 22nd, and the rainfall of the month was 2·19, with 17 dry days.

Frost was registered this month on one morning, 2° being recorded on the 13th. The thermometer readings show that the temperature was on no occasion very high, the highest reading being 66° on the 27th. On nine occasions the thermometer fell below 40°, and the average maximum was 58° and the average minimum 42°.

Notwithstanding the cold winds of the middle of the month, vegetation made satisfactory progress, and trees and shrubs were in better foliage than has been the case for several years. With the comparative freedom from frost, flowering trees and shrubs, such as laburnum, lilac, and cherry, bloomed exceedingly well, and made a brilliant display—the notable exception being rhododendrons, which generally bore a light load of flower. The ash leafed on the 18th, and the oak on the 24th, both some days later than usual, and in reversed order to what usually occurs, and, as the sequel proved in our district, not in accordance with the old "saw," which gives a dry season when the ash leafs first. The notes of the cuckoo were first heard on the 7th.

June.—The bright warm days of the close of May continued through the first week of June, though on the 7th the weather became dull and unsettled. Saturday, the 9th—the "Children's Day" in the Parks of Glasgow—was dull and wet in the morning, but, fortunately, broke up fine, enabling the youngsters to enjoy their fête under fairly comfortable conditions. On the evening of the 12th, after two or three sultry days, a sharp thunderstorm was experienced. From the 14th there was a spell of fine warm days, and on the 22nd there was a recurrence of the thunder, and the weather was changeable and showery. On the 25th the total rainfall recorded for the preceding twenty-four hours was 1·42 inches, and the total rain for the month was 4·04 inches, there being 13 dry days.

The atmospheric pressure during the month was very steady, varying little between 30·20 inches on the 1st to 29·30 inches on the 30th.

The highest reading of the thermometer in the shade was 74°, which was recorded on the 11th and 12th, and on other five occasions the thermometer was at or above 70°. The averages for the month were—maximum 65° and minimum 49°, while in 1899 these were 69° and 50° respectively.

The genial warmth and frequent showers of the month gave an impetus to vegetation, and there was a strong growth on trees and shrubs, as well as a superabundance on grass lawns. Newly-planted stuff made an excellent start and rapid progress, whilst there was a development and freshness of foliage on the trees in our City Parks above the usual average. The hawthorns came into bloom during the first week, but they, like the rhododendrons, were much below the average in floriferousness.

July.—The first days of the month were somewhat dull and changeable, and on the 3rd rain, accompanied by thunder, was experienced. For the succeeding fortnight the weather was more settled, but with occasional showers. On the 12th the weather was again broken, and the outlook for the holiday-makers was not particularly bright. With a heavy rainfall on the night of the 16th the atmospheric conditions improved, and continued generally fine till the close.

The rainfall of the month (3·03 inches) was moderate, and there were 11 dry days.

The thermometer in the shade was at or above 70° on nine occasions, and the average maximum and minimum temperatures were 67° and 54° respectively, while in 1899 these figures were 68° and 53°.

On the 1st the barometer indicated the atmospheric pressure at 29·20 inches, being the lowest of the month; for the succeeding few days it rose sharply, and on the 7th and 8th the reading was 30·00 inches, and continued steady at about 29·80 inches through the rest of the month.

With a fair amount of moisture during the month vegetation made good progress, though bedding plants, owing to the want of bright sunshine, did not make so good a show of bloom as formerly, but the foliage on plants and trees bore a fine dark, green appearance.

August.—August opened with a day of rain and strong wind, and the first week of the month was showery. On the 6th rain fell in torrents, and a thunderstorm passed over the city. The amount of rain registered for these twenty-four hours was 1·17 inches. On the 13th the thermometer began to rise considerably, and there followed a number of days of bright and warm weather. On the 19th the weather again became showery, and on the 23rd some hail showers fell. The closing days of the month were dry but cold, with a prevailing east wind.

The atmospheric pressure during the month was rather lower than the average. Only on two occasions did it rise above 30·00 inches—once about the middle and once at the end of the month—the lowest readings being 29·20 inches, happening on the 7th and on the 22nd. The direction of the wind varied a good deal, but on 10 days it blew from the east.

With the exception of one or two days during the month, when the thermometer rose above 70°, the temperature was moderate. The maximum thermometer in shade was at or above 70° on 5 occasions, and at or below 60° on 12 occasions. The average temperatures were lower than the preceding August by 7° and 3° respectively, the figures for 1900 being—maximum 62° and minimum 50°.

The rainfall of the month was 4·36 inches, and there were 16 dry days.

The moist weather of the month tended to keep vegetation fresh and bright, though for want of sunshine flowering plants did not come up to the usual standard.

September.—Throughout this month the weather was of a pleasanter character than that of the previous month. The wind, except on one day, was from the south-west, and, though strong at times, was mild and refreshing, and there were longer periods of dry weather. The rainfall registered at Queen's Park was 3·70 inches, and there were 18 dry days. On two days of the month over half an inch of rain fell, namely, 0·84 inch on the 27th, and 0·70 inch on the 30th.

The barometer readings show a higher range than usual. During the first half of the month the pressure varied between 29·75 inches and 30·30 inches; for the second half the range was lower, from 30·00 inches on the 21st to 29·00 inches on the 27th.

The average temperatures for the month were—maximum 61° and minimum 47°, and higher than in 1899, which for the same month were 59° and 46° respectively.

The fine weather of the first part of the month improved the flower beds in the parks, and the effect was bright and pleasing. Dahlias and chrysanthemums were in full bloom by the middle of the month, and many deciduous trees rapidly became divested of their leaves, especially elms, limes, and sycamores.

October.—For the first fortnight the weather was very rainy and unsettled, with, as a rule, fine dry forenoons, which usually gave way in the afternoons to rain or hail. The temperature during this period was high considering the season, but on the 15th the atmosphere became much colder, and for two days the weather was bright and frosty, with a keen snell wind, which suggested the approach of winter. On the 17th a sudden change again took place in the atmospheric conditions, when the barometer fell sharply, and heavy rain came down. During the forenoon of this day a dense blackness overspread the city. Throughout the later part of the month the weather was brighter, though there were few dry days.

The pressure of the atmosphere as shown by the barometer was moderate and comparatively steady till the 17th, when it rose from 29·40 inches to 30·00 inches on the 19th, and for five days the readings were above 30·00 inches. On the 24th the pressure decreased, and on the 26th the reading was 29·00 inches.

For the month the rainfall amounted to 5·05 inches, and there were only ten days on which rain was not recorded.

Frost to the extent of 5° was registered on one morning, and on one other occasion only did the thermometer fall to freezing point (32°). The average maximum temperature was 51° and the average minimum 40°, the maximum being 3° lower and the minimum the same as in the corresponding month of last year.

The sharp touch of frost experienced on the 16th was sufficient to bring to a close for the season most of the outside flowers, Chrysanthemums alone withstanding the cold, and at the end of the month were still giving a little brightness to the flower beds. The grass was also green and fresh, though most of the deciduous trees had divested themselves of foliage.

November.—This was a month of mild and wet weather. For the first 17 days only two days were dry, and the amount of rain which had fallen during that time measured over 5 inches

On the 18th the thermometer fell considerably, and 4° of frost was registered at Queen's Park on that morning. On the next day the frost increased, and was accompanied by a black dismal fog, which hung over the city for two days. The spell of frost broke up on the 23rd, and the atmospheric conditions again became mild and wet.

Throughout the month there were only 9 dry days, and the amount of the rain which had fallen measured 6·20 inches.

The range of the barometer was wide, and had some sharp changes. On the 2nd it was at 29·90 inches, from which it fell steadily to 29·10 inches on the 7th. From 28·90 inches on the 15th it rose sharply to 30·20 inches on the 18th and 19th, and falling again to 29·10 inches on the 25th.

Frost to the amount of 21° was registered on five mornings. The average maximum temperature was 46° and the average minimum 38°, as against 49° and 40° respectively for the corresponding month of last year.

December.—The protracted spell of wet weather prevailing last month continued throughout December, and on only three days out of the 31 was no rain recorded. Until the 7th the weather conditions were dull and depressing, but on this date the weather improved a little, being dry and mild. On the 8th rain again prevailed, and was accompanied by a strong wind from the south-west. These atmospheric conditions obtained till the 20th, when the wind greatly increased in force, and a severe gale raged for several hours between the 20th and the 21st, the worst experienced in this part of the country for a number of years, causing much damage to property, and considerable loss of life in the city and throughout the country. Christmas day was dull and damp, and the closing days of the year were likewise dull and unseasonably mild.

The rainfall for the month amounted to 7·71 inches, and is the greatest monthly total since February of 1894, when the total for that month was 8·96 inches.

As showing the unseasonable mildness of the month, no frost was recorded at Queen's Park, and the thermometer fell to freezing point (32°) on only one occasion. The average maximum and minimum temperatures of the month were 47° and 40° respectively, while these for December 1899 were 39° and 30°.

For the first three weeks of the month the barometer readings show no especially sharp changes, but on the 21st, the day of the great gale, the atmospheric pressure was indicated at 28·90 inches. On the 28th it dropped from 29·20 inches to 28·50 inches on the 29th, this being the lowest reading of the year.

The effect of the abnormal mildness was seen by the condition of the grass, which was bright and green. The buds on some forms of hawthorns swelled nearly to bursting, and roses made fresh growth; the Japanese species, *Rosa rugosa*, being as precocious as any of its congeners. *Jasminum nudiflorum*, which began to open its blooms during November, was in many cases in fine flower during the month.

With regard to the rainfall of 1900, it may be noted that the total amount registered for the year, 46·46 inches, is greatly in excess of the yearly records for the last twelve years. The next highest yearly record is that of 1899, when 41·67 inches were registered. The number of dry days during the year was 164, while in 1899 there were 193 dry days, and the lowest for the twelve preceding years was in 1890, which had 170 dry days. A striking contrast, and as showing the period during which the rainfall of 1900 exceeded that of the preceding year, is the total for the last three months of the year. The amount registered in 1899 for this period was 12·15 inches, and for the same period of 1900, 18·96 inches. The heaviest rainfall for one day in 1900 was 1·42 inches on the 25th of June, while in 1899 the heaviest daily rainfall was 1·50 inches on the 18th of May. The wettest month of the year was December, with a total of 7·71 inches. In the preceding year the wettest month was also December, which had 5·64 inches. The driest month of 1900 was March, with the month of 1899 with total of 0·28 inch, August being the driest exceptionally small 1·38 inches.

As already stated, these notes are based on records taken at Queen's Park, but the following table of the rainfall recorded in the other Parks, &c., where gauges have been placed, show interesting points of comparison; due allowance being made for the altitude, exposure, and other local conditions, as in no case are they alike:—

RAINFALL DURING 1900 IN THE PUBLIC PARKS.

	Queen's.	Max-well.	Kelvin-grove.	Spring-burn.	Alex-andra.	Glasgow Green.	Bella-houston.	Toll-cross.	George Square.
Height of Gauge above Sea-level.	145 ft.	69·1 ft.	48·3 ft.	361 ft.	141·4ft.	34·7 ft.	160 ft.	85 ft.	40 ft.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January, -	5·08	5·34	4·52	4·47	4·56	4·94	4·25	5·54	4·63
February, -	2·68	1·72	2·95	2·28	2·90	2·86	2·60	2·48	2·63
March, - -	0·28	0·28	0·51	0·42	0·65	0·63	0·30	0·57	0·49
April, - -	2·14	2·27	2·08	2·27	1·68	1·88	1·95	2·02	1·78
May, - - -	2·19	2·20	2·11	2·02	1·97	2·25	2·07	2·34	2·05
June, - - -	4·04	3·88	2·75	3·32	3·67	3·76	3·48	4·30	3·26
July, - - -	3·03	3·05	2·87	2·69	3·16	3·30	3·01	3·54	3·32
August, - -	4·36	4·37	4·75	3·99	4·02	5·33	4·21	4·59	4·85
September, -	3·70	3·70	3·50	3·69	3·05	3·37	3·61	3·26	3·59
October, - -	5·05	4·80	4·92	4·86	4·42	4·57	4·74	4·92	4·75
November, -	6·20	6·23	5·70	5·56	5·67	6·35	6·02	6·46	6·53
December, -	7·71	8·03	7·18	6·50	5·97	7·05	6·43	7·26	7·42
Totals, -	46·46	45·87	43·84	42·07	41·72	46·29	42·67	47·28	45·30

In reference to the temperature, the mean (47°) is the same as that of the preceding year. Although the amount of frost for the year is considerably less than that of 1899, the absence of any prolonged period of heat during the summer goes to make up the balance. The highest reading of the thermometer in the shade was 75° on the 15th of August, which is 5° lower than the highest reading of 1899. The thermometer was at or above 70° 7 days in June, 9 in July, 5 in August, or 21 times in all, as compared with 35 times in 1899.

The lowest reading of the thermometer was on the 11th February, when the minimum thermometer fell to 9°, or 23° of frost. The amount of frost registered throughout the year was 326°, occurring on 57 days, and the coldest month was February, with 189° of frost registered on 19 mornings. In 1899 December was the coldest month, and the total amount of frost for the year was 415 on 64 mornings. The coldest day was 15th December, when the thermometer touched 15°-17° of frost.

The following comparative table of records taken at different Parks, &c., is of interest. As in the case of the preceding table allowance must be made for local conditions :—

1900.	Queen's Park.	Maxwell Park.	Kelvingrove Park.	Springburn Park.	Alexandra Park.	Glasgow Green.	Bellahouston Park.	Tollcross Park.	George Square.
Thermometer (in shade, 4 feet above ground level).									
Highest reading of year, ...	75°, 15th Aug.	87°, 17th July	81°, 15th Aug.	83°, 16th Aug.	77°, 16th and 17th Aug.	85°, 11th July	78°, 11th June, 20th July, and 17th Aug.	82°, 16th Aug.	80°, 16th Aug.
Lowest do. do.,	9°, 11th Feb.	3° below zero, 10th, 11th and 12th Feb.	10°, 11th Feb.	7°, 12th Feb.	4°, 11th Feb.	3°, 11th Feb.	9°, 12th Feb.	3°, 11th Feb.	18°, 12th Feb.
Number of days on which thermometer fell to freezing point (32°), ...	64 days	140 days	58 days	84 days	116 days	122 days	72 days	95 days	43 days
Number of days on which thermometer did not rise above freezing point (32°),	5 days	11 days	5 days	4 days	7 days	9 days	5 days	5 days	4 days
Degrees of Frost registered—									
January, ...	12° on 5 days	90° on 21 days	16° on 6 days	10° on 6 days	79° on 19 days	84° on 21 days	24° on 11 days	41° on 14 days	...
February, ...	189 " 19 "	320 " 22 "	147 " 16 "	191 " 18 "	257 " 24 "	298 " 24 "	181 " 19 "	247 " 18 "	92° on 15 days
March, ...	83 " 20 "	181 " 25 "	64 " 16 "	118 " 19 "	148 " 23 "	162 " 24 "	84 " 19 "	104 " 22 "	34 " 13 "
April, ...	14 " 6 "	62 " 10 "	8 " 4 "	20 " 6 "	47 " 9 "	42 " 9 "	13 " 5 "	28 " 8 "	...
May, ...	2 " 1 day	16 " 3 "	...	...	10 " 4 "	2 " 2 "	...	6 " 2 "	...
June, ...	...	...	...	...	...	...	...	...	...
July, ...	...	...	...	...	...	...	...	...	...
August, ...	...	...	...	...	...	...	..	...	...
September, ...	...	4° on 1 day	...	...	...	1° on 1 day	...	1° on 1 day	...
October, ...	5° on 1 day	58 " 13 days	2° on 1 day	17° on 5 days	22° on 7 days	25 " 9 days	10° on 2 days	16 " 6 days	...
November, ...	21 " 5 days	75 " 11 "	14 " 4 days	42 " 8 "	47 " 9 "	54 " 10 "	25 " 6 "	37 " 8 "	2° on 1 day
December, ...	...	23 " 7 "	...	4 " 2 "	6 " 1 day	9 " 6 "	1 " 1 day	4 " 2 "	...
Total Frost registered,	326° on 57 days	829° on 113 days	251° on 47 days	402° on 64 days	616° on 96 days	677° on 106 days	338° on 63 days	484° on 81 days	128° on 29 days

In comparing the barometer records with those of the previous year we find that the atmospheric pressure generally has been lower than that of previous years. In 1899 the pressure was over 30·00 inches on 82 days, and under 29·00 inches on 24 days, whilst during 1900 it was only 50 days above 30·00 inches and 8 days below 29·00 inches. The highest reading taken during 1900 was 30·38 inches on the 14th March, and the lowest (28·40 inches) was taken on the 19th February. In 1899 the highest was 30·42 inches on 17th November, and the lowest (28·26) on 30th December.

The points from which the wind blew throughout the year were as follows:—From the south-west, 258; from the north-east, 30; from the west, 17; from the east, 6; from the south, 3; from the north-west, 15; and from the south-east, 36 days. Excluding the direct north and south, the western group shows 290 and the eastern 72 days. In 1899 the western had 255, and the eastern 102 days.

In reviewing the weather of 1900 many interesting features are witnessed. It began as it ended—unseasonably mild and moist. January was very changeable and unsettled, with a preponderance of high temperatures. February and March, on the other hand, were distinctly cold months. Since the break up of this cold spell, and with the exception of some cold days in May, there was no unpleasant reduction of temperature. As early as April there were some very warm days, but perhaps the most notable feature of the weather of 1900 was the abnormal rainfall, especially during the last three months of the year.

In regard to the general effect on vegetation, speaking broadly, the atmospheric conditions which obtained during 1900 were, on the whole, favourable.

After the sharp frosts in February, which rudely checked the unseasonable advance made by certain deciduous plants and seriously damaged many classes of evergreens, there was an absence of severe late spring frosts, consequently the growth, though somewhat slow and late, was satisfactory. In many cases the development of shoot and leaf was better than it has been for a series of years. The paucity of bloom displayed by evergreens can be accounted for by the abnormal mildness and excessive wetness of the late autumn months, which induced a tendency to secondary growth, which is fatal to the satisfactory setting of flower buds. In the case of rhododendrons the amount of arrested or imperfect development of flower buds was very marked. In regard to deciduous plants there was more diversity and irregularity than usual. Why there should be a prodigality of bloom on most of the prunus, laburnums, cherries, and wiegelas, and such a meagre display on most forms of pyrus, chestnut, lilacs, and hawthorns, is one of those features which are decidedly puzzling to those who attempt to correlate the cause and effect of weather on vegetation. That the conditions generally were of an unsatisfactory nature was evidenced by the irregular and meagre crops which were borne by most forms of deciduous trees, as even those which bore a fine display of bloom did not by any means set and carry heavy crops of fruit. In regard to annual vegetation, while cereals were an average in straw and grain, great difficulty was experienced in harvesting these in a satisfactory state, owing to the continuance of inclement weather. Turnips improved towards the end of the season, and the crops were better than was at first anticipated. The dearth of sunshine, combined with the excessive rainfall, seriously affected the potato crop, which was below average in quantity and quality, while in some cases, when planted late on heavy soils, the crop was not worth lifting. There was a superabundance of grass throughout the season, and pasturage at the end of the year was unusually fresh and green.

Regarding the prospects for the coming year, deciduous trees generally are in good condition, and, given congenial weather, there is every prospect of an excellent display of bloom. It is different, however, with most evergreens, which, owing to the superabundance of moisture and abnormally mild weather, are surcharged with sap, and ill-fitted to withstand a serious lowering of temperature, or a long spell of dry, cutting winds. It is to be hoped they will escape the ordeal they passed through in the spring of 1900, which, though of short duration, left them sadly crippled. The difficulty in getting evergreen shrubs to thrive in our city yearly increases; therefore, when the vitality of the plants is lowered by such natural accidents as severe frosts, there is small chance of them regaining vigour where the conditions, such as obtain in a busy, manufacturing centre, are decidedly unnatural, and when coupled with a heavy clay soil, through which water percolates slowly, certainly unfavourable for quick, healthy development, and ability to withstand severe and abnormal atmospheric changes.

Subjoined is the meteorological record for the past three years as kept at Queen's Park, and the averages for the last twelve years.

COPY OF METEOROLOGICAL RECORD KEPT AT QUEEN'S PARK, GLASGOW.

RAIN GAUGE 145 FEET ABOVE SEA LEVEL.

MONTHS.	1898.				1899.				1900.				Averages for the Last 12 Years.					
	Rainfall.	Thermo-meter.		Dry Days.	Rainfall.	Thermo-meter.		Dry Days.	Rainfall.	Thermo-meter.		Dry Days.	Years.	Rainfall.	Mean Temperature.	Dry Days.	Number of Days on which 1° or more of Frost was registered.	Degrees of Frost registered.
		Average.				Average.				Average.								
	Inches.	Max.	Min.		Inches.	Max.	Min.		Inches.	Max.	Min.			Inches.				
January,	2·42	47	39	18	5·61	40	32	13	5·08	43	35	4	1889	26·18	47	194	59	250
February,	3·52	44	32	11	1·84	43	32	20	2·68	38	26	20	1890	38·04	47	170	74	273
March, ...	1·65	46	34	19	3·18	46	35	21	0·28	44	31	27	1891	36·09	46	184	85	371
April, ...	1·65	55	41	21	4·11	52	37	14	2·14	55	38	16	1892	33·84	45	194	101	798
May, ...	2·04	58	40	22	4·45	54	40	18	2·19	58	42	17	1893	33·05	47	186	56	306
June, ...	1·98	64	48	18	1·55	69	50	22	4·04	65	49	13	1894	41·48	46	169	55	256
July, ...	1·46	67	49	24	3·69	68	53	16	3·03	67	54	11	1895	27·57	45	202	99	823
August,...	4·77	65	51	15	1·38	69	53	23	4·36	62	50	16	1896	33·90	47	209	63	331
September,	3·99	63	48	15	3·71	59	46	5	3·70	61	47	18	1897	40·22	46	205	61	347
October,	3·97	54	46	20	3·57	54	40	15	5·05	51	40	10	1898	38·44	48	212	42	190
November,	4·67	46	37	18	5·64	51	42	10	6·20	46	38	9	1899	41·67	47	193	64	415
December,	6·32	48	40	11	2·94	39	30	16	7·71	47	41	3	1900	46·46	47	164	57	326
	38·44			212	41·67			193	46·46			164	Averages.	36·41	46°	190	68	390°

Additions to the List of Scottish Coleoptera.

By Anderson Fergusson.

[Read 25th June, 1901.]

In compiling the list of Coleoptera of Clyde for the Handbook to be issued on the occasion of the meeting of the British Association at Glasgow in September, I found in the material which passed through my hands a number of species which appeared to be new to Scotland. These species are included in the list of Clyde Coleoptera, but I have thought it advisable to put them on record separately, and accordingly I append a list of them hereto. Strictly speaking all the species in the appended list are not new to Scotland, as some of them were recorded previous to the publication of Dr. Sharp's "Coleoptera of Scotland" (*Scottish Naturalist*, 1871-81); but Dr. Sharp evidently was doubtful of the authenticity of these previous records, and the species to which they referred were either excluded from his list altogether, or only included within square brackets as requiring confirmation. Their occurrence in the Clyde area now confirms these doubtful records and gives the species a secure place on the Scottish list. So far as I can ascertain none of the beetles in the following list have been recorded from Scotland since the completion of Dr. Sharp's list.

I am indebted to the gentlemen whose names are mentioned below for permission to record their captures.

I have to thank the Rev. Alfred Thornley, F.L.S., the Rev. H. S. Gorham, F.Z.S., and Mr. G. C. Champion, F.Z.S., for their kindness in confirming my identification of some of the following species and identifying others for me.

The nomenclature followed is that of Sharp and Fowler's "Catalogue of British Coleoptera," 1893.

Leistus spinibarbis, F.—I have received a specimen of this fine species from Mr. John Dunsmore, of Paisley, and there is another in the collection of Mr. Robert Eden, of the same city. Mr. Dunsmore and Mr. Eden inform me that they take it sparingly in a wood near Paisley.

Badister sodalis, Duft.—In Wilson and Duncan's "Entomologia Edinensis" (1834) this species is stated to have been taken by Dr. Leach at Loch Awe. This record is repeated in Murray's "Catalogue of the Coleoptera of Scotland" (1853). Dr. Sharp, however, in his list placed the species within square brackets, and remarked, "Doubtful as Scottish. 'Loch Awe, Dr. Leach' (Ent. Edin.). I am nearly certain this is an error." A single specimen (which has been shown to the Rev. Mr. Thornley) was taken by Mr. Andrew Adie Dalglish, F.E.S., by shaking moss near Barr, South Ayrshire, in April, 1900. Although Mr. Dalglish and I searched the locality thoroughly we could not find any further specimens.

Bembidium affine, Steph.—Although this pretty species was recorded as occurring near Glasgow in 1860, by A. and M. Soloman (*Entomologist's Weekly Intelligencer*, ix., 52), it was not included in Dr. Sharp's list. It had even earlier than this, in 1858 and 1859, been taken in the Glasgow district by the Rev. J. E. Somerville, B.D., F.S.A.Scot. More recently Mr. Dalglish has taken it sparingly at Giffnock and Mr. Dunsmore near Paisley.

Cercyon depressus, Steph.—A single specimen of this species was taken by Mr. Dalglish under decaying seaweed on the shore at Barassie, in June, 1899. The specimen has been submitted to the Rev. Mr. Thornley and Mr. Champion.

Gyrophæna pulchella, Heer.—At an excursion of the Society to Drymen, in September, 1900, I took several examples of this rare *Gyrophæna* in a decaying fungus in the policies of Buchanan Castle. Canon Fowler ("Coleoptera of the British Islands," ii., 155) states that "the species was first introduced as British by Dr. Power, and has only occurred in the London district." The Rev. Mr. Thornley and Mr. Champion have examined specimens.

Tachyporus formosus, Matth. I found an immature *Tachyporus*, which the Rev. H. S. Gorham assigns to this species, in tidal refuse at Ayr in 1894. The records for this species in Fowler (*l.c.*, ii., 195) are confined to the South of England.

Cryptophagus distinguendus, Sturm. — I took one example amongst refuse on the margin of a pond at Bishopton in March, 1900.

Phyllotreta sinuata, Steph.—Mr. Dalglish obtained this species by sweeping at Luss in June, 1900.

Crepidodera aurata, Marsh.—One example was swept by Mr. Dalglish at Bonhill, in July, 1900.

Rhynchites nanus, Payk.—Murray, in his "Catalogue of the Coleoptera of Scotland," gave Penmanshiel Wood, Berwickshire, and Raehills as localities for this species, and the late Mr. Robert Hislop also recorded it from the outskirts of Forres (*Entomologist's Monthly Magazine*, vii. (1870-71), 11); but Dr. Sharp placed it within square brackets in his list, and stated that he had never seen a Scottish individual of the species, and that he thought it very probable that the specimens should rather be referred to *R. uncinatus*, Thoms. Examples of *R. nanus*, which have been examined by the Rev. Alfred Thornley, were taken last summer by Mr. Eden near Paisley, and by Mr. Dalglish at Bishopton.

Balaninus villosus, F.—One specimen of this fine weevil was taken by the Rev. Mr. Somerville on the north side of the Holy Loch in 1860.

Notes on the Marine Deposits of the Firth of Forth, and their Relation to its Animal Life.

By F. G. PEARCEY, Naturalist to the Fishery Board for Scotland.

[Read 27th August, 1901.]

IN 1898 I was enabled to examine the deposits at present forming the floor of the Firth of Forth, and especially those found in the areas of the stations laid down for special observations by the Fishery Board for Scotland.

The Firth of Forth may be taken as extending from Alloa to the Isle of May. From Grangemouth to near Queensferry it measures 1½ miles in breadth, with a depth of less than 10 fathoms. At Queensferry it contracts to 1 mile, and the depth increases over a small area near by to 40 fathoms, but diminishes afterwards. From Queensferry the breadth increases again to 5 miles at Leith, and to 16 at Musselburgh. The firth again contracts to 8 miles between Fidra and Chapel Ness, after which it again widens to 18 miles across, where it merges with the North Sea at the May Island.

A short tract of 10 fathoms, known as the narrow deep, lies to the south of Inchkeith, and a few miles to the north-east of that island the 20-fathom area begins, tending north-eastwards, and spreading out off Largo towards both shores till quite close up to the May Island. The Isle of May is connected to the mainland of Fife by a submarine plateau, rising to within 20 fathoms from the surface, and a few miles to the eastward of it depths of over 30 fathoms commence.

The mean depth of the whole firth is 14 fathoms, the deepest water found where deposits were obtained and examined, at Station IX., is 35 fathoms.

The greatest extent of shallow water ranges from Leith to North Berwick along the south shore, across Aberlady Bay, on the south side, and from Kirkcaldy close along Largo Bay, off the coast, to Fife Ness, on the north side.

From Queensferry to Alloa the deposits cannot, in the true sense of the term, be classed among the marine deposits, as this area is for the most part formed of or covered by mud flats derived almost wholly from material deposited and brought there by the influence of the River Forth itself, and are therefore not taken into account in describing the deposits.

From Queensferry to Inchkeith the deposits consist for the most part of dark sandy muds in the North Channel. Drum Sands and Flats, as the name indicates, are made up of sandy and shelly muds, merging into pure sands, between Hound Point and Cramond Island; those on the middle bank comprise muddy sands to pure sands, and sand, gravel, and shells. In Leith Roads the deposits are made up of sandy mud to brown unctuous mud, which again gradually merges off into sandy muds and sand, as the water shallows, south of the south channel.

Nine stations have been laid down on the chart by the Fishery Board for special observations, over which zoological, physical, and other work has been carried on from time to time. As these stations are fairly well distributed, the deposits found at each station may be taken as typical examples of the district in question. I consider it as important, therefore, not only to give a detailed description of the deposits from each of these stations, but also lists of the animals obtained, so as more fully to ascertain what bearing, if any, the deposits, and their condition as we now find them, have upon the "Benthos" (animals that live on the bottom), the movements of the fish and their food supply, the results of which will be found in the following pages.

These stations, with the exception of VIII. and IX., which lie a little to the south-east of the Isle of May, are all situated between Inchkeith and the May Island, their positions are given in the following table, but may be better understood by reference to the accompanying chart on which they are represented :—

No. of Station.	Locality.	Length in Miles.	Position of each End of Station.	Depth in Fathoms.	Nature of Deposits.
I.	East of Inchkeith.	4	*West End.*—Inchkeith Lighthouse bearing W. ½ S., and Long Craig, S. by W. ½ W., 1 mile. *East End.*—Wemyss Castle, N.N.W., Inchkeith Lighthouse, W. by S., 5 miles.	10 to 18	*Sandy Mud* and dead *Shells*, mottled blue-grey and brown with coal ash and clinker.
II.	North Bay of West Wemyss.	3½	*West End.*—Dysart Pier-head, N.W. by W., and Wemyss Castle, N.N.W., 2 miles. *East End.*—Buckhaven Pier-head, N.W., and Methil Pier-head, N. ½ W., 2½ miles.	10 to 15½	*Muddy Sand*, grey-brown, with coal ash and clinkers.
III.	East of Inchkeith.	7	*West End.*—Inchkeith Lighthouse, W. by N. ½ N., and Leith West Pier-head, W.S.W., 4¼ miles. *East End.*—Gullane Ness Point, S. by E., and Eyebrough Rock, E. ½ S.	7½ to 10	*Sandy Mud* and dead *Shells*, with coal ash and clinkers.
IV.	South Bay.	6½	*West End.*—Portobello Pier-head, W.S.W., and Fisherrow Pier-head, S. ½ W., 2 miles. *East End.*—Gullane Ness Point, E.S.E., and West Point, Aberlady, S. by E., 1¾ miles.	5 to 9	*Blue-grey Sandy Mud*, with dead shells, stones, coal ash, and clinkers.
V.	West of the Isle of May.	4¾	*West End.*—Craigleith, S. by W. ½ W., and May Island Lighthouse, E., 6½ miles. *East End.*—May Island, South Ness, E. by S. ¼ S., and May Island, North Ness, E. by N., 1¾ miles.	20 to 30	*Dark brown Mud.*

No. of Station.	Locality.	Length in Miles.	Position of each End of Station.	Depth in Fathoms.	Nature of Deposits.
VI.	Off St. Monance and Pittenweem (Fluke Hole).	$1\frac{3}{4}$	*West End.*—St. Monance Pier-head, N. by E. easterly, and Pittenweem Pier-head, N.E. $\frac{1}{2}$ E., $2\frac{1}{4}$ miles. *East End.*—St. Monance Pier-head, N.W. $\frac{1}{4}$ W., and Pittenweem Pier-head, N. $\frac{1}{2}$ W., $1\frac{1}{2}$ miles.	13 to 16	*Shell Sand.*
VII.	Off and between the Bass Rock and Fidra.	$4\frac{1}{2}$	*West End.*—Fidra Lighthouse, S.S.W., and Lamb Island, S.E. $\frac{1}{4}$ S., $1\frac{1}{2}$ miles. *East End.*—North cheek of Bass Rock, S.E. by E. $\frac{1}{4}$ E., and Tantallon Castle, S. by W. $\frac{1}{4}$ W., $1\frac{3}{4}$ miles.	12 to 17	*Blue-grey Sandy Mud* and *Sand*, with coal ash and clinker.
VIII.	Four miles south of the May Island.	$4\frac{3}{4}$ full	*South-West End.*—North cheek of Bass Rock, W. by N. $\frac{1}{4}$ N., and South Car Beacon, S.W. $\frac{3}{4}$ W., $1\frac{3}{4}$ miles full. *North-East End.*—North cheek of Bass Rock, W. by S., and May Island Lighthouse, N. by W., $3\frac{3}{4}$ miles.	$21\frac{1}{2}$ to 30	Dark brown *Sandy Mud* at north-east end; *Brown Sand* at south-west end.
IX.	Five to ten miles south-east of the May Island.	5	*South-East End.*—Dunbar Pier-head, W. by S. $\frac{1}{4}$ S., and May Island Lighthouse, N.W. $\frac{1}{2}$ N., $10\frac{3}{4}$ miles. *North-West End.*—May Island Lighthouse, N.W. by N., and Dunbar Pier-head, S.W. $\frac{1}{4}$ S., $8\frac{1}{4}$ miles.	29 to 35	*Bluish-grey* homogeneous *Mud* or ooze.

At several points over the area of each of these stations, besides numerous points outside these areas, samples of the deposits were obtained by sounding tube or dredge. In many cases fully one hundredweight of the deposit came up, which was submitted to careful washing on the spot through sieves of various material and size of mesh; all the animals noted and preserved, as also those taken by the beam trawl and tow-nets; the microscopical organisms collected and preserved for further examination, while good typical examples of the deposits, were carefully preserved and brought on shore for detailed examination and microscopical analysis. This work, which required a considerable amount of time and careful manipulation, has been accomplished by myself from time to time, as circumstances would permit.

The methods employed in the examination of these deposits are the same as those applied by Messrs. Murray and Ronard in describing the marine deposits obtained during the "Challenger" Expedition. The carbonate of calcium was determined by estimating the carbonic acid, weak and cold hydrochloric acid being used for the purpose. The part insoluble in the acid is designated residue, which, by washing, decantation, and microscopical inspection, is separated into three parts—(*a*) *Minerals*, the contraction m. di., indicating the mean diameter in millimetres; (*b*) *Siliceous organisms*, including the casts of Foraminifera and other calcareous organisms; (*c*) *Fine washings*, including those particles which, resting in suspension, pass off with the first decantations.

The numbers in brackets (20·00 per cent.) indicate the percentage of $CaCo_3$ of the whole sample.

Classification and General Character of the Deposits of the Firth of Forth.

The deposits found in the area under consideration come under the classification of shallow-water terrigenous deposits*, and are, as would be expected, of a true terrigenous character. They are mainly made up of the *débris* derived from the general disintegration of the land along the shores of the estuary and coast of the firth, from land drainage, and by solid matter borne

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* After Messrs. Murray and Ronard.

down by currents from the River Forth, in suspension, the former, however, being the chief factor from which these deposits owe their origin.

They consist for the most part of blue-grey or brown plastic sandy muds, of fine grain; along the north channel to the May Island these merge into brown sandy mud, with dead shells or shell sand, to siliceous sands, and from these to sand and stones, shingle or rock fragments, the latter forms being found in depths less than 10 fathoms, in and off bays, close inshore along the coast to the low-water mark. A well-marked reach of dark grey and brown unctuous mud extends from within four miles east of Inchkeith, spreading out north and south, funnel shaped, to within a short distance of the May Island, varying in depths from 20 to 30 fathoms. About a mile further east it merges into the grey muds or oozes of the North Sea, coloured grey on the reference chart.

On the north and south side of this area we find sandy muds, with dead shells, predominating, especially over the area of Stations I. and III.; from 18 to 10 fathoms they become more mixed and sandy, while between 10 and 5 fathoms and less they emerge into siliceous sands, with stones and rock fragments. At one or two localities, especially off St. Monance, Station VI., in 10 to 18 fathoms, we find a more or less pure shell sand, containing from 30 to 70 per cent. of carbonate of lime (see reference chart). It should be noted that coal, coal ash, and clinkers have been taken, in more or less quantities, in all the deposits examined from the Firth of Forth.

Summary of the Deposits.

The deposits obtained at Stations I. and III. are similar in composition, and to them the name "*Turritella Mud*" might appropriately be applied, on account of the great number of the dead shells of the genus bearing that name it contains, and and from which the high percentage of $CaCo_3$ is chiefly due.

A thin surface layer of brown fine argillaceous matter, in which the *Turritella* lay imbedded, is of a recent formation, and a striking feature over the whole floor of the firth, like in composition to a river mud, derived partly from material carried down from the River Forth and partly from matter thrown over from harbour dredgers, which are constantly at this work. The deposit beneath this again has more the character of an ordinary shallow-water marine deposit.

At Station II. the deposit was found to be similar in composition to that at Stations I. and III., with the exception that the dead *Turritella* shells and other organisms are rare in comparison. The deposit taken at Station IV. is more of a transitional character than those found at Stations I. to III. Over the area of Station IV. we pass through patches of a siliceous sand, which again merges into grey sandy mud and shells or dark-blue mud, similar to those obtained in and along the South Bay, till within the 5-fathom line. Mixed with these deposits was obtained at times masses of a blue plastic clay corresponding to material taken from the new dock workings in course of construction at Leith and deposited here by the harbour dredgers, all of which tend in no small measure to obliterate the animal life at the bottom.

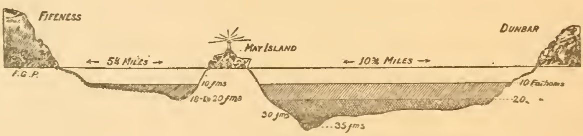
At Station V. a dark-brown or grey homogenous mud of fine grain is found, which stretches over a considerable area inside the 20-fathom line to within a short distance of the May Island. Many soundings were taken in this locality, all showing the brown surface layer of river mud.

At Station VI. a typical shell sand was found, and the Mollusca, Foraminifera, and other animal remains which make up the bulk of this deposit are of interest. The majority of these are seen to be more or less infiltrated with a ferruginous-like substance, and are for the most part of a deep ferric brown—some are brown, pinkish, or white, and many of a greenish-grey colour; in some crystallization has taken place, and the majority of the material which forms this deposit, when treated with cold dilute hydrochloric acid, leaves beautiful and perfect casts of the Foraminifera and many of the other organisms, which, however, are very friable. This appears to be due to some chemical combination, which has most probably taken place inside the organisms themselves, and which I have not yet been able to determine, a feature not uncommon in many marine deposits, more especially in tropical and sub-tropical regions, where in some localities it plays an important part in forming phosphatic and other conglomerations on the sea floor; it is therefore of considerable interest to have found a similar action going on in the Firth of Forth. This form of deposit, which often makes up extensive banks or reefs, can be traced for a considerable distance along the coast, till it passes off into siliceous sands, sandy muds, sand, mud, and shells, or ooze of the open sea, where life on the bottom is more prolific.

The deposits found over the areas of Stations VII. and VIII. may be taken as typical offshore transitional forms on account of their variation, for instance, at the west end of Station VII. and south-west end of Station VIII. a fine-grained, reddish-coloured siliceous sand is found, which gradually emerges into a homogenous plastic mud at points farthest from the coast line.

The deposits found at Station IX. consist of a typical marine shallow-water mud, although on its surface distinct traces of the brown, fine argillaceous material was observed, clearly demonstrating, which all my observations go to prove, how this deposit of fine mud is being laid down over the floor of the firth, diminishing gradually as the open sea is reached.

A marked feature in all the deposits examined by me between Inchkeith and the May Island is their impurity, the amount of detrital, decaying organic matter and dead remains of animals they contain. Marine life on the whole is found more abundant at Station VII., the deposit itself much cleaner and healthy looking than those found at Stations I. to VI. At Station VIII. the purity of the deposit and amount of life was found more striking (see lists of animals obtained at this station, and compare with others), and even more so at Station IX. where comparatively little foreign material was observed. It will also be observed that marine life was found to be more prolific at this station than at either of the others.



Section across mouth of the Firth of Forth through the Isle of May.

No. of Station.	Date.	Position.	Depth in Fathoms.	Temperature of the Sea Water (Fahr.). Surface.	Bottom.	Trans-parency. Faths.	Designation and Physical Characters.	Carbonate of Calcium Per Cent.	Foraminifera	Other Organisms	Per Cent.	
I.	1898. April 14,	One mile east of Inchkeith,	10 to 18	43·2	42·8	2	Mottled Blue-grey and Brown Sandy Mud, with dead shells, gritty, earthy, dries into hard, dark, greyish-brown lumps, which readily break up when placed into water. *Residue*—Dark brown.	20·00	(3·00 per cent.). Miliolina, Biloculina, Reophax, Trochammina, Haplophragmium, Textularia, Nodosaria, Lagena, Polymorphina, Truncatulina, Discorbina, Gypsina, Rotalia, Nonionina, Polystomella, chiefly dead shells.	(17·00 per cent.). Otoliths of Fish, Gasteropods, Lamellibranchs, Balanus, Serpula tubes, Polyzoa, fragments of Echinoderms, Ostracods.	80·00	(1·0 Cosm and spicul
II.	April 14,	North Bay of West Wemyss,	10 to 15½	43·3	43·1	2½	Muddy Sand, greyish brown, slightly coherent, dries into dark-brown friable lumps. *Residue*—Reddish brown.	10·00	(2·00 per cent.). Miliolina, Reophax, Haplophragmium, Textularia, Bolivina, Lagena, Polymorphina, Truncatulina, Globigerina, Discorbina, Gypsina, Rotalia, Polystomella, Nonionina, &c.	(8·00 per cent.). Fish otoliths, Gasteropods, Lamellibranchs, Serpula, Polyzoa, fragments of Echinoderms, Ostracods.	90·00	(1·0 as Rh Chæt Spon
III.	April 14,	East of Inchkeith,	7½ to 10	44·9	43·6	1½	Blue-grey Sandy Mud and shells, coherent, dries into grey-brown hard lumps, which do not readily break up in water. *Residue*—Dark brown.	20·00	(3·00 per cent.). Miliolina, Biloculina, Reophax, Haplophragmium, Textularia, Lagena, Polymorphina, Truncatulina, Discorbina, Gypsina, Rotalia, Polystomella, Nonionina.	(18·00 per cent.). Fish otoliths, Gasteropods, Lamellibranchs, Balanus, Serpula tubes, Polyzoa, Echinoderm fragments.	80·00	(1·0 as Co Pleur and o
IV.	April 15,	South Bay,	5 to 9	East end, 44·0 West end, 44·3	43·8 44·5	2¾ 2½	Blue-grey Sandy Mud, with dead shells, coherent, earthy, gritty, dries into dark-brown more or less friable lumps, which do not readily break down in water. *Residue*—Dark slate-brown.	10·00	(2·00 per cent.). Biloculina, Miliolina, Spiroloculina, Cornuspira, Trochammina, Textularidæ, Lageuidæ, Discorbina, Truncatulina, Rotalidæ, &c.	(8·00 per cent.). Fish otoliths, Gasteropods, Lamellibranch and Ostracod shells, fragments of Crustacean tests, Echinoderms, Serpula, and Polyzoa.	90·00	(1·0 as Cl Navi rella,
V.	April 14,	West of May Island,	20 to 30	42·9	42·4	3½	Dark-brown Mud, homogeneous, plastic, earthy, gritty, dries into brown coherent lumps, which break up with some difficulty in water. *Residue*—Dark reddish-brown.	5·00	(1·00 per cent.). The chief families of foraminifera are represented, but are on the whole very rare, and chiefly dead shells.	(4·00 per cent.). Fragments of Gasteropod and Lamellibranch shells, Ostracods, Serpula tubes, Polyzoa, Echinus, spines, and a few small Coccoliths.	95·00	(2·0 as C Chæt Rhizo spon
VI.	April 15,	Off St. Monance and Pittenweem (Floke Hole),	13 to 16	43·0 Middle of Station.	42·8	3	Shell Sand, with traces of mud sufficient to allow of the particles to hold together, forming small balls in a few instances. *Residue*—Yellowish brown.	60·00	(2·00 per cent.). Nubecularia, Biloculina, Miliolina, Cornuspira, Reophax, Haplophragmium, Textularidæ, Lagenidæ, Discorbina, Rotalidæ, Truncatulina, Planorbulina, &c.	(58·00 per cent.). Otoliths of fish, Gasteropod and Lamellibranch shells, fragments of Crustacean tests, Serpula tubes, Polyzoa, and Echinoderms, all more or less rounded.	40·00	(5·0 casts the r isms. discu spon
VII.	April 13,	Off and between Bass Rock and Fidra,	12½ to 17	East end, 43·4	43·00	2½	Blue-grey Sandy Mud, with shell fragments, more coherent in places than in others, plastic, gritty, dries into dark brown friable lumps, which readily break down in water. *Residue*—Dark brown.	10·00	(2·00 per cent.). Miliolina, Biloculina, Haplophragmium, Reophax, Trochammina, Textularia, Bulimina, Lagenidæ, Globigerinidæ, Rotalidæ, &c.	(8·00 per cent.). Fish otoliths, Gasteropods, Lamellibranchs, Ostracods, fragments of the tests of Crustaceans and Echinoderms, worm tubes, and Polyzoa.	90·00	(1·0 as Co Rhizo Spon
VII. West end,	„	„	12½	West end, 43·3	43·2	2½	Fine Reddish-brown Sand, with slight traces of mud.		Traces.		100·00	Tra discu
VIII. East end,	April 15,	Four miles south of the Isle of May,	30	43·5	43·4	3¾	Dark-brown Sandy Mud, greyish when wet, coherent, plastic, earthy, homogeneous, dries into friable light-brown lumps, fine grained, which are not difficult to break down in water. *Residue*—Bismuth brown.	5·00	(2·00 per cent.). Miliolina, Biloculina, Cornuspira, Haplophragmium, Reophax, Textularidæ, Lagenidæ, Globigerina, Discorbina, Rotalia, Truncatulina, &c.	(3·00 per cent.). Gasteropods, Lamellibranchs, Ostracods, fragments of Echinoderms and Polyzoa. Worm tubes.	95·00	(1·0 spicu discu cula,
VIII. West end,	„	„	21½	43·3	43·2	3½	Reddish-brown Sand, with shells.	3·00	(Traces). Miliolina and Discorbina.	(3·00 per cent.). Gasteropods, Lamellibranchs, Echinoderms.	97·00	No
IX.	April 15,	Five to ten miles south-east of the May Isle,	29 to 35	42·9	42·9	5	Bluish-grey Mud, homogeneous, plastic, coherent, dries into hard grey-brown lumps, somewhat friable, earthy, pulverulent, which do not readily break down in water. *Residue*—Dark brown.	10·00	(3·00 per cent.). Nubeculina, Biloculina, Spiroloculina, Miliolina, Cornuspira, Ophthalmidium, Reophax, Haplophragmium, Textularidæ, Lagenidæ, Globigerina, Discorbina, Rotalidæ, &c., &c.	(7·00 per cent.). Otoliths of fish, Gasteropods, Lamellibranchs, Crustacean remains, Ostracods, Echinoderm fragments, Polyzoa, Coccoliths.	90·00	(1·0 as Co Navi rella,

	RESIDUE.				ADDITIONAL OBSERVATIONS.
	Per Cent	Siliceous Organisms.	Minerals.	Fine Washings.	
of i- s.)-	80·00	(1·00 per cent.). Diatoms, as Cosinodiscus, Chætoceros, and Pleurosigma. Sponge spicules.	(55·00 per cent.) m. di. 0·3 m.m. Many particles of quartz, &c., fully 1 m.m; mica, felspar, hornblende, magnetite, augite, and coloured altered particles; fragments of coal and coal ash; glassy fragments	(24·00 per cent.). Consisting of fine argillaceous matter, fine mineral particles, with fragments of diatoms and sponge spicules, decayed organic matter.	The dredge brought up fully one hundredweight of the deposit, which showed three distinct layers. The surface layer, some two inches in thickness, composed of a soft, thin, dark-brown mud, amongst which were great numbers of *Turritella terebra.* Quite 98 per cent. of these were dead shells. Many had attached to them a small bright pink-coloured actinia (*Bunodes coronata*), and some an ascidian (*Styelopsis grossularia*). The middle layer, 4½ inches in thickness, was made up of a compact sandy mud, with extremely few remains of organisms. The lower layer consisted of a dark blue unctuous clay of doubtful thickness, in which no organic remains were observed.
s, s, of	90·00	(1·00 per cent.). Diatoms, as Rhizosolenia, Cosinodiscus, Chætoceros, and others. Sponge spicules.	(60·00 per cent.) m. di. 0·4. Many particles over 1 m.m. Quartz, mica, felspar, hornblende, augite, magnetite; many coloured red and yellow-green altered particles; fragments of coal and coal ash; glassy fragments	(29·00 per cent.). Argillaceous matter, fine mineral particles, and fragments of siliceous organisms, with some organic material.	A considerable quantity of the deposit from this station was examined, but, in comparison to Station I., the organisms obtained here were much less abundant. A thin surface layer of fine brown mud found here also.
s, s, y-	80·00	(1·00 per cent.). Diatoms, as Cosinodiscus, Chætoceros, Pleurosigma, Rhizosolenia, and others. Sponge spicules.	(55·00 per cent.) m. di. 0·2 m.m. Some quartz fragments from 1 to 3 m.m. Mica, quartz, felspar, hornblende, augite, magnetite; fragments of coal and coal ash; glassy fragments.	(25·00 per cent.). Argillaceous matter, finer mineral particles, fragments of sponge spicules and diatoms, organic matter.	The dredge gave a similar mass of deposit as was obtained over the area of Station I. The sample brought up in sounding tube, as also that in the dredge showed the three distinct layers. The surface layer in this case contained a greater quantity of the dead shells of *Turritella terebra.* The other organisms obtained were also, with one or two exceptions, similar to those obtained at Station I.
s, d of s,	90·00	(1·00 per cent.). Diatoms, as Chætoceros, Cosinodiscus, Navicula, Pleurosigma, Surirella, and sponge spicules.	(60·00 per cent.) m. di. 0·32. A few fragments of rounded quartz 1 m.m. Mica, quartz, felspar, augite, hornblende, coal and coal ash; some glassy fragments.	(29·00 per cent.). Argillaceous matter, fine mineral particles, fragments of siliceous organisms, flocculent, amorphous matter, and traces of organic material.	The dredge brought up a considerable quantity of the deposit both at the east and west end of the station. That obtained at the east end was a blue-grey sandy mud containing many dead shells of *P. opercularis*, and colonies, or bosses, of the worm tubes *Sabellaria alveolata.* At the west end the dredge gave a dark blue muddy sand and shells with patches of [illegible] very coherent, plastic clay; in other parts a pure brown sand, with fragments of rounded—a few angular—fine-grained compact red Sandstone, Quartzite, Shale, and Schistose rock, ¾ to 3 inches, all more or less overgrown with balanus, serpula, and gypsina, mostly dead. Traces of the fine argillaceous material was observable.
of h s, a	95·00	(2·00 per cent.). Diatoms, as Cosinodiscus, Navicula, Chætoceros, Pleurosigma, Rhizosolenia, Surirella, and sponge spicules.	(60·00 per cent.) m. di. 0·1. Mica, quartz, augite, felspar, hornblende, magnetic particles and glassy fragments; a few coloured altered particles; clinker; coal and coal ash.	(33·00 per cent.). Argillaceous matter, fine mineral particles, traces of organic material, fragments of sponge spicules and diatoms.	Both the sounding tube and dredge gave at this station a more typical homogeneous mud, differing from that obtained at Stations I. to IV. by the absence of perfect dead shells of the larger mollusca, and the size of the mineral particles, which are here more uniform, and the absence of rock fragments, with a thin surface layer of brown argillaceous material.
of 1- of s, ll	40·00	(5·00 per cent.). Friable casts of foraminifera, and the remains of other organisms. Diatoms, as Cosinodiscus, Chætoceros, and sponge spicules.	(25·00 per cent.) m. di. 0·5. A few quartz fragments 1 to 2 m.m. Rounded quartz, felspar, mica, hornblende, augite; magnetic particles; glassy fragments; many coloured altered particles; coal and coal ash; clinker.	(10·00 per cent.). Ferruginous, flocculent, amorphous matter, traces of argillaceous matter, fragments of casts, sponge spicules, diatoms, organic matter, and semi-chitonous material.	The sounding tube gave only a few grains of shell fragments. The dredge brought up fully one hundredweight of the deposit at the middle of this station, made up chiefly of the broken-down parts of gasteropod and lamellibranch shells, from which the bulk of carbonate of lime is derived, the majority of these, with the other organic remains, are seen to be more or less infiltrated throughout with ferruginous material, while some are dark greenish-grey in colour. In some crystallisation has taken place. All these fragments, when treated with dilute hydrochloric acid, beautiful and perfect casts remain, brown, reddish, yellowish-green, and grey-black. The whole of the deposit taken by dredge was carefully passed through sieves on board. In this way a number of smoothly-rounded and angular rock fragments and pebbles were obtained, viz.:—Coarse and fine-grained sandstone, mica-schist, augite, diorite, gneissic rock, quartz, clinker, and coal, measuring ⅛ to ¾ inch. Many of these were much altered. Some are perfectly round, with smooth surfaces, while others are angular.
s, s, ie o- y-	90·00	(1·00 per cent.). Diatoms, as Cosinodiscus, Pleurosigma, Rhizosolenia, and Navicula. Sponge spicules.	(65·00 per cent.) m. di. 0·3 m.m. A few particles from 6 to 1 m.m. Rounded and angular quartz, felspar, mica, magnetite, augite; glassy particles; coal ash, coal, coloured altered particles.	(29·00 per cent.). Argillaceous matter, fine mineral particles, fragments of sponge spicules and diatoms, amorphous matter.	A considerable quantity of the deposit came up in the dredge showing in parts layers of shelly sand, in others a coherent plastic mud. Another haul with dredge in the *middle* of this station gave somewhat similar results, but more sandy; while at the *west end* the dredge gave a *fine-grained reddish-brown sand*, with a few shells of Mollusca, and slight traces of brown mud on the surface.
	100·00	Traces. Several Cosinodiscus.	(98·00 per cent.) m. di. 0·6 m.m. to 1 m.m.	(2·00 per cent.). Argillaceous matter, and fine mineral particles.	
s, g- id	95·00	(1·00 per cent.). Sponge spicules, Chætoceros, Cosinodiscus, Pleurosigma, Navicula, Rhizosolenia.	(60·00 m.) di. 0·2 m.m. Rounded and angular quartz grains (the surface of some coated with ferric oxide), mica, augite, felspar, hornblende, magnetite; glassy fragments; and a few particles of coal ash.	(34·00 per cent.). Argillaceous matter, fine mineral particles, fragments of sponge spicules and diatoms, some glassy particles.	The dredge came up filled with this homogeneous mud, from which, after being washed through sieves, a number of *Gasteropoda, Lamellibranchs, Crustacea, Echinoderms, Worms, &c., &c.*, were obtained. The dredge at the west end of this station gave a pure reddish sand, with a few shells, as *Fusus, Aporrhais, Solen, Cardium*, and *Asterids.*
s, .	97·00	None observed.	(97·00 per cent.) m. di. 0·2 m.m. to 1 m.m. Chiefly rounded quartz grains, many coated with ferric oxide.	Traces.	
of li- is, g-	90·00	(1·00 per cent.). Diatoms, as Cosinodiscus, Pleurosigma, Navicula, Chætoceros, Surirella, Mitzschia, Rhizosolenia.	(65·00 per cent.) m. di. 0·2 m.m. Rounded and angular quartz, mica, augite, hornblende, felspar, magnetite; glassy fragments; traces of coal ash.	(34·00 per cent.). Argillaceous matter, fine mineral particles, glassy fragments, fragments of sponge spicules and diatoms.	The sounding tube brought up a small quantity of bluish-grey mud, with a thin surface layer of fine mud of a reddish-brown colour. The dredge brought up a quantity of similar material, showing traces of a thin layer of the same fine red-brown mud, which appears to owe its origin to a more recent time, probably to the settling down of the fine argillaceous matter in suspension carried out from the River Forth. Most of this deposit was passed through the sieves and the organisms preserved, which are here more abundant than at any of the other stations examined.

LIST OF ANIMALS OBTAINED BY TRAWL, DREDGE, AND TOW-NET OVER THE AREAS OF THE FIRTH OF FORTH STATIONS.

Station I.—10-18 fathoms.

ABBREVIATIONS.—v.r., very rare; r., rare; f., few; fr., frequent; c., common; abdt., abundant; m., many; d., dead; l., living.

PISCES.

Lophius piscatorius, L., v.r.
Anarrhichus lupus, L., v.r.
Cyclopterus lumpus, L., v.r.
Gadus morhua, L., r.
,, *æglefinus*, L., r.
,, *virens*, L., r.
Pleuronectes platessa, L., v.r.
,, *microcephalus*, Don., r.
,, *limanda*, L., r.
Hippoglossoides limandoides, Bloch., r.
Clupea harengus, L., v.r.
,, *sprattus*, L., m. c.
Raia clavata, L., v.r.

TUNICATA.

Styelopsis grossularia, V. Ben., f. l.

MOLLUSCA.

Anomia ephippium, L., f. d.
,, *patelliformis*, L., r. d.
Ostrea edulis, L., valves, f.
Pecten opercularis, L., v.r. d.
,, *pusio*, L., valves, v.r.
Mytilus edulis, L., valves, r.
,, *modiolus*, L., r. d.
Modiolaria marmorata, Forbs., [valves, v.r.
Nucula nitida, G.B.S., r. d.
Leda minuta, Müll., v.r. d.
Cardium echinatum, L., valves, r.
,, *edule*, L., v.r. d.
Diplodonta rotundata, Mont., [valves. r.
Cyprina islandica, L., r. d.
Scrobicularia alba (Wood), f. d.
,, *prismatica*, Mont., f. l.
Solen siliqua, L., r. d.
Thracia papyracea, Poli., v.r. d.
Corbula gibba, Olivi., f. d.
Saxicava rugosa, L., f. d.
Turritella terebra, L., abdt. d.
,, *terebra*, var. *nivea*, Jeff., [r. d.
Buccinum undatum, L., v.r. d.
,, *undatum*, eggs of, l. [colonies.
Fusus antiquus, L., v.r. d.

CRUSTACEA.

Hyas coarctatus, Leach, r.
Zoœa of Brachyura, f.
Eupagurus bernhardus (L.), r.
,, *pubescens* (Kroyer), r.
Porcellana longicornis, Penn., v.r.
Crangon vulgaris, Fabr., f.
Hyperia galba (Mont.), v.r.
Calanus finmarchicus (Gunn.), f.
Caligus rapax., M. Edw., f.
Candaciapectinata, Brady, f.
Hyperoche turriformis, r.
Parathemisto oblivia, abdt.
Peroculodes longimanus, f.
Alteutha, sp? f.
Metopa, sp? r.
Balanus hameri, Ascan., v.r.
,, *balanoides* (L.), c.
,, *crenatus* (Brug.), v.r.

Vermes.

Tomopteris onisciformis, Esch., r.
Serpula vermicularis, Ellis, r. d.
,, *triquetra* (Linné), v.r.
Polynoë squamata (Johnst.), r.
Pectinaria belgica (Pallas), r. d.
Glycera dubia, Blainv., v.r.
,, *alba* (Müll.), r.
Phascolosoma strombi (Mont.), v.r.
Pontobdella muricata (L.), r.
Sagitta bipunctata, Q. and G., f.
Alcyonidium parasiticum, Flem., f.
Membranipora pilosa, Linné, v.r. d.
Flustra papyracea, Ell. and Sol., v.r.
Gemellaria loricata (Linn.), f.

Echinodermata.

Echinus esculentus, L., v.r. d.
,, *miliaris*, L., v.r.
Echinocardium flavescens, O.F.M., [v.r.
Asterias rubens, L., r.
Solaster papposus, Fabr., v.r.
Ophiothrix fragilis, Abild, f.
Ophiura ciliaris, L., f.
Ophiura albida, Forb., v.r.

Actinozoa and Hydrozoa.

Uticina crassicornis ? O.F.M., abdt. [on dead Turritella shells.
Alcyonium digitatum, L., r.
Hydrallmania falcata, L., v.r.
Beroë ovata, Lam., r.
Clytea johnstoni, Ald., v.r.
Companularia flexuosa, Hincks, r.
Cydippe pomiformis ? f.

Foraminifera.

Biloculina depressa, d'Orby, v.r. d.
Miliolina seminulum, L., r.
,, *oblonga*, Montag., v.r.
Reophax fusiformis, Will., r. d.
,, *scorpiurus*, Montf., v.r. d.
Haplophragmium pseudo-spirale, [Will., f.
,, *canariense*, [d'Orby, r.d.
Textularia porrecta, Brady, v.r. d.
Spiroplecta sagittula, Defr., v.r. l.
Gaudryina filiformis, Ber., f. d.
Virgulina subsquamosa, d'Orby, r.
Bolivina plicata, d'Orby, v.r. d.
,, *pygmæa*, d'Orby, v.r. d.
Bulimina elegans, d'Orby, v.r. d.
,, *marginata*, d'Orby, f. l.
,, *exilis*, Goes., v.r.
Bulimina elegantissima, d'Orby, v.r.
Lagena striata, d'Orby, r. l.
,, *sulcata*, W. and J., l.
,, *Williamsoni*, Alcock, f.
,, *vulgaris*, Will., r. l.
,, *lævis*, Montagu, r.
Nodosaria communis, d'Orby, v.r. d.
Cristellaria gibba, d'Orby, v.r. d.
Discorbina orbicularis, Terg., f.
,, *globularis*, d'Orby, r. l.
,, *rosacea*, d'Orby, r.
Planorbulina mediterraniensis, [d'Orby, r.
Truncatulina lobatula, W. and J., [v.r. d.
Rotalia beccarii, L., c. chiefly d.
Polystomella striato-punctata, L. and [M., f.
Polystomella arctica, P. and J., r. d.

Station II., North Bay of West Wemyss.—10-15½ fathoms.

Pisces.

Lophius piscatorius, L., f.
Anarrhichus lupus, L., v.r.
Gadus morhua, L., r.
,, *æglefinis*, L., f.
,, *merlangus*, L., f.
Pleuronectes platessa, L., r.
,, *limanda*, L., r.
Hippoglossoides limandoides, Bloch.
Raia radiata, Don., v.r.
,, *clavata*, L., r.

Tunicata.

Ascidia mentula, O.F.M., v.r.
Ascidiella virginea, O.F.M., f.
Botrylloides rubrum, M.Edw., v.r.

Mollusca.

Pecten opercularis, L., r. d.
Nucula nitida, G.B.S., v.r. d.
Scrobicularia alba, Wood, r. d.
,, *prismatica*, Mont., r. d.
Solen siliqua, L., v.r. d.
,, *pellucidus*, Penn, one, l.
Saxicava rugosa, L., valves, f.
Pholas candida, L., v.r. d.
Dentalium entalis, L., three, d.
Eulima intermedia, L., one, dead.
Rissoa, sp? r. d.
Aporrhaïs pes pelecani, L., two, d.
Buccinum undatum, L., r. d.
Fusus antiquus, L., one, d.
Nassa reticulata, L., r. d.
Polycera, sp? v.r.
Loligo vulgaris, Lnk., one, l.

Crustacea.

Carcinus mœnas (L.), v.r. l.
Cancer pagurus, L., v.r. l.
Nephrops norvegicus (L.), f.
Eupagurus bernhardus (L.), r.
Calanus finmarchicus (Gunner), f.
Parathemisto oblivia, f.
Caligus rapax, M.E., v.r.
Hyperoche tauriformis, r.
Thysanoessa, sp? f.

Vermes.

Tomopteris onisciformis, Esch., f.
Sabella pavonia (Savegny), f.
Nereis pelagica (L.), v.r.
Pectenaria belgica (Pallas), v.r.
Gemellaria loricata (L.), f.
Membranipora pilosa (L.), r.
Aphrodite aculeata (L.), r.
Polynoe squamata (Johnston), f.
Sagitta bipunctata, Q. and G., f.
Flustra foliacea, L., r. d.
Alcyonidium parasiticum, Flem., f.

Echinodermata.

Echinus esculentus, L., one, d.
Spatangus purpureus, Mull., r.
Echinocardium flavescens, O. Ed. Mull., three, d.
Ophiura ciliaris, L., f. l.
Asterias rubens, L., f.
Ophiothrix fragilis, Abild., r.

Hydrozoa.

Alcyonium digitatum, L., r.
Sertularia arbietina, L., v.r.
Hydrallmania falcata, L., r.

Foraminifera.

Miliolina seminulum, L., r. l.
,, *circularis*, Bom., v.r. d.
,, *oblonga*, Montague, v.r. l.
Hippocrepina, sp ? nov. v.r.
Reophax scorpiurus, Montf., v.r. [chiefly d.
,, *fusiformis*, Will., f. l.
,, *Scotti*, Chaster, v.r. l.
Haplophragmium pseudo-spirale, [Will., f. l.
,, *canariensis*, [d'Orby, f. d.
Textularia porrecta, Brady, v.r. d.
Spiroplecta sagittula, Defr., v.r. l.
Gaudryina filiformis, Ber., f. d.
Virgulina subsquamosa, d'Orby, f. d.
Clavulina obscura, d'Orby, v.r. d.
Bolivina decussata, r. d.
,, *punctata*, d'Orby, f. d.
,, *pygmæa*, d'Orby, r. d.
Bulimina elegans, Brady, v.r. l.
,, *marginata*, d'Orby, c. l.
,, *exilis*, Brady, v.r. d.
,, *elegantissima*, d'Orby, [v.r. d.
,, *contraria*, Will., v.r. d.
Cassidulina crassa, d'Orby, v.r. d.
Nodosaria filiformis, Brady, v.r. d.
Cristellaria cultrata, Mont. ? young, [one d.
Polymorphina communis, Will., v.r.
Uvigerina angulosa, Will., v.r. d.
Lagena sulcata, W. and J., f. l.
,, *Williamsoni*, Alcock, r. d.
,, *vulgaris*, Will., r. l.
,, *lævis*, Mont., f. d.
,, *squamosa*, Mont., r. d.
,, *quadricostulata*, Rss., v.r. d.
,, *globosa*, Mont., r. d.
,, *quadrata*, Will., r. d.
,, *semistriata*, Will., r. d.
,, *marginata*, W. and B., r. d.
Globigerina bulloides, d'Orby, r. d.
Discorbina orbicularis, Terg., f. [chiefly d.
,, *globularis*, d'Orby, r. d.
,, *rosacea*, d'Orby, f. [chiefly d.
Planorbulina mediterraniensis, [d'Orby, f. d.
Truncatulina lobatula, W. and J., r. d.
Rotalia beccarii, L., c. l. and d.
Nonionina turgida, Will., v.r. d.
Polystomella striato-punctata, F. and [M., c. d.
,, *arctica*, P. and J., r.d.

Station III., East of Inchkeith.—7½-10 fathoms.

Pisces.

Lophius piscatorius, L., r.
Anarrhichus lupus, L., v.r.
Gadus morhua, L., v.r.
,, *æglefinus*, L., r.
,, *merlangus*, L., v.r.
Merluccius vulgaris, Cuv., v.r.
Pleuronectes platessa, L., v.r.
Pleuronectes microcephalus, Don., v.r.
,, *cynoglossus*, L., r.
,, *limanda*, L., f. r.
Hippoglossoides limandoides, r.
Clupea harengus, L., r.
,, *sprattus*, L., f. r.
Raia clavata, L., v.r.
Raia batis, L., v.r.

TUNICATA.

Styelopsis glossularia, V. Ben., f. r. l.

MOLLUSCA.

Ostrea edulis, L., v.r. d.
Pecten opercularis (L.), r. m. d.
Mytilus edulis, L., v.r. d.
Cardium edule, L., v.r. d.
Cyprina islandica (L.), f. d.
Scrobicularia prismatica (Mont.), f. l.
,, *alba* (Wood), r. d.
Solen siliqua, L., v.r. d.
Thracia papyracea (Poli.), v.r. d.
Buccinum undatum, L., r. d.
Fusus antiquus (L.), v.r. d.

CRUSTACEA.

Hyas araneus, L., one.
,, *coarctatus*, Leach, v.r.
Eupagurus Bernhardus (L.), f.
,, *cuanensis* (Thomp.), one.
Balanus balanoides, (L.), f. d.
,, *hameri*, Ascanius, v.r. d.
,, *crenatus*, (Brug.), v.r. d.
Nephrops norvegicus (L.), r.
Pandalus montagui, Leach, r.
Thysanoessa, sp. f.
Parathemisto oblivia (Kr.), r.
Mysidopsis gibbosa, G.O.S., f.
Macromysis flexuosus (Mull.), f.
Schistomysis spiritus (Norm.), f.
,, *ornatus* (Sars.), f.
Diastylus, sp ? f.
Parathylus swammerdami (M. [Edw.), f.
Calanus finmarchicus (Gunner), f. r.
Hyperoche tauriformis (Bate), f.
Erythrops Goessi, f. r.
Lyanasidid, sp. f.
Iphimidea obesa, Pathke, f.
Caligus rapax, M. Edw., f.
Perioeculodes longimanus (Bate), f.

VERMES.

Tomopteris onisciformis, Esch., fr.
Sagitta bipunctata, Q. and G., fr.
Membranipora pilosa, L., r.
Flustra securifrons, Pall., v.r. d.
Flustra foliacea, L., v.r. l.
Membranipora membranacea, L., [v.r. d.

ECHINODERMATA.

Echinus esculentus, L., v.r. young, l.
Solaster papposus, Fabr., one, l.
Ophiura albida, Forbs., one l.
Asterias rubens, L., f. l.
Ophiothrix fragilis, Abild., fr.

ACTINOZOA AND HYDROZOA.

Actinoloba dianthus (Ellis), one.
Cydippe pomiformis ? f.
Bunodes coronata, Penn., m. l. on [dead Cyprina valves.
Sertularia argentea, E. and Sol., v.r.

Foraminifera.

Biloculina depressa, d'Orby, v.r. d.
,, *oblonga*, d'Orby, v.r. d.
Miliolina seminulum, L., f., chiefly [d.
Reophax scorpiurus, Montf., f. [chiefly d.
,, *fusiformis*, Will., r. l.
,, *Scotti*, Chaster, v.r.
Haplophragmium pseudo-spirale, [Will., r.d.
,, *canariensis*, [d'Orby, v.r. d.
Spiroplectra sagittula, Defr., r. d.
Gaudryina filiformis, Ber., r.
Virgulina squamosa, d'Orby, v.r. d.
Bolivina plicata, d'Orby, v.r. d.
Bulimina marginata, d'Orby, r. l.
,, *elegans*, d'Orby, r. d.
,, *exilis*, Brady, v.r. d.
Lagena sulcata, W. and J., r. d.
,, *vulgaris*, Will., r. d.
,, *lævis*, Montague, r. l.
,, *Williamsoni*, Alcock, v.r. d.
Discorbina rosacea, d'Orby, r. d.
,, *globularis*, d'Orby, v.r. d.
Rotalia beccarii, L., f., chiefly d.
Polystomella striato-punctata, F. and [M., r. d.

Station IV., South Bay.—5-9 fathoms.

Pisces.

Cottus scorpius, L., v.r.
Lophius piscatorius, L., r.
Gadus morhua, L., r.
,, *merlangus*, L., r.
Pleuronectes platessa, L., r.
,, *flesus*, L., v.r.
Pleuronectes microcephalus, Don., r.
Hippoglossoides limandoides, [Bloch., r.
Pleuronectes limanda, L., f.
Nerophis aquareus, L., one.
Raia radiata, Don., v.r.

Tunicata.

Ascidiella virginea, O.F.M., v.r. l.

Mollusca.

Anomia ephippium, L., f. d.
Pecten opercularis, L., one l., m. d.
Mytilus edulis, L., r.d.
,, *barbatus*, L., v.r. d.
,, *modiolus*, L., r. d.
Modiolaria marmorata, Forb., [v.r. d.
Cardium echinatum, L., r. d.
,, *edule*, L., r. d.
Tapes pullastra, L., r. d.
Donax vittatus, Dal., v.r. d.
Scrobicularia alba (Wood), v.r. d.
Scrobicularia prismatica, Mont., f. l.
Diplodonta rotundata, Mont., one d.
Mya arenaria, L., r. d.
,, *truncata*, L., v.r. d.
Saxicava rugosa, L., f. d.
Turritella terebra, L., c. d.
,, *var. alba*, f. d.
Buccinum undatum, L., f. d.
Fusus antiquus, L., r. d.
Eolis viridis (Forb.), r.
Eolis Landsburgi, v.r.
Polycera ocellata, Ald. and Han., r.

Crustacea.

Bottom forms—

Eupagurus Bernhardus (L.), one.
Pandalus brevirostris, Rathke, v.r.
,, *montagui*, Leach, v.r.
Balanus balanoides, L.. r.d.
Portunus holsatus, Fabr., one l.
Porcellana longicornis, one l.
Hyas araneus (L.), one l.
Cuma scorpioides (Mont.), r. l.

Pelagic forms—

Schistomysis spiritus, Norm., v.r.
Euphasidiæ, r.
Hyperia galba (Montagu), v.r.
Hyperoche tauriformis (Bate), r.
Calanus finmarchicus (Gunner), f.
Temora longicornis, Müll., f.
Parathemisto oblivia (Kr.), r.
Eurydice pulchra, Leach, v.r.
Caligus rapax, M.E., r.
Acartia, sp? r.
Pseudo calanus elongatus, Baird, f.
Longipedia cornuata, Clause., f.

Vermes.

Tomopteris onisciformis, Esch., r.
Serpula vermicularis, Ellis, f. d.
Nereis pelagica, L., r. l.
Polynoë reticulata, Clop., r.
Sagitta bipunctata, Q. and G., f.
Pontobdella muricata, (L.), one l.
Sabellaria alveolata, m. c. on [stones and shells, d. and l.
Gemellaria loricata (L.), r. d. [colonies.
Membranipora membranacea, L., [v.r. d.
Flustra securifrons, Pall., v.r.
Alcyonidium parasiticum, Flem., r.

Echinodermata.

Echinus esculentus, L., v.r. young, l.
Asterias rubens, L., v.r. young, l.
Ophiothrix fragilis, Abild., v.r. l.
Solaster papposus, Fabr., v.r. young.
Ophiura ciliaris, L., one.

Hydrozoa and Actinozoa.

Bunodes coronata, Penn., moderately [c. on d. Turritella.
Alcyonidium digitatum, L., two [colonies.

Foraminifera.

Nubecularia lucifuga, Defr., v.r. d.
Biloculina elongata, d'Orby, f.
Miliolina seminulum, L., m. c. f. l.
,, *oblonga*, Mont., r.
,, *venusta*, Kar., v.r. d.
,, *circularis*, Bom., v.r. d.
Spiroloculina limbata, d'Orby, one d.
Cornuspira involvens, Rss., v.r. [fragt.
Reophax scorpiurus, Montf., f.
,, *fusiformis*, Will., r.
,, *Scotti*, Chaster, two [specimens.
Haplophragmium canariensis, [d'Orby, one.
,, *pseudo-spirale*, [Will., r. d.
Textularia gramen, d'Orby, r. d.

Spiroplecta sagittula, Defr., r.
Verneulina polystrophia, Rss., v.r.
Gaudryina filiformis, Ber., f. d.
Bulimina elegans, d'Orby, v.r. d.
,, *marginata*, d'Orby, v.r.
,, *elegantissima*, d'Orby, r. d.
Bolivina decussata, d'Orby, v.r.
,, *punctata*, d'Orby, r.
,, *difformis*, Will., v.r. d.
Lagena globosa, Montagu, r. d.
,, *marginata*, W. and B., r.
,, *semistriata*, Will., f.
,, *striata*, d'Orby, f.
,, *squamosa*, Mont., f.
,, *lævis*, Mont., m. c.
,, *Williamsoni*, Alcock, r. d.
,, *vulgaris*, Will., f.
,, *gracillima*, Segu., f.
,, *distoma*, D. and J., v.r.
,, *costata*, Will., v.r.
,, *quadricostulata*, Rss., v.r.
,, *lagenoides*, Will., r.
Nodosaria filiformis, L., r.
,, *radicula*, L., v.r. d.
Nodosaria pyrula, d'Orby, v.r.
,, *scalaris*, Batsch, f.
Cristellaria crepidula, F. and M., [v.r. d.
,, *gibba*, d'Orby, v.r. d.
Polymorphina lactea, W. and J., r.
,, *elegantissima*, Will., [r. d.
Discorbina orbicularis, Terg., f. [chiefly d.
,, *globularis*, d'Orby, f. [chiefly d.
,, *rosacea*, d'Orby, m. c. [chiefly d.
Planorbulina mediterraniensis, [d'Orby, f. d.
Gypsina inhaerens, Schul., m. c. [chiefly d.
Rotalia beccarii, L., c. m. d.
Polystomella striato-punctata, F. and [M., m. c. chiefly d.
,, *subnodosa*, d'Orby, f. d.
,, *arctica*, P. and J., v.r. d.
Nonionina turgida, Will., v.r.

Station V.—20-30 fathoms.

PISCES.

Zeus faber, L., one.
Anarrhichus lupus, L., one.
Gadus morhua, L., r.
,, *æglefinus*, L., r.
Gadus merlangus, L., r.
Pleuronectes platessa, L., v.r.
,, *cynoglossus*, L., f.
,, *limanda*, L., r.
Hippogloissoides limandoides, Bloch., v.r.

MOLLUSCA.

Turritella terebra, L., r. d.
Natica alderi, Forb., v.r. d.
Fusus antiquus, L., v.r.
,, *gracilis*, Da.C., one d.
Pecten opercularis, L., valves, r.
,, *pusio*, L., v.r. d.
Leda minuta, Müll., r. d.
Scrobicularia prismatica, Mont., f. l.
Scrobicularia alba (Wood), f. d. three l.

CRUSTACEA.

Eupagurus bernhardus (L.), one.
Nephrops norvegicus (L.), v.r.
Pandalus montagui, Leach, v.r.
Schistomysis spiritus? Norm., r.
Pseudocuma cervaria, Van. Ben., r.
Parathylus swammerdami [(M. Edw.), f.
Parathemisto oblivia (Kr.), f.
Calisoma crenata (Bate), fr.
Thysanoessa, sp? fr.
Caligus rapax, M. Edw., f.
Calanus finmarchicus (Gunner), fr.

Echinodermata.

Spatangus purpureus (O. F. Mull), [young, r.
Asterias rubens, L., young, f.
Ophiura albida, L., v.r.
Amphiura filiformis, (O. F. Mull), r.

Vermes.

Phascolasoma vulgare (Mont.), [one l.
Serpula vermicularis, Ellis, v.r. l.
Trophonia glauca, Malm., v.r. l.
Pectenaria belgica (Pallas), r. l.
Sabellaria alveolata, L., f. l.
Aphrodite aculeata, (L.), one.
Nephthys cœca, Fab., one.
Glycera alba, Blain, one.
Ammotrypane aulogaster, Rath., [one.
Tomopteris onisciformis, Esch., f.
Pigalion idunæ, v.r.
Membranipora membranacea, L., r.
,, *pilosa*, L., r.
Sagitta bipunctata, Q. and G., f. r.

Actinozoa and Hydrozoa.

Actinoloba dianthus, Ed., one l.
Virgularia mirabilis, Lamk., one l.
Alcyonium digitatum, L., v.r. l.
Sertularia argentea, L., v.r. l.
Aurila aurita, Lamk., one.
Ctenophora, fr.

Foraminifera.

Biloculina depressa, d'Orby, one l.
,, *oblonga*, d'Orby, v.r. l.
Miliolina seminulum, L., r. l.
,, *oblonga*, Mont., one d.
Cornuspira involvens, Rss., one d.
Reophax scorpiurus, Will., f. l.
,, *Scotti*, Chaster, one l.
,, *fusiformis*, Will., r. l.
Haplophragmium pseudo-spirale, [Will., f. l. and d.
,, *canariensis*, [d'Orby, v.r. l.
Spiroplecta sagittula, Defr., v.r. l.
Gaudryina filiformis, Ber., f. l.
Virgulina subsquamosa, d'Orby, [v.r. d.
Bolivina plicata, d'Orby, v.r. d.
,, *nobilis*, d'Orby, v.r. l.
Bulimina marginata, d'Orby, r. l.
,, *exilis*, Brady, v.r. l.
,, *aculeata*, d'Orby, v.r. d.
Cassidulina crassa, d'Orby, v.r. d.
Lagena striata, d'Orby, r. l.
,, *Williamsoni*, Alcock, r. l.
Lagena sulcata, W. and J., r. l.
,, *vulgaris*, Will., r. l.
,, *lævis*, Mont., v.r. d.
,, *squamosa*, Mont., v.r. l.
,, *globosa*, Mont., v.r. d.
,, *semistriata*, Will., v.r. l.
,, *marginata*, W. and B., [v.r. l.
,, *gracillima*, Segu., v.r. l.
,, *quadricostulata*, Rss., [v.r. d.
,, *gracilis*, Will., v.r. d.
,, *costata*, Will., one d.
Nodosaria communis, d'Orby, v.r. d.
,, *pyrula*, d'Orby, v.r. l.
Cristellaria gibba, d'Orby, one l.
Polymorphina lactea, W. and J., v.r. l.
,, *communis*, d'Orby, one.
Discorbina orbicularis, Terg., v.r.
,, *globularis*, d'Orby, v.r. d.
,, *rosacea*, d'Orby, v.r. d.
Rotalia beccarii, L., f. l.
Polystomella striato-punctata, v.r. d.
,, *arctica*, P. and J., one d.

Station VI., off St. Monans.—13-16 fathoms.

PISCES.

Gadus morhua, L., r.
,, *æglefinus*, L., r.
,, *merlangus*, L., r.
Rhombus lævis, Rond., v.r.
Pleuronectes platessa, L., r.
,, *microcephalus*, Don., r.
,, *limanda*, L., f.
Hippoglossoides limandoides, Bloch., r.

MOLLUSCA.

Anomia patelliformis, L , frag., m. c.
,, *ephippium*, L., d.
Pecten opercularis, L., c. d.
,, *pusio*, L., r. d.
,, *varius*, L., frag., r.
,, *striatus*, Müll., v.r. d.
Mytilus modiolus, L., f. d.
,, *edulis*, L., frag., m. c.
Nucula nitida, G.B.S., r. d.
Leda minuta, Mull., v.r. d.
Cardium edule, L., c. d., frag., c.
,, *echinatum*, L., f. frag., d.
Cyprina islandica, L., frag., m. c.
Astarte compressa (Mont.), r. d.
,, *sulcata*, Da. C., r. d.
Venus fasciata, Da. C., frag., c.
,, *lineta*, Pult., frag., d.
,, *exoleta*, L., frag., c.
Tellina crassa, Penn., r. d.
,, *pusilla*, Phill., r. d.
,, *balthica*, L., m. c. d.
Donax, *sp.*, frag., d.
Mactra solida, L., c. d.
Solen ensis, L., r. d.
Solen siliqua, L., f. d.
Thracia papyracea, Poli., r. d.
Corbula gibba, Olivi., r. d.
Saxicava rugosa, L., frag., m. c.
Patella vulgata, L., f. m. c.
Helcion pellucidum, L., frag., d.
Trochus tumidus, Mont., frag., d.
,, *umbilicatus*, Mont., d. m. c.
Rissoa proxima, r. l., f. d.
,, *violacea*, Desm., f. l., d. f.
Cæcum glabrum, Mont., f. l., m. c. d.
Odostomia insculpta, Mont., r. l., d. f.
,, *acuta*, r. l., d. f.
,, *albella*, Lov., r. l., d. f.
Eulima polita, L., r. l., d. r.
Natica alderi, Forb., r. l., f. d.
Aporrhais pes-pelecani, L., frag., m. c.
Buccinum undatum, L., frag., m. c. d.
Fusus gracilis, Da. C., v.r. d.
Nassa incrassata, Str., d. r.
Pleurotoma turricula, Mont., r. d.
Utriculus mamillatus, Phil., r. d.
Dentalium entale, L., f. m. c.
,, *tarentinum*, Lmk., f. m. c.
Chiton ruber, Mont., f. l.

CRUSTACEA.

Carcinus mænas, Penn., v.r.
Paratylus, *sp ?* fr.
Mysis, *sp ?* r.
Calisoma crenata (Bate), f.
Temora longicornis, Müll., r.
Parathemisto oblivia (Kr.), fr.
Thysanoessa, sp ? fr.
Caligus rapax, M. Edw., fr.
Calanus finmarchicus (Gunner), f.

VERMES.

Serpula vermicularis, Ellis, frag., c.
Nereis pelagica, L., v.r.
Tomopteris onisciformis, Esch., fr.
Serpula triquetra, L., frag., m. c.
Sagitta bipunctata, Q. and G., fr.
Membranipora hexagona, Bush., r. d.
,, *pilosa*, L., r. d.
Flustra securifrons, Pall., r.

Echinodermata.

Echinus esculentus, L., frag., m. c.
Echinocyamus pusillus, O.F.M., [f. l., c. d.
Henricia sanguinolenta, O.F.M., r.
Spatangus purpureus, Müll., frag., r.
Asterias rubens, L., young, fr.

Hydrozoa and Actinozoa.

Sertularia abietina, L., v.r.
Ctenophora, fr.
Alcyonium digitatum, L., v.r., [young colonies.

Foraminifera.

Biloculina depressa, d'Orby, v.r. d.
,, *elongata*, d'Orby, d.
Miliolina circularis, Bom., f. d.
,, *seminulum*, L., f. d.
,, *venusta*, Kar., v.r. d.
,, *oblonga*, Mont., v.r. d.
Spiroloculina limbata, d'Orby, v.r. d.
Hyperammina arborescens, Norm., [v.r.
Reophax findens? P., v.r. d.
Haplophragmium canariensis, [d'Orby, f. d.
Ammodiscus gordialis, Pch. J., d.
Textularia gramen, d'Orby, r. d.
Spiroplecta sagittula, Defr., f. d.
Verneuilina polystropha, Rss., r. d.
Bulimina marginata, d'Orby, v.r. d.
,, *elegans*, d'Orby, v.r. d.
Bolivina decusata, d'Orby, v.r. d.
Lagena vulgaris, Will., r. d.
,, *globosa*, Mont., r. d.
Lagena marginata, W. and B., r.
,, *trigono-marginata*, Will., [v.r. d.
,, *striata*, d'Orby, m. c. l. and d.
,, *Williamsoni*, Alcock, f. l. [and d.
Nodosaria communis, d'Orby, v.r. d.
Polymorphina lactea, W. and J., v.r.
,, *oblonga*, Will., v.r.
,, *communis*, Will., v.r.
Patellina corrugata, Will., v.r.
Discorbina orbicularis, Terg., f. d.
,, *rosacea*, d'Orby, m. c. d.
Truncatulina lobatula, W. and J., [v.r. d.
Planorbulina mediterraniensis, [d'Orby, r.d.
Rotalia beccarii, L., c. l. and d.
Polystomella striato-punctata, F. and [M., f. l. and d.
,, *arctica*, P. and J., r. d.

Station VII.—21½-30 fathoms.

Pisces.

Lophius piscatorius, L., r.
Callionymus lyra, L., one.
Labrus maculatus, Bl., one.
Centronotus gunnellus, Bl., one.
Gadus morhua, L., f.
,, *æglefinus*, L., f.
,, *merlangus*, L., r.
,, *luscus*, L., one.
Pleuronectes platessa, L., f.
,, *microcephalus*, Don., f.
Pleuronectes cynoglossus, L., f.
,, *limanda*, L., f.
,, *flesus*, L., one.
Hippoglossoides limandoides, [Bloch., r.
Clupea harangus, L., f.
,, *sprattus*, L., f.
Raia clavata, L., r.
,, *radiata*, Don., r.
,, *batis*, L., v.r.

Tunicata.

Ascidia mentula, O.F.M., r. l.
Styelopsis glossularia, V. Ben., r. l.
Ascidiella virginea, O.F.M., f. l.

Mollusca.

Anomia ephippium, L., valves, f.
Ostrea edulis, L., valves, v.r.
Pecten opercularis, L., v.r. d.
,, *pusio*, L., v.r. d.
Mytilus edulis, L., f. d.
,, *modiolus*, L., f. l.
Nucula nitida, G.B.S., v.r. d.
Leda minuta, Müll., v.r. d.
Loripes lacteus, L., v.r. d.
Diplodonta rotundata, Mont., r.
Cardium echinatum, L., f., young, l.
Venus casina, L., valves, young, f.
Mactra elliptica, Bro., r. d.
Solen pellucidus, Penn., f. l.
Thracia papyracea, Poli., v.r., d.
Corbula gibba, f. d., one l.
Saxicava rugosa, L., v.r. d. f.
,, var. *arctica*, L.
Pholas crispata, L., valve, v.r.
Trochus tumidus, Mont., v.r. d.
Turritella terebra, L., f. d., r. l.
Natica alderi, Forb., r. l.
Velutina lævigata, Penn., r. l.
Fusus antiguus, L., r. l.
Buccinum undatum, L., f. l.
Actæon tornatilis, L., v.r. d.
Dentalium entalis, L., f. d., r. l.
,, *tarentinum*, Lmk., r. l.
Loligo vulgaris, Lmk., r. l.
Octopus vulgaris, Lmk., one l.

Crustacea.

Bottom living—

Cancer pagurus, L., v.r. l.
Portunus depurator, (L.), two l.
,, *holsatus*, Fabr., v.r.
Eupagurus bernhardus (L.), v.r. l.
Pandalus montagui, Leach, r. l.
Idotea lincaris, L., r. l.
Atylus bispinosus, r.

Pelagic—

Eurydice pulchra (Slabb), r.
Erythrops Goesii, f.
Calissoma crenata (Bate), f.
Paratylus swammerdami (M. Edw.), f.
Parathemisto oblivia (Kr.), c.
Hyperoche tauriformis (Bate), r.
Paratylus, sp? f.
Caligus rapax, M. Edw., f.
Calanus finmarchicus (Gunner), fr.
Balanus hameri, Ascan., r. l.
,, *balanoides*, L., f. d.

Vermes.

Sagitta bipunctata, Q. and G., fr.
Pectinaria belgica, Pallas, f. l.
Sabella pavonia, Sav., r. l.
Tomopteris onisciformis, Esch., fr.

Echinodermata.

Echinus esculentus, L., frag. of tests.
Echinocardium flavescens, O.F.M., v.r., young, l.
Solaster endica, L., one l.
Ophiura albida, Forb., f. l.
Spatangus purpureus, Müll., v.r., young, l.
Asterias rubens, L., v.r. l.
Henricia sanguinolenta, O.F.M., one l.
Amphiura filiformis, O.F.M., f. l.

Actinozoa.

Virgularia mariabilis, Lamk., r. l.
Alcyonium digitatum, L., r. l.

FORAMINIFERA.

Biloculina depressa, d'Orby, f. l.
,, *oblonga*, Mont., f. l.
Miliolina seminulum, L., f. l.
,, *boueana*, d'Orby, r. d.
Spiroloculina limbata, d'Orby, r. l.
Cornuspira foliacea, Philip, r. d.
Astrorhiza limicola (Sandahl), f. l.
Reophax scorpiurus, Montf., f. l.
,, *Scotti*, Chaster, r. l.
,, *fusiformis*, Will., f. l.
Haplophragmium canariensis, [d'Orby, v.r. l.
,, *pseudo-spirale*, [Will., r. l.
Textularia gramen, d'Orby, r. d.
Spiroplecta sagittula, Defr., f. l.
Verneulina polystrophia, Rss., r. l.
Gaudryina filiformis, Ber., f. l.
Bulimina marginata, mod., [d'Orby, c. l.
,, *elegans*, d'Orby, r. l.
,, *elegantissima*, d'Orby, r. l.
,, *aculeata*, d'Orby, v.r. l.
Virgulina schreibersiana, Czjz., [one l.
,, *texturata*, d'Orby, v.r. d.
,, *subsquamosa*, d'Orby, r. l.
Bolivina punctata, d'Orby, r. d.
,, *reticulata*, Rss., v.r. d.
Cassidulina subglobosa, Brady, [v.r. d.
Lagena sulcata, W. and J., r. l.
,, *striata*, d'Orby, r. l.
Lagena gracillima, Segu., f. l.
,, *distoma*, P. and J., f. l.
,, *lævis*, Mont., f. l.
,, *marginata*, W. and B., l.
,, *globosa*, f. l.
,, *squamosa*, Mont., r. l.
,, *quadricostulata*, Rss., r. l.
Nodosaria scalaris, Bate., v.r. l.
,, *pyrula*, d'Orby, v.r. l.
,, *communis*, d'Orby, one d.
Cristellaria rotulata, Lamk., one l.
,, *gibba*, d'Orby, r. l.
Polymorphina communis, d'Orby, [vr. l.
,, *lanceolata*, Rss., v.r. d.
Uvigerina pygmæa, d'Orby, v.r. d.
Globigerina bulloides, d'Orby, v.r. d.
,, *triloba*, Brady, v.r. d.
Patellina corrugata, Will., v.r. d.
Discorbina globularis, d'Orby, r. l. [and d.
,, *orbicularis*, Terg., v.r. d.
,, *rosacea*, d'Orby, v.r. d.
Truncatulina lobatula, W. and J., [r. d.
Rotalia beccarii, L., c. l. and d.
Gypsina inhærens, Schul., f. l. and d.
Nonionina scapula, F. and M., v. r. l.
Operculina ammonoides, Gron., r. d.
Polystomella striato-punctata, F. and [M., r. d.
,, *sub-nodosa*, d'Orby, v.r. l.
,, *arctica*, P. and J., v.r. d.

Station VIII.—21½-30 fathoms.

PISCES.

Cottus scorpius, L., v.r.
Trigla gurnardus, L., f.
Lophius piscatorius, L., v.r.
Gadus morhua, L., r.
,, *æglefinus*, L., m. c.
,, *merlangus*, L., f.
Pleuronectes platessa, L., r.
,, *flesus*, L., one.
,, *microcephalus*, Don., r.
Pleuronectes cynoglossus, L., f.
,, *limanda*, L., f.
Hippoglossoides limandoides, [Bloch., r.
Arnoglossus megastoma, Don., one.
Clupea harengus, L., r.
Raia clavata, L., r.
,, *batis*, L., v.r.
,, *radiata*, Don., v.r

Tunicata.

Ascidia mentula, O.F.M., v.r. l.
Eugyra glutinaris? Möll., f. l.
Ascidella virginea, O.F.M., thirteen l.
Styelopsis grossularia, V. Ben., v.r. l.

Mollusca.

Anomia ephippium, L., f. l.
Pecten opercularis, L., d. v.r.
,, *striatus*, Müll., v.r. d.
,, *pusio*, L., v.r. d.
Nucula nitida, G.B.S., r. l.
Diplodonta rotundata, Mont., v.r. l.
Leda minuta, Müll., f. d. r. l.
Axinus flexuosus, Mont., f. l.
Cardium edule, L., f. d.
,, *echinatum*, L., young, r. l.
Cyprina islandica, L., r., young, l, [valves, adult, f.
Astarte elliptica, Bro., one l.
Venus fasciata, da C., r. d.
,, *verrucosa*, L., r., young, l.
,, *lincta*, Pult., f. d.
,, *casina*, L., d.
Loripes lacteus, L., r. l.
Tellina crassa, Penn, v.r. d.
Scrobicularia alba (Wood), r. l.
,, *tenuis*, Mont., r. ? l.
,, *prismatica*, Mont., f. l.
Solen ensis, L., v.r. d.
Solen pellucidus, Penn., f. l.
,, *siliqua*, L., v.r. d.
Thracia prætenuis, Pult., v.r. l.
,, *papyracea*, Poli., r.
Corbula gibba, Olivi., v.r. d.
Saxicava rugosa, L., f. l.
Trochus umbilicatus, Mont., v.r. d.
Turritella terebra, L., r. l.
Eulima polita, L., v.r. l.
Natica alderi, Forb., r. l.
Aporrhaïs pes pelicani, L., v.r. l.
Buccinum undatum, L , v.r. l.
Trophon muricatus, Mont., one l.
Fusus antiquus, L., v.r. l.
Pleurotoma turricula, Mont., v.r. d.
Utriculus mamillatus, Phil., r. l.
Cylichna cylindracea, Penn, f. l.
,, *umbilicata*, Mont., r. l.
Actæon tornatilis, L., v.r. d.
Philine scabra, Müll., r. l.
Tritonia Hombergi, Cuv., one l.
Dentalium entalis, L., f. l.
,, *tarentinum*, Lmk., r. l.
Sepia officinalis, L., one l.

Crustacea.

Portunus depurator (L.), two l.
Hyas araneus (L.), one l.
,, *coarctatus*, Leach, r. l.
Ebalia pennanti (Leach), one l.
Eupagurus bernhardus (L.), r.
Galathea nexa, Emb., one l.
Cuma scorpioides (Mont.), f. l.
Parathemisto oblivia (Kr.), fr.
Thysanoessa, sp? fr.
Altentha, sp? r.
Acartia, sp? r.
Calisoma crenata (Bate), f.
Nephrops norvegicus (L.), f. l.
Balanus balanoides, L., f. l.
,, *hameri*, Ascan., r. l.
Hyperoche tauriformis (Bate), r.
Parathylus, sp? r.
Calagus rapax, M. Edw., fr.
Metopa, sp? r.
Calanus finmarchicus, c.

Echinodermata.

Echinus esculentus, L., v.r. l.
Spatangus purpureus, Müll, f., [young, l.
Asterias rubens, L., f. l.
Henricia sanguinolenta, (O.F.M.), r. l.
Ophiura albida, Forbes, r. l.
,, *ciliaris*, L., f. l.
Ophiothrix fragilis, Abild., r. l.
Amphiura filiformis (O.F.M.), f. l.

Vermes.

Pontobdella muricata, L., r. l.
Sagitta bipennata, Q. and G., c. l.
Aphrodite aculeata, L., f. l.
Polynoe imbricata, L., r. l.
Nereis pelagica, L., r. l.
,, *virens*, Sars., v.r. l.
Sabellaria alveolata, L., few colonies.
Pectinaria belgica, Pall., f. l.
Sabella pavonia, Sav., f. l.
Tomopteris onisciformis, Esch., fr.
Membranipora membranacea, L., r. l.
Gemellaria loricata, L., fr. l.

And several other Annelids not identified, l.

Actinozoa and Hydrozoa.

Actinoloba dianthus, Ell., f. l.
Alcyonium digitatum, L., r. l.
Vergularia variabilis, Lamk., f. l.
Ctenophora, fr.
Sertularia abietina, L., r. l.
,, *argentea*, E. and Sol., [vr. l.
Diphasia pinaster, E. and Sol., v.r. l.

Foraminifera.

Biloculina depressa, d'Orby, fr. l.
,, *ringens*, Lamk., v.r., l.
,, *oblonga*, Montag., f. l.
Miliolina tricarinata, d'Orby, v.r. l.
,, *seminulum*, L., c. l.
,, *oblonga*, Montag., r. l.
Spiroculina limbata, d'Orby, v.r. d.
Cornuspira foliacea, Philip, r. l.
,, *involvens*, Rss., v.r. d.
Astrorhiza limicola, Sandahl, r. l.
Psammosphæra fusca, Schz., r. l.
Reophax scorpiurus, Mont., abdt. l.
,, *Scotti*, Chaster, fr. l.
,, *fusiformis*, Will., f. l.
Haplophragmium canariensis, [d'Orby, r.
,, *pseudospirale*, [Will., c.
Ammodiscus gordialis, J. and P., [v.r.
,, *charoides*, J. and P., [v.r. l.
,, *incertus*, Brady, v.r. d.
Textularia gramen, d'Orby, f. l.
Spiroplecta sagittula, Defr., m. c. l.
Gaudryina filiformis, Ber., fr. l.
Verneuilina polystropha, Rss., fr.
Bulimina marginata, d'Orby, [m. c. l.
,, *aculeata*, d'Orby, r. l.
Bulimina elegans, d'Orby, v.r. d.
,, *inflata*, Sequ., v.r. d.
,, *elegantissima*, d'Orby, r. d.
Virgulina schreibersiana, Cz., v.r. l.
,, *subsquamosa*, d'Orby, [r. d.
,, *texturata*, d'Orby, v.r. l.
Bolivina punctata, d'Orby, v.r. l.
,, *robusta*, Brady, v.r.
,, *reticulata*, Hant., v. r.
Cassidulina crassa, d'Orby, v.r. l.
,, *subglobosa*, Brady, one.
Lagena distoma, P. and J., f. d.
,, *sulcata*, W. and J., m. c. l.
,, *striata*, d'Orby, r. l.
,, *gracillima*, Segu., r. l.
,, *lævis*, Montag., f. l.
,, *semistriata*, Will., f. l.
,, *globosa*, Mont., r. l.
,, *fimbriata*, Brady, v.r. l.
,, *alveolata*, Brady, v.r.
,, *marginata*, W. and B., r. l.
,, *quadricostulata*, Rss., v.r.
,, *globosa*, var., r. l.
,, *lævis* var. Montag., r. l.
,, *squamosa*, Mont., r. l.
,, *plumigera* var., v.r.
Nodosaria scalaris, Batsch, v.r. l.
,, *filiformis*, v.r. l.
,, *pyrula*, d'Orby, r. l.

Nodosaria communis, d'Orby, r. d.
Cristellaria gibba, d'Orby, v.r. l.
,, *articulata*, one d.
,, *convergens*, Born., one d.
Polymorphina augusta, Egger., v.r. l.
,, *communis*, d'Orby, v.r. l.
,, *elegantissima*, P. and J., one l.
,, *lanceolata*, Rss., v.r. l.
,, *lactea*, W. and J., v.r. d.
Globigerina bulloides, d'Orby, r. d.
,, "*cretacea*-like form, d'Orby,"* f. d.
Patellina corrugata, Will., r. l.
Discorbina globularis, d'Orby, r. l.
Discorbina orbicularis, Terq., f. l.
,, *tuberculata*, B. and W. v.r. l.
,, *rosacea*, d'Orby, f. l.
Planorbulina mediterraniensis, d'Orby, v.r. l.
Truncatulina lobatula, W. and J., v.r. l.
Rotalia beccarii, L., abdt. l.
Gypsina inhærens, Schul., v.r. l.
Nonionina turgidæ, Will., f. l.
,, *scapha*, F. and M., r. l.
,, *depressula*, v.r. d.
Operculina ammonoides, Gron., f. l.
Polystomella striato-punctata, F. and M., r. l.
,, *subnodosa*, v.r. l.

Station IX.—29-38 fathoms.

Pisces.

Cottus scorpius, L., v.r.
Trigla gurnardus, L., fr.
Lophius piscatorius, L., r.
Anarrhichus lupus, L., r.
Liparis vulgaris, Flem., r.
Gadus morhua, L., f.
,, *æglefinus*, L., f.
,, *merlangus*, L., f.
Pleuronectes platessa, L., f.
,, *microcephalus*, Don., f.
Pleuronectes cynoglossus, L., f.
,, *limanda*, L., f.
Hippoglossoides limandoides, Bloch., f.
Arnoglossus megostoma, Don., f.
Clupea harangus, L., f.
,, *sprattus*, L., f.
Acanthias vulgaris, Risso, one.
Raia radiata, Don., r.
,, *clavata*, L., f.
,, *batis*, L., f.

Tunicata.

Acidiella virginea, O.F.M., r. l.
Ascidia mentula, O.F.M., r. l.
Styelopsis glossularia, V. Ben., m. c. l.
Eugyra glutinans, Möll., r. l.

Mollusca.

Anomia ephippium, L., r. l.
Pecten opercularis, L., valves, r.
,, *pusio*, L., v.r. l.
,, *striatus*, Müll., r. l., valves, f.
,, *varius*, L., v.r. l.
Mytilus modiolus, L., one l.
Modiolaria marmorata, Forb., f. l.
Nucula nitida, G.B.S., f. l.
Leda minuta, Müll., f. l.
Montacuta substriata, Mont., v.r. l.
Loripes lacteus, L., f. l.
Axinus flexuosus, Mont., f. l.
Diplodonta rotundata, Mont., v.r. d.
Cardium echinatum, L., f. l.
,, *nodosum*, Turt., v.r. l.
Cyprina islandica, L., r. l.

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* This form is a variety of *G. bulloides*, resembling very closely *G. cretacea* described by d'Orbigny, Mém. Soc. Géol., France.

Venus faciata, Da. C., v.r. l.
,, *casina*, L., v.r. l.
Tellina pusilla, Phil., v.r. l.
,, *balthica*, L., r. d.
Scrobicularia alba (Wood), m. c. l.
,, *prismatica*, Mont., r. l.
,, *tenuis*, Mont., v.r. l.
Solen pellucidus, Penn., f. l.
Thracia prætenuis, Pult., r. l.
,, *papyracea*, Poli., v.r. l.
Corbula gibba, Olivi., f. l.
Saxicava rugosa, L., r. l.
Pholas dactylus, valves, v. r.
Mya arenaria, L., valves, v.r.
Neaera cuspidata, one l.
Xylophaga dorsalis, c., in dead wood.
Dentalium entalis, L., f. l.
,, *tarentinum*, Lmk., v.r. l.
Chiton marginatus, Penn., r. l.
,, *ruber*, Lowe, f. l.
Emarginula fissura, L., one l.
Trochus tumidus, Mont., f. l.
,, *umbilicatus*, Mont., v.r. d.
,, *magus*, L., v.r. d.
Rissoa costata, Ad., v.r. l.
,, *punctura*, Mont., v.r. l.
Cæcum trachea, Mont., r. l.
Turritella terebra, L., f. l.
,, ,, var. *nivea*, Jeff., r. l.
Odostomia rufa, Phil., v.r. d.
Eulima polita, L., r. l.
,, *bilineata*, Ald., one l.
Natica montacuti, Forb., v.r. l.
,, *alderi*, Forb., r. l.
Aporrhaïs pes pelicani, L., r. l.
Buccinum undatum, L., f. l.
Fusus antiquus, L., r. l.
,, *gracilis*, Da. C., r. l.
,, *propinquus*, Ald.
Nassa reticulata, L., r. d.
,, *incrassata*, Str., v.r. d.
Velutina lævigata, Penn., r. d.
Pleurotoma turricula, Mont., r. d.
,, *striolata*, v.r. d.
Defrancia linearis, Mont., r. l.
Cylichna cylindracea, Penn., f. l.
,, *umbilicata*, Mont., r. l.
Utriculus mamillatus, Phil., r. l.
Philine scabra, Müll., r. l.
,, *catena*, Mont., r. l.
Tritonia hombergi, Cuv., v.r. l.
Loligo vulgaris, Lenz., one l.
,, *media*, L., one l.

Crustacea.

Cancer pagurus, L., r. l.
Portunus holsatus, Fabr., r. l.
,, *depurator* (L.), f. l.
Hyas coarctatus, Leach, r. l.
,, *araneus* (L.), one l.
Stenorhynchus rostratus (L.), r. l.
Eupagurus pubescens (Kroy), f. l.
,, *cuanensis* (Thomp.), v.r. l.
,, *bernhardus* (L.), r. l.
Nephrops norvegicus (L.), f. l.
Pandalus montagui, Leach, f. l.
Crangon allmani, Kin., f. l.
Pseudocuma cercaria, f. l.
Cuma scorpioides (Mont.), f. l.
Caprella linearis (L.), f. l.
Arcturus longicornis (Low), r. l.
Callisoma crenata (Bate), f. l.
Neomysis vulgaris (Thomp.), f. l.
Thysanoesea, sp?
Parathemisto oblivia (Kr.), r. l.
Calliopsis bidentata (Kr.), fr. l.
Nyphon gallicum, Hoek., *one l.*
Hyperoche tauriformis (Bate), r. l.
Erythrops Goesii, G. O. Sars., r. l.
Cleone borealis, v.r. l.
Paratylus, sp?
Leucon nasicus (Kroyer), f. l.
Calanus finmarchicus (Gunn), c. l.
Temora longicornis, Müll., fr. l.
Pseudocalanus elongatus, Baird, r. l.
Caligus rapax, M. Edw., f. l.
Ampelisca brevicornis, Costa, f. l.
Balanus balanoides, L., r. d.
,, *porcatus*, Costa, f. l.
Peltogaster paguri (Rathk), r. on *Eupagurus bernhardus*, r. l.

Vermes.

Sipunculus bernhardus? r. l.
Aphrodite aculeata, L., r. l.
Pectinaria belgica, Pall., f. l.
Sabella pavonia, Sav., f. l.
Serpula vermicularis, Ellis, f. l.
,, *triquetra*, L., f. l.
Filigrana implexa, Berk., r. l., [colonies.
Tomopteris onisciformis, Esch., f. l.
Sagitta bipunctata, Q. and G., m. c.
Flustra securifronds, Pall.
Membranipora pilosa, L., m. c.
,, *membranacea*, L., r. l.
Gemellaria loricata, L., r. l.
Cellaria sinuosa, Hass., r. l.
Crisia eburnea, L., r. l.
Diastopora obelia, Johnt., v.r. l.
Alcyonidium parasiticum, Flem., m. c.
Mucronella variolosa, Johnt., v.r. l.

Echinodermata.

Spatangus purpureus, Müll., r. l.
Solaster papposus, Fabr., r. l.
Ophiura ciliaris, L., v.r. l.
Amphiura filiformis, O.F.M., r. l.
Ophiothrix fragilis, Abild., f. l.
Echinocardium flavescens, O.F.M., [f., young, l.
Asterias rubens, L., v.r. l.
Ophiura albida, Forb., f. l.
Henricia sanguinolenta, O.F.M., r. l.
Luidia sarsii, Dub. and Kor., one, l.

Actinozoa and Hydrozoa.

Actinoloba dianthus, Ellis, r. l.
Rhizastoma, sp, r. l.
Heterocordyle Conybearei, f., c. on [d. Aporrhaïs shells.
Hydrallmania falcata, L., v.r. l.
Sertularia abietina, L., v.r. l.
Sertularia argentea, E. and S., r. l.
Virgularia mirabilis, Lamk., f. l.
Ctenophora, f. l.
Eudendium ramosum, Pallas, f. l.
Antennularia antennina, L., v.r. l.
Diphasia pinaster, E. and S., r. l.
Plumularia pinnata, L., r. l.

Porifera.

Suberites ficus, Johnston, v.r. l.
Chalina? sp? several l.

Foraminifera.

Nubecularia lucifuga, Defr., v.r. l.
Biloculina ringens, Lamk., m. c. l.
,, *depressa*, d'Orby, f. l.
,, *elongata*, d'Orby, r. l.
Spiroculina limbata, d'Orby, f. l.
,, *excavata*, d'Orby, v.r. l.
Miliolina seminulum, L., c. l.
,, *circularis*, Born.
,, *oblonga*, Montag., f. l.
,, *trigonula*, Lamk., r. l.
,, *venusta*, Karr., v.r. l.
Miliolina tricarinata, d'Orby, v.r. l.
,, *boueana*, d'Orby, r. l.
,, *secans*, d'Orby, r. l.
,, *contorta*, d'Orby, v.r. l.
,, *agglutinans*, d'Orby, [v.r. l.
Ophthalmidium inconstans, Brady, [f. l.
Cornuspira involvens, Rss., f. l.
,, *foliacea*, Philip, r. l.
Astrorhiza limicola (Sandahl), r. l.

Psammosphæra fusca, Schz., f. l.
Hyperammina arborescens, Norm., [f. l.
Reophax scorpiurus, Montf., c. l.
,, *Scotti*, Chaster, f. l.
,, *fusiformis*, Will., f. l.
Haplophragmium canariensis, [d'Orby, c. l.
,, *glomeratum*, [Brady, c. l.
,, *pseudo-spirale*, [Will., f. l.
Ammodiscus gordialis, P. and J., [v.r. l.
,, *charoides*, P. and J., [v.r. l.
,, *incertus*, d'Orby, v.r. l.
Trochammina inflata, Montf., r. l.
,, *ochracea*, Will., f. l.
Textularia gramen, d'Orby, f. l.
,, *agglutinans*, d'Orby, f. l.
Spiroplecta sagittula, Defr., c. l.
Gaudryina filiformis, Berth., [m. c. l.
Verneuilina polystropha, Rss., f. l.
Bulimina elongata, d'Orby, r. l.
,, *marginata*, d'Orby, f. l.
,, *aculeata*, d'Orby, r. l.
,, *elegans*, d'Orby, r. l.
,, *elegantissima*, d'Orby, f. l.
,, *inflata*, Sequ., f. l.
,, *fusiformis*, Will., f. l.
Virgulina schreibersiana, Cziz., [m. c. l.
,, *squamosa*, d'Orby, f. l.
,, *texturata*, f. l.
Bolivina punctata, d'Orby, f. l.
,, *plicata*, d'Orby, f. l.
,, *robusta*, Brady, v.r. l.
,, *reticulata*, Hartken, f. l.
,, *lævigata*, Will., v.r. l.
Cassidulina crassa, d'Orby, f. l.
,, *lævigata*, d'Orby, v.r. l.
Lagena sulcata, W. and J., f. l.
,, *interrupta*, Will., v.r. l.
,, *costata*, Will., f. l.
,, *distoma*, P. and J., v.r. l.
Lagena striata, d'Orby, f. l.
,, *gracillima*, Segu., f. l.
,, *fimbriata*, Brady, v.r. l.
,, *lævis*, Mont., m. c. l.
,, *lævis* var., f. l.
,, *globosa*, Mont., f. l.
,, *globosa* var., v.r. l.
,, *marginata*, W. and B., v.r. l.
,, *alveolata*, Brady, r. l.
,, *quadricostulata*, Wr., v.r. l.
,, *pulchella*, Brady, v.r. l.
,, *squamosa*, Mont., r. l.
,, *lævigata*, Rss., f. l.
,, *tenuistriata*, Brady, r. l.
,, *distoma* var., P. and J., [v.r. l.
,, *orbignyana*, Seg., r. l.
,, *trigono-marginata*, P. and [J., v.r. l.
Nodosaria communis, d'Orby, f. l.
,, *pyrula*, d'Orby, f. l.
,, *scalaris*, Bate, r. l.
,, *filiformis*, L., r. l.
Cristellaria rotulata, Lamk., v.r. l.
,, *gibba*, d'Orby, f. l.
,, *cultrata*, Montf., f. l.
,, *articulata*, Reuss, l.
Polymorphina lactea, W. and J., [v.r. l.
,, *augusta*, v.r., l.
,, *communis*, d'Orby, r. l.
,, *compressa*, d'Orby, r. l.
,, *lanceolata*, Rss., r. l.
,, *elegantissima*, P. and J., [v.r.
Uvigerina angulosa, Will., v.r. l.
,, *pygmæa*, d'Orby, one d.
Globigerina bulloides, d'Orby, f. d.
,, *triloba*, Rss., f. d.
,, *cretacea*-like form, d'Orby, [f. d.
Spirillina limbata, Brady, r. l.
Patellina corrugata, Will., r. l.
Discorbina rosacea, d'Orby, f. l.
,, *ochracea*, Will., r. l.
,, *globularis*, d'Orby, f. l.
,, *orbicularis*, d'Orby, f. l.

Planorbulina mediterraniensis, [d'Orby, f. l.
Truncatulina lobatula, W. and J., r. l.
,, *lobatula* var., W. and [J., f. l.
Pulvinulina Karsteni, Rss., r. l.
Rotalia beccarii, L., abdt. l.
,, *nitida*, Will., f. l.
Gypsina inhærens, Schul., v.r. l.
Nonionina turgida, Will., f. l.
,, *scapha*, F. and M., f. l.
,, *depressula*, W. and J., [v.r. l.
,, *stelligera*, d'Orby, v.r. l.
Operculina ammonoides, Gron., f. l.
Polystomella striato-punctata, F. [and M., f. l.
,, *subnodosa*, r. l.

MARINE DEPOSITS AND THEIR BEARING ON MARINE LIFE.

It is possible by careful examination of most marine deposits to determine very closely what kind and amount of marine life is likely to be found in any given area over the sea floor.

It has, therefore, often occurred to me that an examination of the marine deposits round our coasts, and over the areas of our great fishing grounds and banks, would greatly assist in throwing light upon the question as to the cause of the destruction of marine life, the movements and depopulation of fish from our inshore fishing grounds, banks, and estuarian waters, which, it is well known, were at one time thickly populated with abundance of marketable fish, but are at the present time, in some localities, scarcely worth the fishing.

Under ordinary natural conditions, animal life is usually found plentifully distributed all over these areas, but I have to record here that, so far as the Firth of Forth is concerned, a change of conditions has taken place which is undoubtedly detrimental to the marine life generally.

By examination of the deposits and general condition of the ground in these localities, a key to this question is, in my opinion, possible to be found. To carry this out, it is necessary to keep in mind the following chief points :—

1. The geographical features and position of the area to be considered.
2. The physical conditions; the amount, condition, and number of species of animals found living on the sea floor; and in the deposits themselves.
3. The age of the deposits, rate of accumulation, their permanency, and in what measure they are affected by wave action and currents.

4. The amount of detrital and other matter brought to and deposited over these areas from rivers, general land drainage, and disintegration of the coast line.
5. The amount of material deposited from steam-ships, dredgers, and sewage, or solid matter in suspension.

Or one might put the question in two words—are the deposits *clean* or *polluted?* Upon the greater or less degree the grounds are affected by these agencies, will the destruction of the bottom-living and pelagic animals and movements of the fish be regulated.

The Firth of Forth may, perhaps, be taken as a more or less typical example. Not many years past in this area marketable fish were to be taken in plenty, while we know at the present time comparatively few can be captured either by trawl, line, or other appliances. Continuous trawling would, doubtless, in such a restricted area, soon clear it of fish for a time, but if left undisturbed for a reasonable time, there can be little doubt that it would become repopulated were the surrounding conditions favourable, which is the case where ordinary natural conditions of the sea are not disturbed or polluted. It will not be disputed that where the water is pure and the deposits not continually disturbed or polluted, everywhere at a reasonable depth, from the tidal line downwards over the sea floor, marine life is abundant, and that the lower animals furnish the chief food of the higher forms.

The examination of the deposits found in the area under consideration, and described in these notes, indicate fully that the conditions are not favourable to the attraction and necessary support of marine life, especially of any large quantity of fish whose chief food consists of invertebrate animals which live in and on the deposits over its floor. Not many years past there was to be found living, generally distributed over the floor of the Firth of Forth, patches or banks of considerable extent, covered thickly with living *Pecten opercularis*, L. ("clam" of the fishermen); *Turritella terebra*, L. (a long, conical, univalve Mollusc); *Ostrea edulis*, L. (oyster); *Mytilus edulis*, L. (the common mussel); *Buccinum undatum*, L. (buckie); and other Mollusca, with abundance of many species of invertebrate animals, as CRUSTACEA, ANNELIDS, ECHINODERMS, HYDROZOA, &c., &c., "fish food." At present, however, comparatively few of the latter, and nothing like the quantity of the former species are to be found living. The deposits, on the other hand, are full of their dead remains, the dredge often bringing up huge quantities at each haul.

The "Clam," "Oyster," "Mussel," and *Turritella* beds have greatly diminished in size. They are, in some places, entirely destroyed, and are only now to be had in comparatively small quantities in a few more or less favourable localities, namely:— About the North Craig Buoy, off Cockenzie, Prestonpans, and a few here and there on and near the edges of the Middle Bank. That the marine life generally on the floor of the Firth of Forth has been gradually killed off appears evident. The greater portion of the area within 3 or 4 miles west from the May Island, as seen by the examination of the deposits, reminds one more of a huge burial-ground, so numerous are the quantity of the bones, "so to speak," of the marine organisms one finds in them.

In working over the district, the struggle for existence is strikingly illustrated by the difference in the number of living animals captured. The nearer one approaches the mouth of the Firth from Inchkeith, gradually the various forms of marine life (especially the lower forms) increase in number and species, as will be seen by reference to the lists accompanying these notes of the animals obtained at each of the special observing stations (see Chart). Taking Stations I. and IX., for example, we find at Station I., at a depth of 10 to 18 fathoms, 1 to 5 miles east of Inchkeith, the following result:—

Name of Group.	No. of Species obtained.	No. of Species obtained living.	No. of Species obtained dead.	No. of bottom-living Species.	No. of Species which lead a pelagic life.	No. of Species found living on the bottom at the time of observation.
Fish,	14	14	...	8	6	6
Tunicates,	1	1	...	1	...	1
Mollusca,	23	1	22	23	...	1
Crustacea,	18	18	...	8	10	5
Vermes,	19	12	7	17	2	10
Actinozoa and Hydrozoa,	8	8	...	6	2	6
Foraminifera,	32	6	26	32	...	6
Total,	115	60	55	95	20	35

At Station IX., at a depth of 29 to 35 fathoms, 5 to 10 miles south-east of the May Island:—

Name of Group.	No. of Species obtained.	No, of Species obtained living.	No. of Species obtained dead.	No. of bottom-living Species.	No. of Species which lead a pelagic life.	No. of Species found living on the bottom at the time of observation.
Fish, . .	20	20	...	13	7	7
Tunicates, .	4	4	...	4	...	4
Mollusca, . .	69	64	5	69	...	64
Crustacea, .	35	34	1	19	16	18
Vermes, . .	28	27	1	26	2	27
Actinozoa and Hydrozoa,	12	12	...	10	2	10
Porifera, . .	2	2	...	2	...	2
Foraminifera, .	115	112	3	112	3	112
Total, .	285	275	10	255	30	244

From the above Tables it will be seen that the number of different species of animals obtained at Station I. is altogether 115. Twenty of these lead a truly pelagic life; 95 live on the bottom or in the deposit itself. Of these 55 were dead, leaving only 35 species living.

At Station IX., near the mouth of the Firth, we find quite a different state of matters. Here we have in all 285 species, 30 pelagic and 255 bottom-living forms. Of these, only 10 were found dead, less than 5 per cent.; while 244 species were found living on the bottom at the time these observations were made, against 55 species obtained at Station I.* So far as my investigations have extended, I have not been able to find any quantity of pelagic life that might be termed permanent local "Plankton," as is to be found in other similar localities, *i.e.*, Clyde estuary and Loch Fyne, &c. These organisms would appear to be chiefly regulated in this case by tidal influences, shallowness of

* It should be mentioned here that the Ostracoda have been omitted, as I have not yet been able to identify them all. They would, however, not alter the total results materially. The fish stated to be living on the bottom in Column 5 have been placed in this Column, as they are true bottom feeders, and do not lead a truly pelagic life.

the Firth, and purity of its waters, at different seasons of the year, by the greater or less amount of detrital and solid matter in suspension.

These pelagic organisms are usually, under ordinary circumstances, in such quantities that vast numbers of them are constantly dying off with the ever-changing physical and developmental conditions in the surface and sub-surface waters; their remains, sinking to the bottom, carry down with them quantities of organic material, forming one of the chief factors from which many of the bottom-living animals derive their food supply. The want of this constant supply in the Firth of Forth would be disastrous to their existence.

That a great destruction of many of the more important forms of marine life on the floor of the Firth of Forth has taken place there can be no doubt. In the case of the *Oyster*, *Clam*, and *Mussel* it has been well known for some time. To account for this serious destruction many causes have been put forward from time to time. The most likely may be mentioned here:—(1) reckless fishing; (2) deposition of peat, &c., brought down the Forth from its upper reaches by currents; (3) deposition of mud, &c., from harbour dredgers; (4) pollution from oil and other factories situated along its shores; (5) changes in the seasons; (6) the throwing over of ashes and "clinker" from steamers. With the exception of the first, perhaps, all the causes above mentioned are strikingly illustrated by the examination of the deposits found all over the area between Inchkeith and May Island. Not one of the samples examined by me can be said to be free from one or other of these polluting substances.

It is also true that during the winter months and early spring the waters of the Forth often become heavily laden with fine argillaceous matter in suspension. A large amount of dredged material from harbours have been and are still deposited in this area. The number of steam-ships entering and leaving the Firth have greatly increased, and are answerable for many thousands of tons of material in the form of ashes, "clinker," &c., indiscriminately thrown overboard and distributed over its floor. An increase of sewage and other detrital matter constantly enters its waters. This, with any sudden extra large amount of argillaceous matter brought down by the rivers and general land

BATHYMETRICAL CHART OF THE FIRTH OF FORTH, SHOWING THE PRINCIPAL RIVERS AND STREAMS ENTERING THE FIRTH AND DISTRIBUTION OF DEPOSITS.

drainage—which at times takes place during westerly and south-westerly gales, with heavy rain—on sinking to the bottom, forms layers of fine mud, from a $\frac{1}{8}$ to 1 inch in thickness, over a large area of its surface, and is traceable out to the extreme limits. Many of the dead and living animals brought up by the dredge or trawl often showed distinctly a thin coating of this material, which mostly resembles river mud. Further investigation is necessary to determine the exact quantity of the solid matter in suspension, and would be of great importance in determining decisively as to whether the introduction of so much solid and detrital matter is the true cause of the destruction of the marine life. It is quite probable that it chokes off great quantities of the invertebrate animals mentioned as inhabiting the floor of the Forth, and in the deposits themselves, causing them to become, as I have said, polluted and unfit for the maintenance and existence of marine life, causing the destruction of the feeding grounds, and migration of the fish. Hence it is to the more open waters, or where the deposits are *clean*, that such agencies above mentioned cannot affect them to such a degree, that we may, by reasonable methods, expect a constant and plentiful supply of both vertebrate and invertebrate marine life.

Further and systematic investigations on this subject in the Firth of Forth and other localities is necessary, and would be of great interest and importance in discussing these matters more fully.

Reports on Excursions.

CAMIS ESKAN, 1st September, 1900.—A party of fifteen, under the guidance of Mr. D. R. Somerville, visited this old residential estate on a fine afternoon. The estate of Colgrain, together with Meikle and Little Camis Eskan, belonged to the family of Dennistouns before 1377, and continued in possession of the family for nearly 500 years. In 1836 it was sold to Mr. Colin Campbell, third son of Mr. John Campbell of Morreston, Lanarkshire. There was a chapel dedicated to St. Blane, erected on the lands by an early laird of Colgrain, but no trace of it remains. The mansion is well situated in wooded grounds. On a stone in the older part of the house are cut the letters and date 16 ID. IS. 48. These are evidently the initials of the eleventh laird, John Dennistoun, and of his wife Jean Sempill, daughter of William Sempill of Fulwood, who were married 15th February, 1648. John Dennistoun was an active Royalist, and died in 1655 of wounds received in an attempted rising in the Highlands in the previous year.

The only plant of special interest observed was the Twayblade, *Listera ovata*, R. Br. Attention was directed principally to the trees, among which were some very fine specimens of silver fir, walnut, elm, and sycamore. Mr. Renwick and Mr. M'Kay made the following measurements of trees :—

Silver Fir, below house, on side of avenue—
11 ft. 2½ins. at 5 ft. side next avenue.

Sycamore, to south east of house—
14 ft. 2¾ ins. at 5 ft. next avenue, bole 14 ft.

Elm, to south west of house—
14 ft. 10 ins. at 4 ft. 10 ins.; bole 8½ ft.; height 81 ft.; spread, N.E. to S.W., 90 feet.

Walnut, to south of house—
9 ft. 3½ ins. at 5 ft.; bole 11 ft.

Silver Fir, on side of burn above house—
13 ft. 1 in. at 5 ft.

Silver Fir, farther up burn—
13 ft. 7 ins. at 5 ft. = 7 ft. 1 in. above walk.

Silver Fir, still farther up—
12 ft. 11¼ ins. at 5 ft. next avenue.

Mr. Wm. Stewart has drawn up the following list of 27 Fungi and 8 Ferns obtained at Camis Eskan :—

Fungi.

Ag. phalloides, Fr.
,, *rubescens*, Pers.
,, *vaginatus*, Bull.
,, *cristatus*, A. & S.
,, *papilionaceus*, Fr.
,, *radicatus*, Rehl.
,, *laccatus*, Scop.
,, *virgatus*, Fr.
,, *geophyllus*, Sow.
,, *calolepis*, Fr.
Lactarius blennius, Fr.
,, *quietus*, Fr.
,, *vellereus*, Fr.
,, *hysginus*, Fr.
Russula fellea, Fr.
,, *emetica*, Fr.
,, *nigricans*, Fr.
,, *cyanoxantha*, Fr.
Hygrophorus psittacinus, Fr.

Fungi.

Hygrophorus calyptræformis, B. & Br.
,, *virgineus*, Fr.
,, *chlorophanus*, Fr.
Marasmius peronatus, Fr.
,, *porreus*, Fr.
Cantharellus cibarius, Fr.
Boletus flavus, With.
Lycoperdon pyriforme, Schæff.

Ferns.

Athyrium Filix-fœmina Bernh.
Lastrea Filix-mas, Rich.
,, *dilatata*, Desv.
,, *Oreopteris*, Desv.
Polystichum aculeatum, Sw.
,, form *lobatum*, Sw.
Polypodium vulgare, L.
Pteris aquilina, L.

Douglas Support, 15th September, 1900.—Mr. William Stewart, the conductor of this excursion, reports that the fungi were remarkably scarce even in very suitable ground, but that the following species were obtained :—

Ag. (*Amanita*) *rubescens*, Pers.
,, (*Clitocybe*) *laccatus*, Scop.
,, (*Collybia*) *radicatus*, Rehl.
,, (*Inocybe*) *rimosus*, Bull.
,, (*Hypholoma*) *velutinus*, Pers.
Coprinus micaceus, Fr.

Lactarius blennius, Fr.
,, *serifluus*, Fr.
Russula nigricans, Fr.
,, *fellea*, Fr.
,, *ochroleuca*, Fr.
Clavaria cinerea, Bull.

Mr. Renwick and Mr. M'Kay measured the following trees :—

Hornbeam, 8 ft. 1½ ins. at 5 ft. S.W; bole, 17 ft; spread, 60 ft; height, 78 ft.

Hornbeam, 7 ft. 6¼ ins. at 5 ft.; bole 18 ft.

Beech, E. of four, 12 ft. 9 ins. at 5 ft. next bridge.

Beech, N. of four, 13 ft 10 ins. at 5 ft. next river; bole, 35 ft.; height, 89 ft.

Beech, W. of four, 14 ft. 0½ in. at 5 ft. N.

Beech, S. of four (near stone bridge), 12 ft. 6½ ins. at 5 ft. next bridge; bole, 32 ft.

Beech, to S. of suspension bridge, 14 ft. 9 ins. at 5 ft.; bole, 40 ft.

Beech, one of a pair on haugh between house and river, 12 ft. 2 inches at 5 ft.; bole, 30 ft.

Beech, the other of pair, 11 ft. 7½ ins. at 5 ft.; bole, 18 ft.; height, 88 ft.

Buchanan Castle, 24th September, 1900 (Glasgow Autumn Holiday).—Mr. John Renwick reported on this excursion, as follows:—

"The party went by rail *via* Balloch to Drymen Station, walking thence to the village of Drymen, fully a mile and a-half distant. The first part of the road, from the station to near the River Endrick, was a turnpike road leading to Glasgow by Easter Kilpatrick, made towards the close of last century. In the Statistical Account of Kilmaronock Parish, written about 1792, it is stated to be 'now nearly completed.' Near Catter House, it joins the military road from Dumbarton to Stirling, which crosses the Endrick 'by an excellent modern bridge,' and passes from the Parish of Kilmaronock, in Dumbartonshire, to that of Drymen, in Stirlingshire. From the townhead of Drymen, a road leads past the Parish Church of Buchanan to Balmaha, and onward, near the shores of Loch Lomond, to Rowardennan. It was completed about 1790, after about thirty years' slow work. The policies of Buchanan lie on the sloping ground between this road and the River Endrick, which winds in many a link among the haughs laid down by itself when the land lay at a lower level than now. The writer of the Statistical Account of Buchanan Parish says 'This river, in the winter season, when the loch is full, covers a great part of the lower grounds on both sides of the parishes of Buchanan and Kilmaronock, and when the water lies dead and goes off gradually, it enriches the ground; but the floods have often proved hurtful in the spring, after the seed was sown, and oftener in harvest, both before the corns were cut down, and afterwards, carrying some away, and greatly damaging the rest. In harvest, 1782, in a flood, the haughs of Endric in this parish were covered with water, and immediately after there came snow and ice, so that in some places people walked on the ice above the standing corn.'

"Buchanan belongs to the Duke of Montrose, but for seven centuries it was the property of the Buchanans of that ilk. The direct line of the old family became extinct in 1682, when John Buchanan, the 22nd laird, died. The estate was then purchased by the third Marquis, who afterwards became the first Duke, of Montrose.

"The policies are of considerable extent, about two and a-half miles in length by fully a mile in breadth, and are well wooded. Mr. Crosbie, the gardener, stated that, from the sheltered situation, Buchanan is more moist than are other localities farther north, on the side of Loch Lomond, and the trees are thus more covered with lichens and moss.

"Under this gentleman's guidance the party visited the hothouses, the flower and fruit gardens, and the policies. In the gardens they were shown the original plant of the Buchanan Fern (*Athyrium Filix-fœmina*, var. *Victoriæ*, Moore). This fern was discovered by Mr. James Cosh in 1861 by the side of a wood on this estate, and was removed to the garden in 1863. Mr. Wm. Stewart states that it grows freely from spores, retaining perfectly its unique character, and is now in all the fern nurseries.

"Between the gardens and the castle are a number of very fine conifers. Nowhere in our excursions have we seen any specimen' of the Menzies Spruce Fir (*Abies menziesii*, Loudoun), at all approaching one here, which rises to a height of 81 feet, has a spread of 49 feet, and a girth of 9 feet 1 inch at 5 feet up. A fine Noble Silver Fir (*Picea nobilis*, Loudoun), also attains a height of 81 feet, with a girth of 7 feet 9¼ inches at 5 feet. A Wellingtonia (*Sequoia gigantea*, Lindley), has a height of 71 feet, and a girth of 9 feet 3½ inches at 5 feet, 10 feet 9 inches at 3 feet, and 13 feet $7\frac{3}{4}$ inches at 1 foot, thus exceeding in height the one seen on the Spring Holiday at Dalquharran, Ayrshire, and nearly rivalling it in girth. A Cedar of Mount Atlas (*Cedrus atlantica*, Manetti), girths 4 feet 11 inches at 5 feet. To the west of the castle is a very fine Yew (*Taxus baccata*, L.), a female tree. It has a girth of 11 feet $9\frac{1}{4}$ inches at 2 feet 9 inches on south side, a bole of $7\frac{1}{2}$ feet, and a spread in one direction of $58\frac{3}{4}$ feet and in another of $55\frac{1}{2}$ feet. But the most abundant conifer is the Douglas Spruce Fir (*Abies douglasii*, Lindl.), which forms quite a feature in the grounds. A plantation of 6 acres, planted about 1858, was pointed out. Two fine specimens near the old house were measured. One had a girth of 11 feet $8\frac{1}{4}$ inches at 5 feet. The other was even a more splendid tree, girthing 13 feet 2 inches at 5 feet, and attaining a height of $84\frac{1}{2}$ feet. From inquiries which Mr. Crosbie has made, this grand tree appears to be about 72 years old.

"In former times the Oak (*Quercus robur*, L.), would seem to have been a feature of the woodlands of Buchanan Parish, which extends from the Endrick up Loch Lomond to opposite Ben Voirlich, thence to near the head of Glengyle, and includes part of Loch Katrine, Loch Arklet, and Ben Lomond. The writer of the (Old) Statistical Account, 1792, says 'Near the house of Buchanan there is an old Oak Wood, great additions have been made to which within these forty years past. The present Duke of Montrose is planting a great deal of different kinds of trees in the bottom of Buchanan. In the Island of Inchcailloch there is a large Oak Wood. From the Grampian Hills to the north end of the parish, along the side of the loch, is one continued wood, consisting of some Ashes, Alders, Hazels, but mostly Oaks.' In the New Statistical Account, drawn up February, 1838, and revised March, 1841, it is stated that 'in the parish there are many Oaks from 10 to 13 feet in circumference. One near Buchanan House, at the height of 5 feet from the ground, is 14 feet in circumference, and contains 200 feet of timber. Another Oak is 18 feet in girth near the surface, but immediately branches out into five stems called 'the Five Sisters of Buchanan.' These trees are supposed to be 500 years old.' The former tree had grown from 14 feet, about 1840, to 16 feet $8\frac{1}{2}$ inches, in May, 1889, and to 17 feet $4\frac{3}{4}$ inches, in September, 1900. The rate of increase in the two terms of years is almost identical, ·67 of an inch yearly in the first, and ·69 of an inch in the second. The bole is short, dividing into two large stems at 7 feet up, but the tree is a tall one, rising to a height of 87 feet. The 'Five Sisters' tree, which was 18 feet near the surface about 1840, was 19 feet 3½ inches at 2 feet 4 inches from the ground in May, 1889, and 19 feet 6 inches at 2 feet 4 inches in September, 1900. The tree is decaying, and part of the stem has been broken off, otherwise the increase would have been greater than 2½ inches in twelve seasons. Another Oak measured 13 feet 6 inches in girth at 4 feet, with a bole of 8 feet.

"In the park west of the castle is a Spanish Chestnut (*Castanea sativa*, Mill.), girthing 18 feet 6 inches at 2 feet 6 inches. It divides at 8 feet from the ground into three large stems, and the bole is evidently breaking asunder into three. The trunk is covered with patches of lead. In May, 1889, the girth was 15 feet 9 inches at 2 feet 6 inches, and part of the apparent increase is evidently due to the trunk being forced asunder by the weight of the three divisions. Near the castle is a Spanish Chestnut planted by Charles Kean in 1865. It has a tapering bole of nearly 35 feet in length. In May, 1889, it had a girth at 2 feet 6 inches up of 2 feet 7½ inches, now it is 5 feet 5¼ inches, an increase of 2 feet 9¾ inches in 12 seasons, or at the rate of fully 2¾ inches yearly.

"A Birch (*Betula verrucosa*, Ehrh.), measured 7 feet 1¾ inches at 5 feet, with a bole of 12 feet.

"In the policies are the ruins of Our Lady Chapel, or the Chapel of St. Mary of Buchanan, which, wrote the late Mr. J. Guthrie Smith, 'are rapidly disappearing, being hid from view by shrubs and undergrowth. It was surrounded by a churchyard, and stands among very fine old trees, notably a magnificent Plane, a little to the north-west of the old house of Buchanan, not far from the present stable-yard. It lay east and west, and its site is still marked by stones, and still standing in the middle is what remains of a large stone font. There are several tombstones lying in and near the old church, but upon none of them is any inscription left.' The present minister of the parish has, we were told, had the font and some of the tombstones removed to the church. We measured the Plane (*Acer Pseudo-platanus*, L.), mentioned by Mr. Smith, and found it to girth 12 feet 7 inches at 7 feet 3 inches from the ground, with a good bole of 20 feet. The stem is curiously irregular, and a measurement at 5 feet would have given a much greater circumference. At an average of 1 foot from the ground it girths 18 feet 1 inch. Above 1 foot up it projects considerably on one side.

"According to the Statistical Account, the Parish of Buchanan was formerly called Inchcailloch, from the island of that name, where the church was until 1621, when a considerable part of the Parish of Luss, situated on the east side of Loch Lomond, was annexed to the Parish of Inchcailloch. Luss, however, had some lands added to it that formerly belonged to Inchcailloch. The church in the island having become dilapidated, and the people not finding it convenient to cross, especially in stormy weather, worship was performed in this chapel, which was formerly a chapel of ease belonging to the Parish of Luss. From this chapel of Buchanan the whole united parish came by degrees to be called the Parish of Buchanan.

"Mr. Anderson Fergusson found the following species of Coleoptera:—*Oxypoda alternans*, Grav.; *Autalia impressa*, Ol.; *Bolitobius trinotatus*, Er.; *Gyrophæna pulchella*, Heer., about twelve examples, all in decaying fungi.

"The last-named proved to be new to Scotland."

Cadzow, 27th April, 1901.—A party of about twenty, with Mr. James Murray as conductor, left Glasgow by the 2.21 p.m. train to Hamilton, and proceeded to Cadzow High Parks. On the way the maple trees at the entrance to Barncluith were noted to be in a healthy condition. Entering Cadzow, the whole party at first walked to the Old Castle, and thereafter dividing into companies, some went through the parks to get a better view of the famous white cattle, others, devoted rather to entomology, kept to the bed of the Avon, and a third party strolled down the glen. The weather was beautiful, and the excursion was much enjoyed. The following Diptera were collected by Mr. Alex. Ross:— *Dixa maculata*, Mg.; *Dicranomyia chorea*, Mg.; *Dactylolabis*, sp. (?); *Trichocera regelationis*, L.; *T. hiemalis*, Deg.; *Rhyphus fenestralis*, Mg.; *Scatophagus stercorarius*, L.

The following trees were measured by Mr. Renwick and Mr. M'Kay:—

Sycamore at Barncluith gate—girth, 15 ft. $8\frac{3}{4}$ ins. at 4 ft. 8 ins., showing an increase in girth of $1\frac{3}{4}$ ins. in 3 years, or an average of ·58 in. yearly.

Sycamore, at Chatelherault—girth, 13 ft. $9\frac{1}{2}$ ins. at 4 ft. 9 ins.; bole, 8 ft.

Oak, near Green Walk—girth, 21 ft. 9 ins. at 5 ft.; bole, 26 ft.

This tree is decaying at the extremities of the branches, the increase in girth in three years is only half-an-inch.

Oak, in High Parks—21 ft. 3 ins. at 3 ft. 6 ins.; bole, 7 ft.

Oak, at sheds in High Parks—girth, 15 ft. $5\frac{3}{4}$ ins. at 4 ft. 6 ins., showing an increase in girth of $2\frac{1}{4}$ ins. in three years, or an average of ·75 in. yearly.

Evergreen Holly Oak, at Chatelherault—girth, 3 ft. 3 ins. at 3 ft. 8 ins.; bole, 4 ft.

CASTLEMILK, RUTHERGLEN, 16th May, 1901.—Only six members joined in this evening excursion, the conductor being Mr. Thomas Boyle. The bedroom in the Castle, where it is reported that Mary Queen of Scots passed the night before the battle of Langside, was inspected, and thereafter the pond, garden, and greenhouses were visited.

CULZEAN CASTLE AND CROSSRAGUEL ABBEY, 23rd May, 1901 (Victoria Day).—This excursion, which was undertaken jointly with the Andersonian Naturalists' Society, was attended by fifty-two, the conductor being Mr. Hugh Boyd Watt, who contributed the following report:—

The route followed was from Maybole by road, and through the policies and gardens of Culzean, and back to Maybole by the Kirkoswald road.

Cameras were much in evidence, and a large number of photographs were taken.

The policies were entered at the Pennyglen Gate, and the shade of the trees afforded welcome cover from the hot sun of one of the warmest days of this very fine month of May. So far as was observed, there were no woodland trees of remarkable size, but there is a great variety of introduced trees, shrubs, and herbs. Mr. Dale, the forester, who acted as guide, said that he understood that the grounds had been planted about 120 years ago by a Mr. Robertson—about the same year (1777) as that in which the present castle was built. The trees are numerous and flourishing in spite of proximity to the sea. North of the castle, a thickly-wooded bank extends right down to the sandy sea-shore, the trees extending nearly to high-water mark. Throughout the policies there was a fine show of flourish on different species of trees.

After visiting the beautiful flower garden and the castle terrace, which commands a noble sea prospect, a descent was made to the shore at the base of the cliff on which the castle stands. Some time was spent here, and the well-known "Coves of Culzean," which are old sea caves, were visited. Some of the party proceeded along the rough shore, but the majority preferred to return to the grounds and woodlands. The picturesque pond, with its water-fowl, was also visited. Shrubs and flowering plants are being planted in considerable numbers on its banks at present. Either to assist in this work, or for some other object, the water had been partially drawn off, and the pond did not appear at its best. A short visit was paid to the gardens; and the Rhododendron, said to be the largest in the country, and the great Fig tree were seen. Leaving the policies at Sunnyside, the bulk of the party proceeded to Crossraguel Abbey, but time only allowed a brief stay to be made here. The abbey is one of the most complete of the ruined ecclesiastical buildings of Scotland, and seems to be carefully preserved. Maybole was reached again about 5 o'clock, and a welcome "high tea" partaken of at the Commercial Hotel.

The following specific observations were made:—

Mammalia.—A herd of Fallow Deer (*Cervus dama*, L.) used to be kept in a park, but they now run wild in the Culzean woods and do so much damage to the trees that the deer are being shot down. There are also a considerable number of Roe Deer (*Capreolus caprea*, Gray) known to be in the policies.

Aves.—Chiffchaffs (*Phylloscopus rufus*, Bechs.) brought themselves to notice at Culzean by calling frequently in the tree-tops. They were heard in some ten different places. The Wood Wren (*P. sibilatrix*, Bechs.) was also heard several times. Crossraguel Abbey and the adjacent Baltersan Castle are great haunts of the Swift (*Cypselus apus*, L.), many dozens of which were flying around. Mr. John Paterson called on the head gamekeeper, and saw in his collection stuffed locally-taken examples of the Rough-legged Buzzard (*Archibuteo lagopus*, Gmel.), a species not otherwise recorded for Ayrshire so far as is known; also a Hen Harrier (*Circus cyaneus*, L.) and Peregrine Falcon (*Falco peregrinus*, Tunst.) This is how our grander birds of prey are accounted for!

Insecta.—Mr. A. Ross collected the following *Tipulidæ*, but reports that "daddies" were scarce, probably because no "wild" ground was gone over:—

1. *Limnobia nebeculosa*, Mg.
2. *Dicranomyia chorea*, Mg.
3. *Rhipidia maculata*, Mg.
4. *Empeda nubila*, Schum.
5. *Molophilus appendiculatus*, Staeg.
6. *Rhypholophus nodulosus*, *Mcq.*
7. *Amalopis immaculata*, Mg.
8. *T. vittata*, Mg.
9. *Tipula oleracea*, L.

Some other *Diptera* were also collected which have not yet been identified.

Phaenogamia et Filices.—Mr. J. R. Lee reports the following as the most noteworthy plants:—

Cheiranthus Cheiri, L.	On shore at Culzean; also at Crossraguel.
Chelidonium majus, L.	At Crossraguel Abbey.
Ligusticum scoticum, L.	On shore at Culzean.
Smyrnium olusatrum, L.	Do.
Asperula odorata, L.	In Culzean Castle Grounds.
Orchis mascula, L.	Do.
Neottia Nidus-avis, Rich.	Do.

* *Ornithogalum umbellatum*, L.	In Culzean Castle Grounds.
Scilla verna, Huds.	On shore at Culzean.
Asplenium Adiantum-nigrum, L.	Do.
A. marinum, L.	Do.
Scolopendrium vulgare, Sm.	Do.

Fungus.—The curious fungus *Hirneola auricula-Judae*, Berk., the Jew's Ear, was gathered by Mr. John Paterson, on an old Elder tree.

AIKENHEAD, CATHCART, 30th May, 1901.—Five members of the Society, with Mr. J. J. Robertson as conductor, joined this evening excursion, and were met at the gate of the policies by Mr. Boucher, the gardener, who led the party over the grounds. The Chestnut trees in front of the house were particularly admired, the new rockery was inspected, and the garden and greenhouses were visited. In some of the latter, the British Maidenhair Fern (*Adiantum capillus veneris*, L.) was growing very luxuriantly, and propagating itself in every nook and crevice.

GARSCUBE, 13th June, 1901.—Only three members of the Society made up the excursion party on this evening. The wide extent of the estate, with its beautiful situation and exquisite views of the Kelvin, was much admired. There was an extraordinary wealth and variety of Rhododendrons, which specially attracted attention.

COREHOUSE, LANARK, 15th June, 1901.—A party of about twenty visited Corehouse Estate and Corra Linn, on the Clyde, in pleasant weather. Interest was particularly taken in the introduced shrubs and trees. It was observed that, while in the various estates of the West of Scotland it is quite usual to come across individual examples of the Common Maple, Norway Maple, and Turkey Oak, at Corehouse the introduced species were not in solitary isolation amongst native trees, but occurred in such abundance and rich profusion as to give quite a characteristic appearance to the various avenues and shrubberies.

* Evidently an introduction, but apparently now naturalised.

Creag-na-Caillich, Killin, 22nd June, 1901.—A joint excursion of the Natural History and Geological Societies of Glasgow was made to this locality under the leadership of Mr. Peter Macnair. The mountain is situated at the western end of Loch Tay, and rises to an elevation of 2,990 feet above sea level, immediately to the north of the village of Killin. It has long been famous in the annals of Scottish botany, being often mentioned in Lightfoot's *Flora Scotica* as most probably the locality where Stuart, the minister of Killin, first gathered the Alpine plants of Scotland. Geologically, it has also been known for a considerable period, a short account of its mineral wealth having been published in 1814 in the *Transactions of the Geological Society of London* by that pioneer in Scottish geology, Macculloch. In this paper he refers to the occurrence of that comparatively rare British mineral—rutile—among the schists capping the summit of this mountain, and from that period we always find it given in English text-books.

On the party arriving at Loch Tay pier, the conductor first explained the geological structure seen at the base of the mountain. Fine sections were seen of the Loch Tay limestone and its accompanying altered basic rocks. The party also examined the old yew trees at Finlarig, whilst a number of interesting plants were noted amongst the thick undergrowth which covers this part of the Loch side. Ascending from the loch to the Kenmore Road, a number of interesting sections in the limestone at Drum-na-Larig were noted. Mr. Macnair pointed out that at this point the limestones had been extremely folded, the axes of the folds hading towards the N.W., and the overfolding being consequently towards the S.E. The under limbs of the folds are distinctly thinned, and the whole evidence goes to show that the thrust has been from the N.W.

After a slight refreshment, the actual ascent of the mountain began, the route being by the stream which enters the Lochay near the inn. 'At first the track leads across the limestones, the mountain stream having at this point cut a deep gorge in these rocks. The botany of this gorge has been well worked out by Mr. D. Haggard. Proceeding up the mountain side, a halt was made to examine some fine sections of the garnetiferous mica schists which overlie the Loch Tay limestone. At certain points the garnets can be gathered in handfuls, weathered out of the schists, but still retaining their crystalline form. Further up the ridge, a series of banded hornblende schists were seen. These, the conductor explained, had at one time been injected into the clastic schists as sills of basic igneous material, and had subsequently undergone the same deforming operations as had affected the clastic rocks.

On reaching the 2,000 feet contour line, an altogether different group of schists was seen to take the place of the garnetiferous schists observed in the lower ground. This apparently overlying group of schists is of the nature of a true phyllite, being finely foliated, and the foliation planes themselves being often folded and crossed by later divisional planes. It is upon these schists that the Alpine plants have established themselves, and they are found growing luxuriantly all along the outcrop of the phyllites from Creag-na-Caillich eastwards towards Ben Lawers. [Regarding the probable influence that these rocks have had in the distribution of this Alpine flora of Scotland, see a paper by Mr Macnair published in the *Transactions of the Perthshire Society of Natural Science.*] The return journey was made by Meal Dhuin Croisg, where a somewhat extensive landslip has recently taken place. The cup-and-ring markings in Glen Lochay were also examined. During the day, a number of the well-known Alpine plants were gathered on the summit of Creag-na-Caillich.

Cathcart Nurseries, 5th July 1901.—The Society this evening visited the Nurseries of Messrs. Austin & M'Aslan, at Cathcart. The large collection of young coniferous trees attracted attention, many species and varieties of *Abies*, *Pinus*, *Cupressus*, *Retinospora*, &c., being cultivated. Not many shrubs were in bloom, but *Hedysarum multijugum*, Maxim, with its deep violet red flowers, as well as several varieties of *Weigelia* and *Spiræa* attracted notice. At this time of the year, many thousands of Roses were being "budded," and the operation was performed and explained by one of the foremen. The fruit trees and glass-houses were thereafter inspected. The conductor was Mr. John Cairns, Jun.

Proceedings of the Society.

SESSION 1900-1901.

24TH SEPTEMBER, 1900.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. D. R. Somerville read a report of the Society's excursion to Camis Eskan (see page 251).

Mr. Wm. Stewart reported on an excursion to Douglas Support, and recorded having found twelve species of fungi (see page 253).

Mr. Thos. Beath Henderson, M.D., 55 Bath Street, was elected an Ordinary Member.

Mr. John Cairns, Jun., exhibited a fertile cone of *Araucaria imbricata*, Pav., from Buchanan Castle, Drymen.

On behalf of Mr. R. D. O'Brien, Limerick, the President exhibited fresh specimens of *Scirpus triqueter*, L., a rare bulrush, new to the Irish flora, which Mr. O'Brien, in company with Mr. R. Lloyd Praeger, M.R.I.A., had discovered last month on the muddy banks of the Shannon, near Limerick. The peculiarities of the plant were referred to, and comparisons instituted between the lake and the sea *Scirpus* dried specimens of which were also shown.

Mr. Johnstone Shearer exhibited a large and interesting collection of plants from Tor Bay, Devonshire.

Mr. Wm. Stewart reported on the Conference at Boat of Garten, from the 17th to the 21st September, of the British Mycological and the Scottish Cryptogamic Societies. He recorded the discovery of *Gyrodon sistotrema*, Fr., a species new to the British flora. He remarked that the special feature of the Rothiemurchus locality was the abundance and variety of the genera *Hydnum* and *Cortinarius*. Of the former, eleven species were found—four being rare, viz., *H. imbricatum*, L., *H. fragile*, Fr., *H. compactum*, Pers., and *H. zonatum*, Batsch. Of the latter, 25 species were identified, many of them unrecorded for the Clyde area, and several of them uncommon in the Rothiemurchus district, such as *C. cyanopus*, Fr., *C. multiformis*, Fr., *C. varius*, Fr., and *C. argentatus*, Fr. Of the *Polypori*, 9 species were found, 2 being rare—*P. schweinizii*, Fr., and *P. vaillantii*, Fr., and 2 uncommon—*P. fragilis*, Fr., and *P. amorphus*, Fr. A rare *Frametes*—*F. pini*, Fr., was found on the same trees from which specimens were taken when the Cryptogamic Society visited the woods in 1890. *Boletus* furnished 14 species, *Hygrophorus*, 13; *Russula*, 9; *Lactarius*, 11; among them *L. scrobiculatus*, Fr., a very rare yellow species, with abundant white milk, soon turning sulphur yellow when exposed to the air. Of the Agarics, *Tricholoma* supplied 20 species, including *T. equestris*, L.; *T. portentosus*, Fr.; *T. pessundatus*, Fr.; *T. acerbus*, Bull.; *T. imbricatus*, Fr.; *T. sulphureus*, Bull.; *T. vaccinus*, Pers., and *T. melalencus*, Pers., uncommon here. Amongst the other rare fungi gathered were *Strobilomyces strobilaceus*, Berk., *Sistotrema confluens*, Pers., *Næmatelia encephala*, Fr., *Meruliu pallens*, Berk., and *Leotia circinans*, Pers. On the way home by the Caledonian Canal, a large and fine specimen of *Sparassis crispa*, Fr., was gathered in a pine wood in Glen Urquhart.

Mr. Stewart exhibited a large number of the fungi thus obtained.

30th October, 1900.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

This being the 49th Annual General Meeting of the Society, the Hon. Secretary read the

Report of the Council (1899-1900).

Meetings.—Eleven were held, at all of which business was transacted. The attendance was satisfactory, the large hall having on two occasions to be requisitioned.

Excursions.—A programme of excursions was drawn up for four whole day, eight afternoon, and three evening excursions, but some of the latter had to be abandoned owing to the inclemency of the weather. Three of the excursions were held jointly with the Geological Society, two with the Andersonian Naturalists' Society, two with the Edinburgh Field Naturalists' and Microscopical Society, and one with the Airdrie Natural History Society. In no case, however, was there a large attendance.

Obituary.—During the Session, the deaths of five members were brought under the notice of the Society.

British Association.—Mr. James F. Gemmill, M.A., M.D., represented the Society as its delegate at the meeting held at Bradford.

Membership. — During the session twenty new Ordinary Members (one of whom was a Life Member) were added to the roll, and also five Corresponding Members. The number on the register is as follows :—

Honorary Members, - - - - -		12
Corresponding Members, - - - -		41
Ordinary Members (Life), - - -	28	
(Annual Subscriptions), - -	273	
		301
Total, - - - -		354

Associates.—The number on the roll stands at eighteen.

Finance.—The Hon. Treasurer (Mr. John Renwick) submitted his Annual Statement of Accounts, duly audited. This was found to show a balance at the credit of the Ordinary Fund of £121 10s. 4½d., and of the Life Members' Fund of £147. It was pointed out that from the Ordinary Fund there should have been deducted the cost of *Transactions* for 1898-99 and 1899-1900, but this could not be done, as the printer's account for the same had not been rendered when the books were audited.

Library.—Mr. Mitchell, the Hon. Librarian, reported as follows :—"The interest of the members in the Library of the Society is being maintained. In addition to the large number of works consulted in the rooms, 300 volumes and journals have been issued to the members during the session, a number that is about equal to last year, which was the largest on record since the Library was formed.

"During the month of March last Part III. of Vol. V. of the Society's *Transactions* was issued to the members. This Part has also been sent to the various British Societies and Institutions with which we exchange publications. The usual number of exchanges have been received during the year. These now include nearly all the Scottish Societies of importance which issue *Transactions*. Several volumes have been gifted to the Library from various members and friends, and to these we owe our thanks.

"The usual number of additions, by purchase, have been made during the session.

"During the summer months one of our Life Members presented to the Library sufficient funds to procure the reproduction of a book-plate for our books. The original of this was artistically drawn by one of our members, Mr. John Fleming. This has now been placed in most of our volumes. We owe our grateful thanks to both of these gentlemen for their kindness in so benefiting the Library.

"The attention of members is again called to the stock of Foreign and Colonial *Transactions* housed in the Mitchell Library, which may be consulted or borrowed at any time during the open hours of the Library. Members are also reminded that books may be consulted or borrowed from our own Library, at any time during the day, on application to Mr. Martin, the Curator. The books in the Library are all in good condition. The *Transactions* and Magazines are all bound up to date."

Transactions.—The Hon. Editor (Rev. G. A. Frank Knight, M.A.) reported that Part III. of Vol. V. (N.S.) of the *Transactions*, covering Session 1898-99, was issued to members in March. He also intimated that the Part dealing with Session 1899-1900 was now being dealt with.

The Reports were all unanimously approved of and adopted.

The following Office-Bearers were appointed to fill vacancies in the Council:—Mr. James F. Gemmill, M.A., M.D., as Vice-President; Mr. Andrew A. Dalglish, F.E.S., Mr. John Fleming, Mr. John Paterson, and Mr. Robert Henderson, as Members of Council. Mr. William Leighton and Mr. James Jack were reappointed Auditors.

The following were elected Ordinary Members of the Society:—Rev. William Trotter, M.A., Free Church Manse, Bannockburn; Mr. W. J. Gibson, M.A., Nicolson Schoolhouse, Stornoway; Mr. William W. Fullarton, M.D., Ballantrae; Mr. David Nimmo, Jun., 17 Duke Street, Hamilton; Mr. James Short, M.A., 40 Blantyre Street.

Dr. J. F. Gemmill drew the attention of the meeting to the fact that their President had been unanimously appointed President of the Conchological Society of Great Britain and Ireland for the meeting to be held in Glasgow in 1901, and suggested that the Society should convey to him their congratulations. This was heartily agreed to. Dr. Gemmill then read his report as the Society's delegate to the British Association Meeting in Bradford. The following work was recommended to be undertaken by local societies. Section C (Geology)—Photographs of erratic blocks and boulders; Section D (Zoology)—(*a*) Migration of birds, (*b*) Number of days in which birds hatch out, (*c*) Records of the captures of injured specimens of insects, chiefly Lepidoptera, showing attacks by birds or lizards; Section H (Anthropology)—Photographs of prehistoric monuments, weapons, pottery, &c.

Mr. James Whitton read a report of an excursion to Tollcross Park (referred to in Part II., page 163). A very interesting collection of trees and shrubs is there being accumulated for experimental purposes. Much satisfaction was expressed that a property so naturally interesting had fallen into the hands of the Corporation, and the hope will be echoed that the natural features will be retained and extended.

Mr. Thos. Wilson, Ayr, exhibited the Larva and Pupa of *Acherontia atropos*, L., the Death's Head Moth, from Lendalfoot, Ayrshire, which are seldom met with. Mr. Wilson showed also the Imago of *Sphinx convolvuli*, L., the Convolvulus Hawk-moth, from Ayr, and in addition, a very fine specimen of Pectolite from Lendalfoot.

Dr. Jas. F. Gemmill showed a set of lantern slides from photographs and micro-photographs, illustrating the anatomy and external appearances of some young one-eyed trout, in which the very rare and interesting phenomenon known as Cyclopia was present.

27th November, 1900.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. John Renwick reported on the Society's excursion to Buchanan Castle, on 24th September (see page 254).

Mr. David Bruce exhibited a stuffed specimen of an Albino Common Cormorant, *Phalacrocorax carbo*, L., shot on Loch Roag. He detailed a former hunt he had had for a specimen of this bird, in the course of which he observed that the wings were not used for propulsion when swimming, and when expanded serve only for purposes of balance.

Mr. John Lindsay, M.A., M.B., C.M., showed specimens of Supernumerary Digits, to illustrate the 12th chapter of Darwin's "Variation of Animals and Plants under Domestication." Of special interest was the foot of a Horse, which, by the presence of an extra toe, revealed reversion to the type of Hipparion, a long extinct ancestor of the Horse. With regard to the explanation generally of extra fingers and toes, Dr. Lindsay demurred to Darwin's suggestion that these were due to reversion to a lower type.

On behalf of Mr. M'Culloch, taxidermist, there was exhibited a Grey-hen from Islay, assuming the plumage of the Blackcock. The neck and shoulders of the bird were blue; the back several shades darker than is usual in the Grey-hen; the tail almost black; under tail coverts white; and it had also white shoulder spots. Such birds are generally known to be barren, but the owner of this specimen believed it to be the same as one frequently observed at the same place with a young brood.

Mr. Alex. Patience exhibited about twenty-four specimens of the Higher Crustacea from the Firth of Clyde, and a few other marine forms. In his remarks he dealt with the phenomenon known as commensalism, illustrated by the dwelling together of the Hermit-crab, *Eupagurus prideauxi* (Leach), with the Sea anemone, *Adamsia palliata* (Bohad.); and of the Hermit-crab, *Eupagurus pubescens* (Kr.), with the Sponge (*Suberites suberea*, Gray), and which receives as a boarder a small segmented worm, which acts the part of a scavenger. Mr. Patience also gave some notable instances of Parasitism, *e.g.*, *Sacculina carcini* (Thomp.), on the abdomen of the Shore-Crab, *Carcinus mœnas* (Penn.); *Chondracanthus lophii*, Johnst., from the gill-pouches of the Angler-fish (*Lophius piscatorius*, L.); *Lernœa branchialis*, L., from the gills of whiting; and the Isopods, *Pseudione affinis*, G. O. Sars, and *Phryxus abdominalis* (Kr.), the former from the gill chambers, and the latter from the abdominal cavity of the shrimp, *Pandalus montagui*, Leach. The phenomenon of "masking" was illustrated by specimens of *Inachus dorsettensis* (Penn.), and *Hyas coarctatus,* Leach, completely covered with algae. Other organisms exhibited were *Stenorhynchus tenuirostris* (Fabr.); *S. rostratus,* L.; *Munida rugosa* (Fabr.); *Galathea squamifera,* Leach; *Porcellana platycheles* (Penn.); *Leander squilla,* L.; *Crangon vulgaris* (L.); *Hippolyte pandaliformis, Portunus puber,* L.; *Ebalia cranchii,* Leach; *E. tuberosa,* Penn.; *E. tumifacta* (Mont.); *Pinnotheres pisum* (L.); *Eurynome aspera,* Penn.

Dr. Robert Brown read a paper entitled "The Upper Engadine: Botanical Work amongst its Higher Peaks," and exhibited many of the specimens he had collected there. He described the formation of the Engadine Valley, with its upper portion so greatly frequented by British tourists. The various peaks, the glaciers, the deep valleys, and the wonderful rock and cliff scenery were passed in review, with a brief account of those mountains whose summits he had reached. Near the top of Pizot, 10,660 feet, many examples of *Eutrichium terglonense,* Kern., were growing, a beautiful plant of the family Boraginaceae, which seems really a *Myosotis.* It is very woolly, the hairs having a silky appearance, and, seen growing in large broad cushions, with its intensely blue flowers open to the sun, it is indeed a fair spectacle. Here also were found *Gnaphalium supinum,* L., and *Phyteuma pauciflorum,* L. Near the base were many plants of *Senecio nicanus,* var. *carexolicus* Willd., rather a rare species, and purely alpine. Besides the common *Gentiana bavarica,* L., with its var. *imbricata,* Schleich, and *Juncus jaeginus,* L., with its bright crimson stamens projecting above its blackish head, was *Arenaria biflora,* L., a rather rare, and certainly very local high alpine species. Another mountain, Piz Padella, 9,460 feet, is noted for its varied flora. Here were found *Lychnis flos jovis,* L., *Senecio abrotanifolius,* L., with orange flowers and leaves of narrow linear segments; *Ranunculus parnassifolius,* L., a very rare and local plant; *Gentiana acaulis,* L., and *Anemone alpina,* L., in great abundance, and the striking flowers of *Arnica montana,* L. At the base of the overhanging cliffs forming the summit were great colonies of *Carex nigra,* All., and *C. atrata,* L., intermixed with large flowering masses of *Hedysarum obscurum,* L., and *Oxytropis montana,* Dec., both very beautiful members of the Leguminosæ. There were many species of Saxifrage, but the most striking was *S. cæsia*, L., its blue-grey leaves beautifully recurved, firmly massed together, and practically covered with white and yellowish flowers. On descending to the green slopes, *Dianthus superbus*, var. *grandiflorus*, L., was seen in great profusion, from one to two feet in height, the large fringed flowers having almost a dazzling appearance in the sunshine. *Botrychium lunaria*, Sw., was observed remarkably fine, and *Serratula rhapontica*, Dec., was very striking in its aspect. The latter, a rare plant, grows about 2 feet high, and the long flower stem is leafless for about a foot at the top. The flower is light purple. On the slope of a mountain near Pontresina, there were large plants of *Sempervivum tectorum*, L., with light red, and *S. wulfeni*, Hoppe, with greenish yellow flowers, and as the colours were in profusion and well mixed, the effect on the hillside was remarkable.

21st December, 1900.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

It was intimated that Dr. Robert Brown, Vice-President, had accepted the office of Senior Honorary Joint-Secretary, and that Mr. H. B. Watt had agreed to act as the Society's representative on the Committee of Management of the Millport Marine Biological Station.

The donors of further contributions to the fund for the purchase of a lime-light lantern were thanked, and it was intimated that the fund had reached £22.

Mr. Anderson Fergusson exhibited two species of Coleoptera, collected many years ago by Rev. J. E. Somerville, B.D., F.S.A.Scot., viz., *Pterostichus lepidus*, F., found at Tollcross, Lanarkshire (where Mr. Thos. G. Bishop also met with it 30 years ago), and *Dytiscus lapponicus*, Gyll., a large water beetle, taken in hill tarns in the Island of Mull, and in County Donegal. The former is a local species, distributed over the British Isles. *D. lapponicus* was discovered in Scotland in 1854 by Rev. H. Clark, who obtained specimens in Mull, where Mr. Somerville met with it between Loch Spelve and Loch Buy. It is a truly hyperborean species, and occurs in lakes in Norway and Sweden, and also in Northern Germany.

The President exhibited dried specimens of *Glaucium flavum*, Crantz. (*G. luteum*, Scop.), the Horned Poppy, from English, Irish, and Scottish coast localities, the Irish specimen having been lent for the occasion by Mr. Nathaniel Colgan, M.R.I.A., joint-editor with Dr. R. W. Scully, F.L.S., of the "Cybele Hibernica." This large and handsome yellow poppy was referred to as "a vanishing quantity" in Scotland, partly owing to the action of the thoughtless in rooting it up. When Hewett C. Watson issued the "New Botanist's Guide," in 1837, the plant was still "plentiful on the shore at Helensburgh," and "abundant in Arran." From both of these quarters it has long since disappeared, and now only occurs, very sparingly, at two spots on islands in our estuary. The six species of *Glaucium* known to science, including the British one, belong to the Mediterranean region. All occur in Syria and Palestine—one (*G. aleppicum*, Boiss.) being of a rich crimson, and all, excepting *G. flavum*, being inland plants.

On behalf of Mr. Thos. G. Bishop and of Mr. John Henderson there were shown a number of specimens of the fruit of the Almond Tree (*Amygdalus communis*, L.) grown in the open air at Helensburgh. Mr. Bishop's trees, at Dalmore, 25 feet above the sea-level, have fruited for the first time this year. Mr. Henderson's trees, at Towerville, about 75 feet above the sea, are older, and have fruited several times previously.

On behalf of Dr. T. F. Gilmour there were exhibited fresh specimens of *Potentilla fragariastrum*, Ehrh., the Barren Strawberry, found blossoming in abundance at Ardbeg, Islay, on 10th instant, quite two months before the usual time of flowering, and indicating the mildness of the season.

The President made a statement with regard to the three prospective European Expeditions to the Antarctic Regions—viz., the British, German, and Scottish—and referred specially to the last named, which is to be under the leadership of Mr. William S. Bruce, F.R.S.G.S. The results of the intended Scottish Expedition are likely to be of special interest to biologists, as deep-sea work, dredging at great depths, and tow netting are to be extensively engaged in. The meeting adopted a motion of sympathy with Mr. Bruce in his arduous work of obtaining the £35,000 required for a three years' absence, and of which about £11,000 have now been subscribed.

29TH JANUARY, 1901.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

The President referred to the great loss sustained by the British Empire, and by the world, through the lamented death of our revered Sovereign, Queen Victoria. In fitting terms, he passed a eulogy on the late Queen's deep interest in everything calculated to promote her people's welfare, on her marvellous attention to the exacting duties of her exalted station, on the largeness of her heart for the distressed and the suffering, on the pathetic manner in which she bore her own great sorrows, and on her obedience to the dictates of highest Christian principle. He pointed out, as a reminder of the great length of Her late Majesty's reign, that although the Society this year attained its Jubilee, Queen Victoria had already been fourteen years on the throne before the Society was instituted. He concluded by the expression of the hope that her son, King Edward, would have a reign equally glorious in every respect.

Mr. J. R. Thomson, 6 Vinicombe Street, Hillhead, was elected an Ordinary Member.

A mounted specimen of the Slavonian Grebe, *Podicipes auritus*, L., shot on Black Loch, Slamannan, was exhibited by Mr. James Jack, by favour of Mr. Reston.

Mr. John Smith, Monkredding, Kilwinning, exhibited a specimen of a minute, white, worm-like animal, supposed by Mr. Thos. Scott, F.L.S., to be *Mermis albicans*. Mr. Smith procured it in the earth about 600 feet above sea-level. When taken out of the earth, it was pure white. Mr. Smith also showed some eggs of the Earth-worm.

Mr. Smith made the following correction on a paper he had contributed to the *Transactions*, on the "Conodonts from the Carboniferous Limestone of the West of Scotland." He had therein stated that the dental apparatus of existing mollusca are silicious. This he believed to be the common opinion of naturalists, founded on the fact that the radula of recent gastropods is not affected by acid, but Dr. G. J. Hinde (who described the specimens) had since informed him that it consists almost entirely of chitinous material, as ascertained by chemical investigation.

On behalf of Mr. James Groves, F.L.S., Corresponding Member, the President exhibited *Statice lychnidifolia*, de Girard, a Sea Lavender, new to the Channel Islands, and not previously recorded from within the limits of the British flora. It was discovered in Alderney, in August last, by Mr. Cecil R. P. Andrew, M.A., First Principal of the new Government Training College, Perth, Western Australia. Mr. Somerville also exhibited examples of the four already known British species of the genus *Statice*, viz., *S. limonium*, L., and its var. *pyramidalis*, Syme; *S. rariflora*, Drejer; *S. auriculaefolia*, Vahl., and its three sub-species (*a*) *occidentalis* (Lloyd); (*b*) *intermedia*, Syme; and (*c*) *dodartii* (de Girard); and *S. reticulata*, L. (=*S. bellidifolia*, Gonan).

Mr. James C. Christie read a paper on "Bird Life in Northern Norway." It was illustrated with lantern views from specimens and from drawings by Thorolf Holmboe, artist-naturalist.

26th February, 1901.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. John George Wight, British Linen Company's Bank, 110 Queen Street, was elected an Ordinary Member, and Miss M. M. Buchanan, 63 West Cumberland Street, was admitted as an Associate.

Mr. R. S. Wishart, M.A., exhibited the following specimens—*Linaria minor*, Desf., from Stepps; *Leontodon autumnalis*, L., var. *pratensis*, Koch., from Robroyston; *Bupleurum rotundifolium*, L., a casual, from Chryston.

On behalf of Mr. D. Dewar, Mr. Christopher Sherry exhibited and read short notes descriptive of—

(1) *Asplenium ceterach*, L., var. *aureum*, Link., a plant found plentifully on the moist rocks of the lower regions of the islands of Teneriffe.

(2) *Asplenium obtusatum*, Forst., var. *difforme*, a fern resembling the *A. marinum* of Britain, and found on the rocks of the south coast of Norfolk Island.

(3) *Aspidium (Polystichum) triangulum*, Swartz, var. *ilicifolium*, a form with elongated fronds rooting at the points.

(4) The fruit and leaves of the Shaddock, *Citrus decumana*, L.

Mr. Wm. Stewart read a part of a paper entitled "Some Notes on the Ferns and Macrofungi of the Clyde Area," in which he described the methods adopted in defining certain districts of the Clyde Area, with their distinctive species and varieties. He showed also a map in which the districts were defined by boundary lines.

The President laid on the table a copy of the Revised List of the British Marine Mollusca and Brachiopoda, and read a paper prepared by Rev. G. A. Frank Knight, M.A., one of the Vice-Presidents of the Society. Mr. Knight explained how this new list came to be published. Fifteen years ago, there had been issued by Mr. Somerville, the President, a Handlist of the British Marine Mollusca and Brachiopoda, which embraced all the species and varieties mentioned in Jeffrey's "British Conchology," as well as all others up to the date of publication (1886). But in the interval much more had been learned. To Mr. Knight had been entrusted the task of drawing up the list of the Marine Mollusca of the Clyde for the Handbook of the Fauna and Flora of Clydeside, in view of the coming of the British Association to Glasgow in 1901, and he naturally desired to use the best classification and nomenclature. After considerable negotiation, a Committee of the Conchological Society of Great Britain was appointed to draw up a new list. The committee consisted of Dr. George W. Chaster, M.R.C.S., Southport; Mr. James Cosmo Melvill, M.A., F.L.S., Manchester; Mr. W. E. Hoyle, M.A., M.Sc., M.R.C.S., F.R.S.E., Director of the Manchester Museum, Owens' College; and Mr. Knight. They were assisted in their deliberations by suggestions from the following:—Mr. W. H. Dall, Smithsonian Institution, Washington; Mr. J. T. Marshall, Torquay; Mr. Richard B. Newton, F.G.S., London; Mr. Edgar A. Smith, F.Z.S., Keeper of the Conchological Department, Natural History Museum, South Kensington; Mr. Robert

Standen, Manchester; Mr. Ernest R. Sykes, B.A., Gray's Inn, London; Mr. Bernard B. Woodward, F.G.S., F.R.M.S., British Museum, London; and the Rev. Canon A. M. Norman, D.C.L., F.R.S., F.L.S.

Many knotty problems presented themselves for solution.

I. *Area.*—This question was thoroughly discussed, and the final decision was to accept Canon Norman's definition of the British Area, as laid down in his paper in the *Annals and Magazine of Natural History* (6), Vol. V., pp. 345, 454, (1890), but with the addition of the Channel Isles. The area embraces the Dogger Bank, but excludes the "Cold Area" between the Shetlands and the Faroes. The area being defined, the committee were at liberty to include in their list all the mollusca obtained by different expeditions within the British limit, and of these the following are the more important:—

(1) The "Lightning," in 1868, under Drs. Carpenter and Wyville Thomson;

(2) The "Porcupine," in 1869, under the same scientists, with the addition of Dr. Gwyn Jeffreys. Only the mollusca obtained by these expeditions within the defined British area could be used in the compilation of the list (*Proc. Zool. Soc.*, 1878-85);

(3) The "Knight-Errant," in 1880, under Sir John Murray (*Proc. Royal Soc. Edin.*, Vol. xi.);

(4) The "Triton," in 1882, under Sir John Murray (*Proc. Zool. Soc.*, 1883);

(5) The Royal Irish Academy's Expedition in the "Lord Bandon," in 1885-86; and in

(6) The "Flying Falcon," in 1888 (*Proc. R.I.A.*, 1886, 1898),

(7) The "Flying Fox," in 1889, under the Rev. W. Spotswood Green (*Ann. and Mag. Nat. Hist.*, Ser. 6, Vol. IV., 1889, p. 409).

(8) H.M.S. "Research," in 1889, by Mr. G. C. Bourne (*Journal of the Marine Biological Assoc. of the United Kingdom*, N.S., Vol. I., 1889-90, p. 306).

II. *Classification.*—The Committee found that while Jeffreys' classification was admittedly very defective, there was no other scheme in the field at present which it would be advisable to adopt *in toto.* They resolved, therefore, to make the anatomical system of Pelseneer their general basis, but in all groups to adopt the classification of individual workers who had specialized in their particular departments. The new classification thus established led to many transpositions of genera and species from the old standard of Jeffreys.

III. *Nomenclature.*—All previous workers in the compilation of lists, and all writers on the Mollusca of Britain, had taken the *12th* Edition of the *Systema Naturæ* of Linné (issued in 1767) as the *terminus a quo* of the binomial nomenclature. The Committee felt bound to follow the recent trend of science, and to go back to the *10th* Edition, which was published in 1758. Following the law of priority of nomenclature, they had to relinquish many time-honoured names, and to substitute titles which had claims to precedence. But wherever a change of this sort was necessary, the former familiar name had been enclosed within square brackets.

IV. *Insufficiently attested species.*—The Committee felt bound to be somewhat severe towards many doubtful claimants for recognition, and in many cases a number of varietal names, apparently based on monstrous, stunted, aborted, or young specimens, had been omitted. Exotic migrants, and recent-looking post-tertiary shells had also to be carefully distinguished from the legitimate ones.

The following is a comparison between Mr. Somerville's List of 1886 and the new Revised List of the Conchological Society in 1901, showing the progress made during the intervening years :—

The total number of *species* of mollusca in 1886 was 551, ... The total number of *species* of mollusca in 1901 is 720, ...	Increase, 169.
The total number of *species* and *varieties* in 1886 was 957, ... The total number of *species* and *varieties* in 1901 is 1,158, ...	Increase, 201.
The total number of *species* of *Brachiopoda* in 1886 was 7, ... The total number of *species* of *Brachiopoda* in 1901 is 9, ...	Increase, 2.

The total number of *species* and *varieties* of *Brachiopoda* in 1886 was 9, ...	Increase, 3.
The total number of *species* and *varieties* of *Brachiopoda* in 1901 was 12, ...	
Grand total of Mollusca and Brachiopoda (spec. and var.) in 1886, ...	966
Grand total of Mollusca and Brachiopoda (spec. and var.) in 1901, ...	1,170

An increase of 210 over all.

26th March, 1901.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

The Secretary reported that the President had been appointed to represent the Society at the Ninth Jubilee Celebrations of the University of Glasgow, to be held in June of the present year.

Mr. Thos. Beath Henderson, M.D., exhibited a fresh specimen of *Ophisaurus apus* (Boul.), the Glass Snake, so called, but which is in reality a lizard closely resembling a snake, the fore limbs being entirely absent, while the hind limbs are extremely rudimentary. He also showed the head and rattle of *Crotalus terrificus* (Cope), the Rattlesnake, from Brazil, and vividly described the structure of the poison glands and fangs.

Mr. Frank M'Culloch brought forward for exhibition the following specimens :—

(1) *Acanthis linaria* (L.), the Mealy Redpoll, from Barra.

(2) *Sylvia nisoria* (Bech.), the Barred Warbler, from Barra.

(3) *Spatula clypeata* (L.), the Shoveler, from Loch Lomond.

(4) *Laurus glaucus*, O. Fabr., the Glaucous Gull, from Barra.

Mr. John Paterson gave a careful description of these birds, with information on their habitats, and their frequency in different districts of this country.

Mr. Paterson also read extracts from a Manuscript, written by the late Dr. John Grieve, dated 1847, and descriptive of the birds seen by him about that period in the North-eastern district of Glasgow. (See page 181.)

30TH APRIL, 1901.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

The meeting was devoted to a lecture on "Ants," given by Mr. J. G. Goodchild, F.G.S., F.Z.S., of H.M. Geological Survey. The lecturer began with a general description of the anatomy of ants, and then in considerable detail gave a series of facts, verified by observation, illustrative of their social life and domestic habits. With the aid of a number of beautiful lantern slides, Mr. Goodchild showed the origin and development of new ant communities under a queen, and described the many ways in which the activities of an ant colony are exercised, the various duties of the males, females, and neutrals or workers being all explained at length. He then touched on the subject of ant parasites and commensals; on the attack made by Aphides on honey-secreting plants; and on how these attacked plants protect themselves against injury. The lecture was highly appreciated by a large audience, and the lecturer awarded a hearty vote of thanks.

28TH MAY, 1901.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. J. J. Robertson reported on the excursion to Cadzow, on 27th April (see page 258), and Mr. Thos. Boyle contributed a similar statement on that to Castlemilk, on 16th May (see page 259).

It was intimated that the Council of the Society had voted a contribution of a guinea towards the maintenance of the Millport Marine Biological Station.

On behalf of Mr. Andrew Gilchrist, there was exhibited a specimen of the alien leguminous plant, *Trigonella fœnum-græcum*, L., the Fenugreek, found growing in 1898, as a casual, at Doonfoot, Ayr, and identified by Mr. S. T. Dunn, B.A., F.L.S., of the Royal Gardens, Kew. The plant is interesting as having been known to, and cultivated by, the ancient Greeks, who grew it for spring forage, and for the properties of its seeds, which, according to Loudon, were "useful in fomentations, and in dispersing tumours, &c." It is native in Northern Italy, Persia, and Mesopotamia; doubtfully so further west.

On behalf of Mr. W. J. Gibson, M.A., there was shown, from the neighbourhood of Stornoway, a luxuriant fresh specimen of *Ajuga pyramidalis*, L., the Pyramidal Bugle, a plant of the Labiate order, rare, though native in Britain. It occurs in Westmoreland, and very sparingly northwards through Argyleshire, West Inverness, and the outer Hebrides, to Orkney; also in County Clare and the Arran Isles.

With this plant were shown by the President, for comparison, dried examples of the other two British species of *Ajuga*, viz., *A. chamaepitys*, Schreb., confined to the south coast of England, and *A. reptans*, L., the Bugle, common throughout our islands.

Mr. Hugh Boyd Watt read a paper on "The Seals, Whales, and Dolphins of the Clyde Sea-area." (See page 191.)

Mr. Andrew Gilchrist contributed a paper "Note on the occurrence in Ayrshire of *Trigonella fœnum-græcum*, L."

A paper by Mr. James Whitton, Superintendent of Parks, entitled "Meteorological Notes and Remarks upon the Weather during the year 1900, with its general effects upon Vegetation," was, after remarks from Mr. J. J. Robertson on its leading features, held as read. (See page 198.)

25th June, 1901.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. H. B. Watt gave in a report of the excursion, on May 23rd, to Culzean Castle. (See page 259.)

Mr. J. J. Robertson reported on the excursion to Aikenhead on May 30th. (See page 262.)

The Society's excursion to Garscube, on June 13th, was commented on (see page 262); and lastly, Mr. John Paterson referred to the excursion, on June 15th, to the Falls of Clyde and Corehouse (see page 262).

Mr. Robert M. Hogg, B.A., Georgefield, Irvine, was elected an Ordinary Member.

On the motion of the President, a vote of thanks was accorded to ex-Lord Provost Sir James Bell, Bart., a Life Member, for a donation of £5 received from him to cover the cost of engraving and printing a book-plate for the Society's library which had been designed by Mr. John Fleming.

On behalf of Mr. Andrew Gilchrist, there was exhibited a fresh specimen of the "Coral-root" orchis, *Corallorhiza innata*, R. Br., from the Kilmarnock district, a leafless saprophyte, or feeder on dead organic matter, whose discovery in this locality re-establishes it as an Ayrshire plant, a circumstance which since 1874 had been doubted. The President read letters received from Professor Traill, F.R.S., and from Mr. Arthur Bennett, F.L.S., corresponding members of the Society, expressing much interest in the rediscovery of this plant in the south-west of Scotland.

Mr. Anderson Fergusson read a paper entitled "Additions to the list of Scottish Coleoptera" (see page 214), and exhibited at the same time some beautifully preserved specimens of some of those named, including *Leistus spinibarbis*, F.; *Badister sodalis*, Duft.; *Bembidium affine*, Steph.; *Gyrophæna pulchella*, Heer.; and *Tachyporus formosus*, Matth.

The President referred to his experiences as the representative of the Society at the Ninth Jubilee Celebrations at the University, and spoke in high terms of the completeness of the equipment of the new Botanical Laboratory, which was opened during that time with a striking and memorable oration from the veteran botanist, Sir Joseph Hooker, followed by an address from Lord Lister.

27th August, 1901.

Mr. James F. Gemmill, M.A., M.D., Vice-President, in the chair.

Mr. Peter Macnair contributed a report of the Society's excursion to Killin on 22nd June (see page 263), and also exhibited the following Alpine plants, *Salix lanata*, L.; *Phleum alpinum*, L.; *Saxifraga nivalis*, L.; *S. cernua*, L.; *Gentiana nivalis*, L.; *Trientalis europea*, L.; *Saussurea alpina*, D.C., mostly from Ben Lawers.

A report on the excursion to Cathcart Nurseries by Mr. John Cairns was read by Mr. Renwick. (See page 264.)

A specimen of the Long-Eared Bat, *Plecotus auritus* (L.), from Islay, was exhibited on behalf of Dr. T. F. Gilmour, who remarked that Mr. Harvie-Brown seems not to have been able to obtain specimens of any bat from that island, though he states that they are "said to occur." Dr. Gilmour had previously recorded the presence both of the Pipistrelle and Long-Eared Bat in the *Annals of Scott. Nat. Hist.*, July, 1897, p. 191. The Pipistrelle is not uncommon in Islay, and has been secured in various parts of the island. The long-eared species is rarer, and Dr. Gilmour had only seen it twice, once in June, 1897, and now on this occasion, when a specimen had been brought to him by the gardener at Kildalton, who remarked that they were to be seen frequently. As the Gaelic names for the two species are not alike, the latter being called by a name signifying "horned," there is in this a proof that both have been known long enough to have acquired distinctive names.

Colonel Harington-Stuart, of Torrance, East Kilbride, exhibited eleven different species of Parasitic Fungi from Natal. Among these were *Aecidium ocimi*, P. Henn. ; *A. royenae*, Cke.; *A. ornamentale*, Kalch.; *Puccinia ipomœa*, Cke.; *P. phyllocladia*, Cke., on *Asparagus falcatus*, L.; *Physalospora chienostoma* ; *Cephaleuros virescens*, Kunz., on leaves of *Ficus indica*, L. ; *Asternia mac-owaniana*, Kalch., on *Celastrus buxifolia*, L.; *Uredo celastrinæ*, Cke., on *Salacia Kraussii*, Harv.

The Colonel also presented to the Society several books, forming part of a series, on "The Plants of South Africa," and received the thanks of the meeting.

A communication was read from the President, Mr. Alex. Somerville, B.Sc., F.L.S., on the cases of poisoning which had recently taken place on the Island of Cumbrae, several lads having received poison from eating the berries of an unknown plant by the wayside. The plant, the President had discovered, was *Oenanthe crocata*, L., the Hemlock Water Dropwort.

The Chairman read extracts from a paper contributed by Mr. F. G. Pearcey, Naturalist on the s.s. "Garland," of the Fishery Board for Scotland, on the "Firth of Forth Deposits." (See page 217.)

ABSTRACT STATEMENT OF ACCOUNTS—SESSION 1900-1901.

1900.—Sept. 1.			
To Balance—Life Members' Fund,	£47 0 0		
Ordinary Fund, on loan,	£40 0 0		
Do., in Bank, and in Treasurer's hand,	81 10 $4\frac{1}{2}$		
		121 10 $4\frac{1}{2}$	
			£168 10 $4\frac{1}{2}$
1901.—Aug. 31.			
To 207 Members' Annual Subscriptions, @ 7s. 6d.,			77 12 6
,, 26 Members' Arrears,			10 2 6
,, 13 Associates' Subscriptions, @ 5s.,			3 5 0
,, 2 ,, Arrears,			0 15 0
,, Interest,			6 18 8
,, *Transactions*, &c., sold,			1 10 7
,, Donations to Library,			7 11 0
,, ,, to Illustration Fund,			2 2 6
,, ,, towards purchase of Lantern,			7 17 0
			£286 5 $1\frac{1}{2}$

From Balance of £103 14s. 1d. fall to be deducted cost of *Transactions* for 1899-1900, and for 1900-1901, and of Lantern.

1901.—Aug. 31.			
By Rent and Attendance,			£9 9 6
,, Postage, Stationery, &c.,			15 18 0
,, Printing Circulars—1899-1900, £6 7s. 6d.; 1900-1901, £12 15s.,			19 2 6
,, Printing *Transactions*, 1898-1899,			68 1 0
,, Carriage on *Transactions*,			1 4 5
,, Lecture and Lantern Expenses,			1 3 0
,, Library—New Books, and Book Plate,	£12 2 6		
Insurance,	0 12 0		
Postage, Stationery, &c.,	1 0 $5\frac{1}{2}$		
Binding — 1899-1900, £3 14s. 2d.; 1900-1901, £2 2s. 6d.,	5 16 8		
			19 11 $7\frac{1}{2}$
,, Donation to Millport Biological Station,			1 1 0
,, Balance, Life Members' Fund, on loan @ 4%,	*£47 0 0		
,, Balance, Ordinary Fund, on loan @ 4%,	*£40 0 0		
,, Balance, Ordinary Fund, in National Security Savings Bank, and in Treasurer's hand,	63 14 1		
		103 14 1	
			150 14 1
			£286 5 $1\frac{1}{2}$

* On Security of Guaranteed Railway Stock.

Life Members' Fund—	
Invested in $2\frac{1}{2}$ per cent. Debentures of The Modern Permanent Building and Investment Society, Melbourne,	£100 0 0
On loan at 4 per cent.,	47 0 0
	£147 0 0

Glasgow, 17*th October*, 1901.—We have audited above Accounts, compared same with relative Vouchers and Securities, and find them correct.

(Signed) JAMES JACK, WM. LEIGHTON, } *Auditors.*

Natural History Society of Glasgow.

SESSION LI.—1901-1902.

OFFICE-BEARERS.

President.

ALEX. SOMERVILLE, B.Sc., F.L.S., 4 Bute Mansions, Hillhead.

Vice-Presidents.

ROBERT BROWN, M.D., 1 Leslie Road, Pollokshields.

JAMES F. GEMMILL, M.A., M.D., 3 Albion Terrace, Hillhead.

JOHN PATERSON, 82 Cumming Drive, Mount Florida.

Hon. Secretaries.

JOHN JAS. ROBERTSON, 9 Queen Mary Avenue.

ROBERT BROWN, M.D., 1 Leslie Road, Pollokshields.

Hon. Treasurer.

JOHN RENWICK, 49 Jamaica Street.

Hon. Librarian.

JAMES MITCHELL, 222 Darnley Street, Pollokshields.

Hon. Editor of Transactions.

Rev. G. A. FRANK KNIGHT, M.A., F.R.S.E., St. Andrew's Manse, Auchterarder.

Members of Council.

John Cairns, Jr.

Robt. Kidston, F.R.S.L.&E., F.G.S.

Johnstone Macfie, M.D.

William Stewart.

A. A. Dalglish, F.E.S.

John Fleming.

Robert Henderson.

John R. Lee.

Peter Ewing, F.L.S.

William Leighton.

John Robertson.

James Whitton.

Auditors.

JAMES JACK and JOSEPH SOMMERVILLE.

LIST OF MEMBERS.

HONORARY.

1851. William Ferguson of Kinmundy, LL.D., F.L.S., F.G.S., F.S.A.Scot., Kinmundy, near Mintlaw, Aberdeenshire.

1880. Professor Gustav Mayr, Haupt Strasse 75, Vienna.

1880. Rev. John Stevenson, LL.D., F.R.S.E., The Manse, Glamis, Forfarshire.

1881. James Murie, M.D., LL.D., F.L.S., F.G.S., F.Z.S., Canvey Cottage, Leigh, Essex.

1884. David Sharp, M.B., C.M., Hon. M.A., F.R.S., F.L.S., F.Z.S., F.E.S., Hawthorndene, Hills Road, Cambridge.

1884. Robert M'Lachlan, F.R.S., F.L.S., F.Z.S., F.R.H.S., F.E.S., West View, Clarendon Road, Lewisham, London, S.E.

1885. Sir John Murray, K.C.B., LL.D., D.Sc., Ph.D., F.R.S., F.R.S.E., F.L.S., F.G.S., F.R.G.S., F.S.A.Scot., Challenger Lodge, Wardie, Edinburgh.

1887. William Carruthers, F.R.S., F.R.S.E., F.L.S., F.G.S., 14 Vermont Road, Norwood, London, S.E.

1887. Sir Joseph Dalton Hooker, M.D., R.N., G.C.S.I., C.B., D.C.L., LL.D., F.R.S., F.L.S., F.G.S., F.R.G.S., etc., The Camp, Sunningdale, Berks.

1888. Rev. Canon A. M. Norman, M.A., D.C.L., F.R.S., F.L.S., The Red House, Berkhamstead, Herts.

1890. M. C. Cooke, M.A., LL.D., A.L.S.

1895. Professor John G. M'Kendrick, M.D., F.R.C.P.E., LL.D., F.R.S., F.R.S.E., The University, Glasgow.

1901. Samuel Chisholm, LL.D., The Hon the Lord Provost of Glasgow, 20 Belhaven Terrace.

1901. Professor John Cleland, M.D., D.Sc., LL.D., F.R.S., The University, Glasgow.

1901. Professor J. W. H. Trail, M.A., M.D., F.R.S., F.L.S., The University of Aberdeen.

1901. J. A. Harvie-Brown, F.R.S.E., F.Z.S., M.B.O.U., Dunipace House, Larbert.

1901. Mrs. David Robertson, Fernbank, Millport.

1901. Mrs. Robert Gray, 59 George Street, Edinburgh.

1901. Andrew Carnegie, LL.D., Skibo Castle, Sutherlandshire.

CORRESPONDING.

1866. The Earl of Haddington, F.S.A.Scot., Tyninghame, Prestonkirk.
1868. Rev. Paton J. Gloag, D.D., 28 Regent Terrace, Edinburgh.
1869. George Stewardson Brady, M.D., LL.D., F.R.S., C.M.Z.S., Mowbray Villa, Sunderland.
1869. Rev. James Keith, LL.D., The Manse, Forres.
1869. Col. H. W. Feilden, R.A., C.M.Z.S., West House, Wells, Norfolk.
1869. Rev. John Fergusson, LL.D., The Manse, Fern, Brechin.
1871. Peter Cameron, F.E.S., Union Road, New Mills, Derbyshire.
1873. Sir George Hector Leith-Buchanan, Bart., Ross Priory, Dumbartonshire.
1877. Robert Etheridge, F.R.S., F.R.S.E., F.G.S., Geological Department, British Museum (Natural History), Cromwell Road, London, S.W.
1879. John Smith, Monkredding, Kilwinning.
1879. Thomas Scott, F.L.S., F.R.Ph.S.E., Naturalist to the Fishery Board for Scotland, 3 Menzies Road, Torry, Aberdeen.
1884. W. Anderson Smith.
1885. J. T. Cunningham, B.A., Lecturer on Fishery Subjects, Penzance.
1885. John Rattray, M.A., B.Sc., F.R.S.E., Dunkeld.
1885. John R. Henderson, M.B., C.M., F.L.S., Professor of Biology, The Christian College, Madras.
1885. Frederick G. Pearcey, 43 Balcarres Street, Morningside, Edinburgh.
1885. James M'Andrew, 21 Gillespie Crescent, Edinburgh.
1887. Arthur Bennett, F.L.S., 143 High Street, Croydon, Surrey.
1887. D'Arcy W. Thompson, C.B., B.A., F.R.S.E., F.L.S., Professor of Natural History in University College, Dundee.
1887. Rev. David Landsborough, LL.D., Kilmarnock.
1888. William Abbott Herdman, D.Sc., F.R.S., F.R.S.E., F.L.S., Professor of Natural History in University College, Liverpool.
1888. Rev. Hugh Macmillan, D.D., LL.D., F.R.S.E., F.S.A.Scot., 70 Union Street, Greenock.

1888. Edgar A. Smith, F.Z.S., British Museum (Natural History), Cromwell Road, London, S.W.

1888. James W. H. Trail, M.A., M.D., F.R.S., F.R.S.E., F.L.S., Professor of Botany in the University of Aberdeen.

1888. William Carmichael M'Intosh, M.D., LL.D., F.R.S., F.R.S.E., F.L.S., L.R.C.S.E., C.M.Z.S., Professor of Natural History in the University of St. Andrews.

1888. George R. M. Murray, F.R.S., F.R.S.E., F.L.S., Keeper of the Botanical Collection, British Museum (Natural History), Cromwell Road, London, S.W.

1888. Edward Morell Holmes, F.L.S., F.R.H.S., Ruthven, Sevenoaks, Kent.

1888. William Phillips, F.L.S., Canonbury, Shrewsbury.

1888. Sir Thomas D. Gibson-Carmichael, Bart., M.A., M.P., F.L.S., Castlecraig, Dolphinton.

1889. James Edmund Harting, F.L.S., F.Z.S., M.B.O.U., Librarian and Assistant Secretary of the Linnean Society, Burlington House, Piccadilly, London, W.

1891. R. J. Harvey Gibson, M.A., F.R.S.E., F.L.S., Professor of Botany in University College, Liverpool.

1895. Robert Broom, M.D., B.Sc., South Africa.

1895. John T. Marshall, M.C.S., Sevenoaks, Torquay.

1895. Frederick J. Hanbury, F.L.S., F.E.S., 37 Lombard Street, London, E C.

1895. Edward E. Prince, B.A., F.L.S., 206 O'Connor Street, Ottawa, Canada.

1896. Robert H. Read, 7 South Parade, Bedford Park, London, W.

1900. James Groves, F.L.S., 58 Jeffrey's Road, Clapham Rise, London, S.W.

1900. William P. Hiern, M.A., F.L.S., Castle House, Barnstaple, Devonshire.

1900. Rev. Edward F. Linton, M.A., Crymlyn, Bournemouth.

1900. Rev. Edward S. Marshall, M.A., F.L.S., Lavington Rectory, Petworth, Sussex.

1900. Robert Lloyd Praeger, B.A., B.E., M.R.I.A., National Library of Ireland, Dublin.

ORDINARY.

* *Life Members.*

1900. *Allan, Claud A., 121 St. Vincent Street.
1883. Arbuckle, Andrew, 4 Farme Loan Road, Rutherglen.
1896. Arthur, E., 11 Battlefield Gardens, Langside.
1880. Bain, Andrew, 17 Athole Gardens.
1888. Baird, J. G. A., M.P., 168 West George Street.
1887. Balfour, D. D., Sheriff-Substitute of Lanarkshire, 6 High Windsor Terrace, Kelvinside.
1884. Ballantine, Matthew, 101 Buchanan Street.
1895. Ballantyne, J., Corporation Gasworks, Hamilton.
1863. Balloch, Robert, 17 Robertson Street.
1882. Baxter, William R., 64 Great George Street, Hillhead.
1893. Beard, Miss M. S. M., 14 Ruthven Street, Hillhead.
1888. Beith, Gilbert, 15 Belhaven Terrace, Kelvinside.
1893. *Bell, Sir James, of Montgreenan, Bart., 7 Marlborough Terrace.
1869. Bennett, Robert J., 50 Gordon Street.
1896. Bennett, William, Struan Cottage, Airdrie.
1883. Bishop, Thomas G., Dalmore, Helensburgh.
1879. Black, Malcolm, M.B., C.M., 5 Canning Place.
1900. Blackie, Walter W., B.Sc., 17 Stanhope Street.
1888. Borland, John, Navara, London Road, Kilmarnock.
1885. Bower, Frederick O., M.A., D.Sc., F.R.S., F.R.S.E., F.L.S., Regius Professor of Botany in the University of Glasgow, 1 St. John's Terrace, Hillhead.
1896. Bowie, William, 188 Comelypark Street.
1882. Boyd, D. A., Seamill, West Kilbride.
1879. Boyle, Thomas, care of D. Bell, 339 London Road.
1895. Briggs, Arthur, Royal Bank, Springburn.
1895. Brown, Hugh, 9 Clairmont Gardens.
1894. Brown, Robert, M.D., 1 Leslie Road, Pollokshields.
1900. Bruce, David, 18 Carrington Street.
1899. Bryce, Thos. H., M.B., C.M., F.R.S.E., Queen Margaret College, University of Glasgow.
1901. Buchanan, Keith, Fairholm, Giffnock.
1901. Buchanan, Robt. M., Fairholm, Giffnock.

1881. *Buckley, T. E., B.A., F.Z.S., M.B.O.U., Castlehill, Castleton, by Thurso.
1895. Burnett, George, 65 Camperdown Road, Scotstoun.
1886. Butler, George, 189 Pitt Street.
1897. Cadell, George Allan, C.A., 116 St. Vincent Street.
1887. Cairns, John, jun., 151 Renfrew Street.
1886. Campbell, James, 85 Gibson Street, Hillhead.
1870. Campbell, J. M., F.Z.S., F.R.S.G.S., 5 Franklin Terrace.
1896. Campbell, Thos. S., 85 Gibson Street, Hillhead.
1893. Campbell, William, 1 Seafield Cottages, Jordanhill.
1889. Clavering, John M., 32 Lynedoch Street.
1902. *Coates, Henry, F.R.S.E., Pitcullen House, Perth.
1887. Colquhoun, Sir James, of Luss and Colquhoun, Bart., Dunclutha, Ore, Hastings.
1900. Cooke, T. Alexandre, 10 Grafton Square.
1883. Coulson, Frank, Finnartmore, Kilmun.
1888. *Craig, William, M.D., F.R.C.S.E., F.R.S.E., 71 Bruntsfield Place, Edinburgh.
1888. Crichton, Mrs. George, 8 Montgomerie Crescent, Kelvinside.
1887. *Cuthbertson, Sir John Neilson, LL.D., 25 Blythswood Square.
1897. Cuthbertson, Michael, F.R.H.S., Sunnypark Nurseries, Rothesay.
1877. *Dalgleish, John J., F.S.A.Scot., M.B.O.U., Brankston Grange, Bogside Station, Stirling.
1898. Dalglish, Andrew Adie, F.E.S., 21 Prince's Street, Pollokshields.
1896. Dalziel, Prof. T. Kennedy, M.B., C.M., F.F.P.S.G., 196 Bath Street.
1895. Dixon, Walter, 59 Bath Street.
1889. Dobie, W. A., Clarendon Place, Stirling.
1896. Donnelly, W. A., Milton of Colquhoun, Bowling.
1891. Dove, Hector, B.Sc., 33 Afton Street, Langside.
1869. Drew, Alexander, Holm Lodge, near Burnley, Lancashire.
1900. Duncan, Robert, Whitefield, Govan.
1896. Duncanson, David B., 149 North Street.
1890. Dunlop, Robert, Orepuki, Southland, New Zealand.
1888. Eadie, Charles, Municipal Buildings, George Square.

1891. Edgar, Samuel C. B., 7 Ibrox Place, Ibrox.
1896. Elliot, Professor G. F. Scott, M.A., B.Sc., F.L.S., F.R.G.S., Ainslee, Scotstounhill.
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TRANSACTIONS

OF THE

Natural History Society of Glasgow.

Ichthyonema grayi* (Gemmill and V. Linstow).

By James F. Gemmill, M.A., M.D.

[Read 24th September, 1901.]

Large nematode worms from specimens of the common sea-urchin taken from different localities in the Firth of Clyde.

The worms were unattached, and lay coiled up within the perivisceral cavity of their hosts, exhibiting during life continual gentle sinuous movements.

Females.

The females, when mature, measure from 600 to 1,500 mm. in length, and from 2 to 4 mm. in breadth. Not more than four occurred in any one sea-urchin, and in one case only a single large specimen was present, which measured quite five feet in length. (This specimen I succeeded in preserving and mounting entire.)

The body is covered by a delicate cuticle, and tapers at both extremities, each of which carries a very small hook-like cuticular process. The tail is slightly blunter than the head, and is usually curved ventrally in a half circle. The body is semi-transparent, with an opaque white strand—the ovary—running along the ventral wall. The body is sharply constricted for about half-an-inch near its middle part. Running along the

*A fuller account of this species is given in *Archiv fur Naturgeschichte*, 1902.

body wall on either side, but nearer to the ventral than the dorsal aspect, is a close-set series of transversely placed shallow depressions, which give the body wall a crenated appearance along two lateral lines. The depth and distinctness of these depressions vary considerably in different conditions of contraction of the body wall.

Mouth and *anus* are absent.

Under the cuticle is a thin *hypodermis*, with nuclei at regular intervals. The *muscular system* is poorly developed, but exists as a single layer of cells in close connection with the hypodermis. These cells show a loose arrangement into longitudinal rows along the ventral side, and less markedly into transverse rows on the dorsal side of the body wall. There are two well-marked lateral *absorptive* lines.

The greater part of the space internal to the muscular layer is occupied by a coarsely vacuolated or reticular tissue, which has large nuclei, surrounded by protoplasm here and there in its substance. This tissue is continuous from near the anterior to near the posterior extremity, is moderately tough, and can be shelled out from the other structures. It contains an irregular central cavity, which ends blindly at either extremity.

The *ovary* is single, ventrally placed, and forms a strand of opaque white tissue almost as long as the worm itself. The ova all ripen at the same time, and, increasing in size, compress the other structures, particularly the muscular layer and the reticular tissue. The early development of the ova takes place inside the body of the female. The segmentation is total and unequal, and is followed by a modified gastrulation. Meantime the ova or young embryos separate from one another, thus taking up more space, and still further compressing the other structures, so that the body of the parent becomes extremely fragile—being, indeed, little more than an elongated sac filled with eggs or embryos. I estimated that my largest specimen contained upwards of 20,000,000 embryos.

Excretory canals are entirely absent.

The *nervous system* seems to be represented by a thickening of the hypodermis at the head end, which is not continued backwards into definite longitudinal cords, except, perhaps, for a short distance on the ventral aspect.

Males.

Besides the large specimens just described, some smaller ones were always present in the sea-urchin hosts. They measured 50-200 mm. in length, and they resemble the large ones so closely in essential points of structure that they must be regarded as belonging to the same species—of which, indeed, they seem to me to be the males. The tail end is almost always curved in a spiral with two or three turns, and it carries near its tip two equal spicula. Transverse sections of the body show, in place of the ovary, two tubes of tissue, with many nuclei. These tubes are no doubt testes, but I have not yet examined any that happened to be mature.

Mistletoe.

By George Paxton.

[Read 19th December, 1901.]

> "On Christmas eve the bells were rung,
> On Christmas eve the mass was sung,
> That only night in all the year,
> Saw the stoled priest the chalice rear;
> The damsel donned her kirtle sheen,
> The hall was dressed with holly green,
> Forth to the wood did merry men go
> To gather in the *Mistletoe*."—Scott.

What is the connection between Christmas and mistletoe? We must look back as far as the days of the Druids to find out the beginning of this.

When the winter solstice, or shortest day, arrived, the Druidical priests led the people to the woodlands, and with great pomp and ceremony cut down the sacred mistletoe.

Two white bulls were tied to the tree, the chief Druid, in robes of white, ascended its trunk, and with a golden sickle cut the sacred parasite. The bulls were then sacrificed, and festivities engaged in. The mistletoe was broken up and distributed among the people to be taken home and hung up above the entrance to their dwellings as a protection against all evil.

Only the mistletoe that grew on an oak tree was considered sacred, probably this was because it so seldom grew on the oak.

A plant on England's national tree ought to be noted, as it is yet a very rare occurrence.

When our Christian fathers found these customs too strongly incorporated to eradicate, they did a wise thing. They depleted them of their pagan meaning, and gave them a Christian connection and significance, and thus the idol worship of the Druids became connected with our Christmas time.

The mistletoe is a tree parasite, deriving most of its nourishment from its host. It is an evergreen, but will grow on almost any soft-wooded tree, whether evergreen or not.

A small shrub with lanceolate leaves, small yellowish flowers without stalks, and often covered with beautiful pearl-like berries in winter and spring.

It is not difficult to propagate from seed. All one requires is berries fully ripened, the proper trees, a little knowledge how to proceed, and a great deal of patience.

Take the ripe berries in April or May, and on a smooth-barked branch squeeze the seed gently out of its skin, which discard; the glutenous substance surrounding the germ causes it to stick to the branch, and when it gets a little dry it adheres firmly. The bark must not be cut or "grafted" in any way.

Choose a tree in good health, and a branch from one to three inches in diameter, preferably on the south side of the tree, with few or no overhanging branches to cause drip or shade.

It is a good plan to put several berries together, as they do not all come to maturity.

In a short time the germ of the berry begins to grow, and puts out a small green shoot or radicle, which turns towards the branch and attaches itself to the bark by means of a regular attachment disc. From the centre of this disc a small growth penetrates the bark and gets as far as the wood, but no further. This is called the "sinker," and is a specially modified root.

From Photograph by *George Paxton.*

MISTLETOE (*Viscum album*, L.),

Showing where old plants have died off leaving sinker holes, and young plants growing from cortical roots.

Growing on a Siberian Crab-apple Tree in front of Richardland House, Kilmarnock. (See page 301.)

Some berries produce two, and a few three, of these shoots, which is rather singular, as nature provides very few seeds with more than one growing germ.

Little more progress is visible till the winter is past and spring sends the sap along the branches to form its yearly layer of new wood or annual ring.

The sinker now produces rootlets, which grow at right angles to itself, running up and down the branch in the inner (or bast) layer of the bark.

These cortical rootlets in their turn produce sinkers similar to the parent one.

The sinkers do not pierce the wood, but the young wood, when forming, surrounds the fixed point of the sinker, and gradually year by year grows round it and banks it up with wood, thus making it appear in a year or two as if the sinker had penetrated the hard wood.

While the roots are developing the plant has been growing very slowly, and about the second year will have only produced two small leaves. After that it gets on much quicker, and when the branch of the tree begins to swell it may be considered established.

When an old mistletoe dies, the sinkers survive for a time, but ultimately moulder and fall to pieces, leaving the wood in which they were embedded exposed and full of holes, looking like holes in a wooden target.

The cortical roots, however, generally survive, and grow through the bark into new plants.

Thus a tree, once infected with this parasite can seldom get rid of it, as, in a few years after the old plant has gone, probably two or three young ones will be found to have taken its place.

The male and female flowers grow on separate plants, so unless there is a male and female plant flowering within pollen-carrying distance of each other there will be no berries produced.

There are a good many different kinds of trees on which the mistletoe can be grown, and it is strange that, although it likes the apple, a sour one best, it will rarely grow upon the pear.

The thorn, rowan, willow, poplar, lime, fir, and Siberian crab are all trees on which it does well. The last is perhaps the best to try, as it is very ornamental both in spring and autumn.

The way the mistletoe is disseminated by its seed has been frequently mis-stated.

It is quite right to suppose that the missel-thrush feeds on and is very fond of the berries, but when it is said that the undigested seed from their excrement is deposited on a branch and grows, that, surely, must be taken with a grain of salt.

The germinating power left in a small, soft seed after coming through the gizzard of a bird must be very poor indeed.

When the thrush feeds ravenously on the berries, a few sometimes stick to the outside of its bill. It flies to a neighbouring tree, wipes its bill on a branch, and there you have natural, simple, and true innoculation and dissemination.

The mistletoe has been blamed for damaging apple trees, and this may be the case to a small extent in the South of England and France, but that need not frighten anyone who wishes to grow this curious and interesting plant, the growing and study of which will afford more pleasure and instruction, and at less expense, than any other plant we know.

Long ago the mistletoe was held in high esteem for its supposed medicinal virtues—a kind of cure-all—but now no one believes in its power, excepting perhaps for one malady, that of a broken heart! This, under certain circumstances, it completely cures, for which statement we have classical authority, for was not the mistletoe plant originally dedicated to the goddess "Frigga," the *Venus* of the Saxons!

Occurrence of *Sirex gigas*, Linn., and *Sirex juvencus*, Linn., in Bute and Arran.

By JOHN BALLANTYNE, Hamilton.

[Read 28th January, 1902.]

SOME four years ago I brought under your notice the occurrence of *Sirex gigas* in Bute and Arran, a number of the females of which had been obtained. At that time the specimens had all been secured from Scotch fir, but since then I have collected a large number from silver fir, and also males of a very small size from larch. Specimens of the latter were submitted to Mr. H. P. Grimshaw, Edinburgh, who states they are the smallest form of the insect he has seen, some of them measuring about half-an-inch in length, and others a little more. One female and one pupa of average size were also obtained from the larch, but all the larvæ were considerably smaller than those from Scotch and silver fir. I am not able to give any explanation as to the smaller size of the insects—especially the males—from larch, unless there is something in the nature of the wood to account for it. Specimens of larvæ, pupæ, and perfect insects are here for inspection, and also pupa sheaths. With regard to the latter, they must be looked for amongst the borings left in the passage through the wood where the larvæ underwent the pupal state. When the larva is ready to enter this state, through some natural instinct it makes for the outside of the wood, and generally ceases boring about three-eighths of an inch from the surface, or immediately underneath the bark, where it enters into the pupal stage of its existence. When ready to emerge, the sheath is thrown off, and the perfect insect cuts through the remaining part of the wood, and emerges through a slightly smaller hole than that occupied by the larva, as will be observed from the pieces of wood exhibited.

Sirex juvencus has been obtained in large numbers from the same localities as those I mentioned for *S. gigas*. It has been found in both Scotch and silver fir. The female is of a violet bluish colour, as described and figured in Mr. Cameron's monograph on the "British Phytophagous Hymenoptera."

The males of *S. gigas* and *S. juvencus* are somewhat different in colour from the descriptions and figures given in Mr. Cameron's work.

The head of the male of *S. gigas* has two yellow spots—one behind each eye — as in the female. The antennæ are reddish yellow, the thorax black, and also the first two segments of the abdomen, except the sides of the second, which are reddish yellow. The next five segments are reddish yellow on the back, and more or less black underneath, although in some these segments are all reddish yellow. The last segment is black, and provided with a small, sharp, triangular projection. The legs are usually black, with the joints and tarsus yellow. In some, however, the femora only is black, and all the rest of the legs reddish yellow.

In the male of *S. juvencus* the antennæ are black; the head and thorax, very dark blue; the first two segments of abdomen, violet blue; and the third one, violet blue on the upper side, but reddish yellow underneath. The other five segments are reddish yellow all over. The triangular projection on last segment is black and sharp at the point. The femora and tarsus are reddish yellow, and all the rest of the legs black. One very small male insect of half-an-inch in length has the last five segments of abdomen yellow. It is evident that the males of both species are variable in colour.

I indicated in 1897 that the fly would probably be found in many more of our woods, and I now find that this is the case, as, so far as I have been able to ascertain, it has been recorded from eight different counties in Scotland in addition to Bute, although, so far, in very small numbers. In most cases it has been obtained in twos and threes only, or, as in the case of Inverkip, eight specimens. But from Bute and Arran of both species more than one hundred specimens were obtained during three seasons.

The following are the counties from which specimens have been reported:—

Bute.
Renfrewshire.
Midlothian.
Perthshire.
Fifeshire.
Peebleshire.
Aberdeenshire.
Ayrshire.
Kirkcudbrightshire.

Arctic Plants from the Dovrefjeld, Norway.

By Mrs. Peter Ewing.

[Read 29th April, 1902.]

The specimens before the meeting to-night are only a few out of the many interesting plants gathered in different parts of the Dovrefjeld last summer. Most of them are to be met with, and indeed I may say that by far the greater number were actually collected, at the Kongsvold, where the greater part of our time during our sojourn in Norway was spent. The district, which takes its name from the farm or posting station of the Kongsvold—now a large hotel to all intents and purposes—lies in the valley of the Driva, almost in the centre of the Dovrefjeld, and is considered by experts one of the richest in Norway in respect of the number of rare plants found within its limits. Indeed Professor Axel Blytt, author of the most important Norwegian flora, who has classified the various parts of the country celebrated for botanical interest, gives this region second place as a botanical centre—the Lapmark of Lulea coming first. But as there is only a difference of four plants in the number of approximately rare forms, it will be allowed that the Kongsvold makes a very satisfactory second indeed, especially in the eyes of the stranger, to whom most of these plants have hitherto been known only by name. The valley, as I have already said, occupies a central position in the great mountainous tract known as the Dovrefjeld; it is furthermore extremely favourably situated for all forms of arctic and alpine vegetation, as it lies about 3,600 feet above sea level, and is protected, especially on its western or seaward side, by high, and in many cases glacier-clad mountains, the highest in the immediate vicinity being Snaehattan, 7,400 feet above sea level. On its eastern side it is also flanked by great mountains, the mighty three-ridged barrier of Knudsho, on the slopes of which the Kongsvold stands, rising to a height of 5,540 feet. This mountain, with its bare rocky summits, its long grassy slopes, its patches of perpetual snow, steep fosses or waterfalls, and deeply sunk rocky declivities, may be said to represent all the chief botanical features of the district.

On the slopes of this mountain, and on the Vaarstein or Spring Path, which, indeed, may be considered a continuation of it, we found, with the exception of one or two forms of apparently local occurrence, everything of floral interest which the district boasted and the season of our visit permitted. Even in this latter respect we were unusually fortunate, for, on account of the early melting of the snows, many of the later flowering plants were already blooming in as luxuriant profusion as those we had a right to expect.

Pulsatilla vernalis, Mill., is one of the plants which occur in the Alps, but at a much higher elevation, naturally, than in boreal regions. This plant we found first at Krokhaugan, about thirty miles further south, in the Foldalen district. It was just over there, and we were afraid we should not find it again in flower. However, we were fortunate enough to discover an entire hill face covered with it at the Kongsvold, on the western side of the Driva, about ten minutes' walk from the hotel. The plants were in every condition from bud to ripe fruit, and the flowers most delicately tinted, the outer sepals being variously pale pink or veined with violet or reddish-purple stripes. The whole plant is covered with gleaming yellowish-brown hairs of silky texture. This is one of the plants which develops true hermaphrodite flowers on some individuals and pseudo-hermaphrodite flowers on others.

Ranunculus glacialis, L., also occurs in the Alps as well as the arctic regions, but that it is a true arctic plant there can be no doubt. It was a most wonderful sight to see great carpets of this covering the ground wherever the snow had melted or was melting, for often it would be seen actually pushing itself through the rough broken edges of icy shelves. It also varied from pure white to a sort of dusky brown, passing through all the stages of pink and crimson.

Ranunculus nivalis, L., occurred in similar situations in many instances, but it might also be found on drier ground somewhat further away from the melting snow. It is of intensely Arctic habit, its southern limit being the Hardanger tract.

Ranunculus pygmæus, L., has much the same habit as the foregoing, but, as its name indicates, it is very much smaller in size. There is a hybrid, however, found growing along with them, which links the two.

Ranunculus hyperboreus, L., is another truly arctic species, found creeping about in muddy places where the glacial water has not found an outlet.

Papaver nudicaule, L.—When in Kristiania a very terrible tale was told to us by a lady there, who said that this plant was almost extirpated from the country by the rapacity of collectors. It was only to be found in the Dovrefjeld, she said, and even there it would soon be a thing of the past. She told how she had been at the Kongsvold when a Swedish botanist (the Swedes stand in about the same relation to the Norwegians as the English do to the Irish) came and ravished the place of all its rarest treasures. In some out-of-the-way corner he managed to discover a single plant of this yellow poppy, and, as my friend remarked, he was very happy, and carried it off as the last of its race and another evidence of the submergence of Norway. We naturally felt a righteous indignation against this vandal, especially as this was one of the plants we very much wanted to see. We found, however, when we got to the Kongsvold that our wrath was just a little premature, as the last plant had not been removed by many a hundred, though, like others which we found there in tremendous profusion, it is no doubt a plant of comparatively rare and local occurrence.

Cardamine bellidifolia, L.—This curious-looking little member of the Cruciferæ is also a rare plant which grows on gravelly water-margins or broken clefts of weathered rocks. In its flowering state it was rather a puzzle, but in fruit it is very characteristic.

Draba alpina, L., is another interesting and very handsome member of the same family. It has its southern limits in the Dovrefjeld.

Polygala amara, L.—This we only found in one station on our way to Kongsvold, and not in the Drivsdalen at all. Its hue when growing was, indeed, "deeply, darkly, beautifully blue," its flowers set in denser clusters, and its habit altogether more compact than our *Polygala vulgaris*. As you see, however, it does not make at all a satisfactory specimen, though that may be owing to its not being properly dried, in which respect, I am sorry to say, most of the plants we collected suffered.

Silene rupestris, L., we found everywhere from south to north, and from the sea level to the height of about 5,000 feet.

Alsine stricta, Wahlen., and *Alsine hirta*, Hartm., are not found further south than 60°.

Myricaria germanica, Desv., is a member of the Tamaricaceæ —a group consisting of only two genera. These really give no adequate idea of this handsome shrub, being only small bits broken from the tops of branches. We were told that it was rather rare in the country, but we did not find it so. It flanked the margins of rivers in some places, and covered the surfaces of small river islands with its closely set, fastigiate branches and dense spikes of reddish-purple flowers.

Lychnis alpina, L., I have included, though it is one of our own Clova plants. Its interest lies in the fact that, while with us it only grows in one district, and then in very small and very few patches, in the Dovrefjeld it was on every roadway, reddening the ground for many a mile, while *Astragalus alpinus*, L., was quite as common.

Astragalus oroboides, Hornem., was scarcely so prolific, but *Oxytropis lapponica* ran it very closely. It was rather difficult to tell the difference between these two when growing even side by side, and both in good condition; but as soon as *Oxytropis lapponica* was off its first bloom, the livid hue it assumed proclaimed it without further examination.

Phaca frigida, L., another member of the Leguminosæ, made a very striking appearance all along the roadways as soon as the higher levels were reached, with its handsome yellow flowers in axillary racemes. All these three leguminous plants occur in the Alps as well as the arctic regions, but they are true arctic species nevertheless.

The saxifrages were, of course, in luxuriant profusion everywhere, *Saxifraga cotyledon*, L., being the handsomest, and a very decorative object as it stood out from the grey rock clefts, above its rosette of shining dark-green leaves. The next most conspicuous member of this order was, curiously enough, *Saxifraga cernua*, L. These specimens, fully twelve inches in height, speak for themselves as far as size is concerned, and as far as quantity was concerned they were everywhere, starring the grey rock faces, the river banks, and the grassy road margins indifferently. To those who know this plant as it grows in its one British station near the summit of Ben Lawers, this may well seem incredible, since even in Kerner it is figured about six inches in height as normal size.

Artemisia norvegica, Vahl.—This plant is not found elsewhere in the Old World than in the tract of the Dovrefjeld.

Petasites frigida, Fr.—A very handsome species of one of our own well-known genera.

Vahlbergella apetala, Fr. — This strange-looking member of the Caryophyllaceæ we met with first at Krokhaugan, in the Foldalen, and found it pretty widely distributed all over the Dovrefjeld.

Campanula uniflora, L., we found only on one mountain, Hogsnyta, on the western side of the Driva, but it is said to occur on Knudsho also. This was one of the few plants we did not find in great quantities, but we really were fortunate in getting it at all, as its flowering months are July and August, and these spécimens are probably the firstlings of the season as far as it is concerned.

Andromeda polifolia, L., I have only brought to give an idea of the size and strength it attains in the far north.

Andromeda hypnoides, L.—This is another plant which has its southern limit just south of the Kongsvold. It is generally to be found on dry, much-weathered rock in the region of the grey willows, above what is known as the Birch-belt. It is quite impossible to convey from the dried specimens any idea of the elegance of this little plant as it hung in richly flowered masses over the glistening grey rocks, its tiny, pale pink, waxen bells resting against trailing foliage of the most delicate green. What I have here shows the luxuriance of its floral character, but the dense tufts of both verdure and blossom which were its chief charm in life rather militate against its success as a dried specimen. These examples also show it to be of rather robust habit—which, in truth, it was, as far as our observation went—but occasionally we found it very much liker its specific name, with the most exquisitely delicate, moss-like foliage and much smaller flowers.

Diapensia lapponica, L.—The same difficulty besets one in the case of the next plant—as, indeed, it does with most of the Ericas. This little plant seemed to be rather local in its distribution. Its flowers are large in comparison with its size, and of a rich, creamy white, while its foliage is pure shining green. Its preference also is for dry shaly rocks, and it is only to be found in lofty situations.

Primula scotica, Hook., is, of course, interesting to us. It occurred in immense quantities in every part of the district, a very different-looking plant from its Caithness-shire relative —larger in size and darker in colour.

Primula stricta, Hornem., which was almost as luxuriant, has its southern limit in the Dovrefjeld, as has also my next and last specimen—

Koenigia islandica, L., an extremely tiny inhabitant of marshy places, as will be at once apparent from its appearance. It is a hardy and intensely arctic little plant, occupying bare and quite unsheltered situations on the slopes of the loftiest mountains.

As you will have observed, I have included several species which occur in alpine as well as arctic regions, also some which occur in our own country. This was intended, of course, principally for purposes of comparison, to afford those who might be interested in the subject, and who had as yet been unable to do so, the opportunity of comparing these denizens of the far north with their knowledge or remembrance of the characteristics of the same species under other circumstances. For instance, the specimens of *Saxifraga cernua*, L., over twelve inches in length, with its large, well-opened white flowers, with the tiny, almost non-flowering *cernua* of Ben Lawers; and the large, showy spikes of *Lychnis alpina*, L., with the small, insignificant Clova form. In size these plants speak for themselves, and the dried specimens give some idea, however inadequate, of the appearance they presented as individuals; but they are quite powerless—and any effort of mine would be as fruitless—to bring before you the glorious profusion in which we found almost all the species we collected — and, indeed, I may say all we saw, which numbered nearly seven hundred species of flowering plants alone. Nothing short of a visit to the Dovrefjeld itself would make our experience in this respect credible.

Meteorological Notes and Remarks upon the Weather during the Year 1901, with its General Effects upon Vegetation.

By James Whitton, Superintendent of Parks, Glasgow.

[Read 29th April, 1902.]

In order to preserve the continuity of this series, these notes have been compiled, as in former years, from the records kept at Queen's Park, Glasgow.

January.—The weather conditions during the opening days of 1901 were similar to those of the past two or three New-Year days—mild and moist—but with occasional gleams of sunshine. Up till this time we had, during the winter, experienced no seasonable weather, but, instead, had incessant rains and high temperatures. A change, however, took place about the 9th, when a sharp attack of cold, frosty weather set in, and continued, with the thermometer registering a few degrees of frost every other morning, throughout the rest of the month. Snow fell in the City on the 25th, and again on the 26th, and the atmosphere became keener and more seasonable.

The atmospheric pressure for the first part of the month was moderate, but during the second part there were some sharp changes. The highest reading of the month occurred during the latter part—30·20 inches on the 23rd—and the lowest, 28·80 inches, on the 27th.

Frost was registered on nine days, and amounted to 25° in all. The lowest reading was taken on the 29th, when 7° of frost were recorded. The average maximum temperature for the month was 42°, and the average minimum 34°, as compared with 43° and 35° respectively for the same month of 1900, when 12° of frost for five mornings were recorded.

The month's rainfall was moderate, and amounted to 2·68 inches, which included a good proportion of melted snow. The greatest daily rainfall was 0·46 inches, on the 19th.

The comparatively dry nature of the weather was much in favour of vegetation generally, which had already become surcharged with moisture with the heavy rains of the preceding months, and the colder weather checked the flow of sap in trees and shrubs. Snowdrops and narcissi in the open borders were well above the ground at the close of the month.

February.—The cold and seasonable weather of the latter part of January continued into this month, the atmospheric conditions being keen and bracing. On the 4th, snow fell to the depth of two inches. As is usual in the City during frost, fog was more or less prevalent, and on the 14th was particularly dense and disagreeable. The keenest frost of the month was recorded on the 15th, when the thermometer fell to 21°, showing 11° of frost. The severe weather somewhat relaxed towards the end of the month, and on the 23rd the minimum thermometer stood at 34°.

The pressure of the atmosphere at the beginning of the month was low and irregular, but from the 8th to the 22nd the readings were all above 30·00 inches. During the closing days of the month the barometer fell rapidly, and on the 28th was at 29·20 inches.

Frost totalling 97° was registered on twenty days, while the average maximum temperature was 42° and the average minimum 30°, which is 4° higher in each case than in the previous February.

The rainfall of the month was somewhat under the average, and measured 1·40 inches. There were 21 dry days.

The cold weather of the month kept the growth of vegetation well in check. Narcissi, &c., were all showing well above the ground, and winter aconite were profusely in flower, and displayed a fine contrast on lawns with the snowdrop.

March.—This month opened with milder weather, but for the first week was stormy, which culminated, on the 6th, in a gale of wind and rain. During the following two weeks the atmospheric conditions were bright and pleasant, but with a slight rainfall. On the 23rd a change set in, and the weather became much colder. Snow fell slightly during the night of the 25th, covering the ground with a coating of white. The cold increased till the 29th, when the thermometer showed 12° of frost at Queen's Park, being the lowest reading since the year commenced. A heavy fall of snow occurred on the 29th and 30th, and lay to a depth of three inches.

The barometric readings show a wide range of pressure. On the 1st the barometer was at 28·60 inches, rising to 30·00 inches on the 9th. From then till the 26th the pressure was more steady, but from that date the tendency was downwards, falling sharply from 29·46 on the 29th to 28·40 inches—one of the lowest readings of the year—on the 30th, during the prevalence of the snowstorm mentioned above.

For the month the rainfall amounted to 2·06 inches, and there were 21 dry days.

The amount of frost recorded was 60° for 10 days, the lowest reading being 20°, on the 29th—12° of frost.

The natural seasonable activity of vegetation was kept in check by the cold and comparatively dry weather which prevailed. Early spring flowers, however, made rapid progress, and Crocuses bloomed profusely.

April.—During the first two weeks of April the weather continued cold and of a rather wintry nature. A few degrees of frost were registered on several mornings up to the 17th. The 8th—the Spring Holiday—was a day of heavy rain and cold wind. On the 17th, however, a change took place in the weather, and it became much warmer, with much bright sunshine. These conditions prevailed till the close of the month, except that on one or two days the wind was cold and from the east.

The barometer during the first fortnight was unsteady, and there were some sudden changes. For the latter part of the month the pressure was much more regular and the readings fairly high. The lowest reading (28·70 inches) was taken on the 8th, and the highest (29·96 inches) occurred on the 26th.

Rain to the depth of 3·30 inches fell during the month, the greatest daily total being 1·25 inches on the 3rd. There were 13 dry days.

The total frost was 11°, and was registered on 6 days, and the coldest day was the 11th, when the thermometer showed 4° of frost. The average maximum and minimum temperatures were 54° and 37° respectively. For April of 1900 there were 14° of frost for 6 days, and the average maximum and minimum temperatures were 55° and 38° respectively.

The warm and genial nature of the weather during the latter part of the month gave a strong impetus to the growth of vegetation. Trees generally showed well in leaf, whilst the earlier varieties of rhododendrons, ribes, geans, and bird cherry were in full bloom. Narcissi were also in full flower, and tulips were rapidly opening.

May.—This proved to be one of the finest months of the year, there being ample sunshine, with just sufficient coolness in the wind to make the atmospheric conditions the best for outdoor recreation. On the second of the month the Glasgow Exhibition was opened with the proverbial "Queen's weather," and the pleasant nature of the weather during the opening weeks went far to ensure the success of the undertaking. The 7th—the date which was originally fixed for the opening of the Exhibition—was one of the few disagreeable days of the month, being wet and cold.

The rainfall was 1·91 inches, and there were 21 dry days.

No frost was registered at Queen's Park during the month, though at some of the City Parks a few degrees were recorded. The average maximum temperature was 62°, and the average minimum 42°, while for the preceding May these figures were 58° and 42° respectively.

Notwithstanding the dry weather, vegetation made satisfactory progress during the month, and there was an excellent display of bloom on most trees and shrubs. In some cases—notably apples, hawthorns, chestnuts, azaleas, and rhododendrons—the bloom was not only finer, but, owing to the absence of frost, lasted longer than usual. The show of hyacinths, tulips, and other bulbous plants in the City Parks and Squares was also particularly brilliant. The oak and ash began to leaf earlier than usual—the former on the 4th and the latter on the 6th—in both cases nearly three weeks earlier than in 1900, when, however, they were somewhat behind the usual period.

June.—The fine weather which prevailed throughout the previous month still held good during the opening weeks of June. Towards the 12th, with a falling barometer and a change of wind to the north, the weather became colder and showers of hail fell. For several days thereafter, though the days were bright and warm, the wind in the evenings was sharp. The closing days of the month were warmer, and there were occasional showers of much-needed rain.

Throughout the month the barometer was fairly steady; on no occasion did it fall below 29·00 inches, and on 8 days the readings were over 30·00 inches.

The amount of rain for the month was moderate, and measured 2·81 inches, rain being recorded on 11 days.

Only on two occasions did the thermometer rise to 70°, the highest reading being that of the 9th, when it rose to 74°, and the average maximum temperature was 63° and the average minimum 47°. For June of 1900 the maximum and minimum temperatures were 65° and 49°.

The prevailing bright sunshine and occasional refreshing showers of rain greatly favoured vegetation, and, having escaped the blighting effects of spring frosts, the development of the growth of trees and shrubs was unchecked, while the vigour and density of foliage was better than we have had for many years past.

July.—With the advent of this month the weather, which had up till now been temperate, became much warmer, and quite a heat wave was experienced, which lasted more or less throughout the entire month. For once the period covered by the Glasgow Fair Holidays was a time of brilliant sunshine, being, in fact, one of the finest weeks of the season. On the 20th and 21st there was a slight thunderstorm in the evening, and on the latter day the rainfall for the 24 hours was 1·03 inches.

The atmospheric pressure was regular and high, the lowest reading being 29·45 inches, on the 24th, and the highest 30·10 inches, on the 8th.

The thermometer was at or above 70° on sixteen occasions during the month, and the highest reading was 77° on the 5th, and again on the 19th, which is also the highest reading of the year. The average maximum temperature was 69°, and the average minimum 55°. This average maximum has only been once reached during the last eight years—namely, in June of 1899—when the average maximum was also 69°.

The month's rainfall was 2·39 inches, and there were 22 dry days.

The dry weather in the early part of the month was somewhat trying on vegetation, especially on subjects recently transplanted, or those which had suffered exhaustion through a prodigality of bloom. After the rainfall on the 20th and 21st these rapidly recovered, whilst the general growth of plants was extremely satisfactory.

August. — There was a continuation of the bright weather throughout this month which had characterised the opening months of the summer. During the former part of the month, however, there were frequent showers, and on the afternoon of the 13th a slight thunderstorm occurred, accompanied by heavy rain. Thereafter the weather was of a more settled nature, the days being warm and sunny and the evenings cool.

The pressure of the atmosphere for the first week was moderate and steady. On the 19th there was a sudden rise to 30·20 inches, and for the succeeding five days the readings were all above 30·00 inches. During the 25th and 26th the barometer fell rapidly, and on the latter date the pressure was indicated at 29·20 inches.

With the frequent showers and cool breezes during the month the temperature was more equable than in the preceding month, and only on four occasions was the thermometer in the shade at or above 70°, and on one occasion was the maximum thermometer below 60°. The average maximum temperature was 65°, and the average minimum 51°, while these figures for August of 1900 were 62° and 50° respectively.

The rainfall for the month amounted to 3·59 inches, and there were 14 dry days.

The moist, warm weather helped to freshen the foliage of trees and shrubs, which had been somewhat scorched by the heat of the previous month. The season was specially favourable for flowering plants. The flower-beds in the various Parks were, in consequence, better filled and brighter bloomed than usually obtains in our City. The defoliation of the lime and elm began about the middle of the month, but in a much less marked degree than usual.

September. — Throughout this month the weather was of a pleasant and enjoyable character. Though there was a considerable rainfall, the showers were light and usually fell during the night, the days being generally bright and sunny. The prevailing wind of the month was from the east, and this tended to keep the temperature somewhat low, the thermometer never reaching 70°, and the highest reading in the shade was 66°, occurring on the 9th and 10th.

The average maximum temperature was 61° and the average minimum 49°, the former being the same and the latter 2° higher than in September, 1900.

The chart of the barometer shows some sudden changes. Until the 16th the atmospheric pressure was comparatively regular, but on that date the barometer dropped sharply from 29·65 inches to 29·20 inches on the 17th, rising again to 29·65 inches on the 18th, from which it fell to 29·00 inches on the 20th. Thereafter there was a gradual rise to 30·00 inches on the 30th.

The rainfall amounted to 2·85 inches, while there were 14 dry days.

Owing to the fine weather and absence of early autumn frosts, vegetation had no check, consequently there was a vigour and brightness in the autumn flowering plants which made an excellent display. The autumnal coloration in the foliage of many deciduous trees was also more pronounced than usual, whilst the defoliation was not very apparent until towards the end of month.

October. — The weather of October was on the whole dull, changeable, and showery. During the former part of the month, though the days opened fine and bright, the afternoons were often dull and wet. Towards the 10th the first touch of winter was experienced, and though no frost was registered during the month the thermometer was frequently hovering about freezing-point. The morning of the 23rd was foggy and damp, but as the day advanced the fog cleared off and the sun broke through. The closing days of the month were dull and wet, and there was a chill easterly wind.

The pressure of the atmosphere, as shown by the barometer, was very irregular, and shows some marked contrasts. Beginning at 29·80 inches, it commenced to fall on the 4th, and on the 6th touched 29·00 inches. On the 11th the pressure had risen to 30·00 inches. Thereafter the tendency was downwards, and on the 17th and 18th the readings were 28·95 inches and 28·90 respectively. During the rest of the month the pressure was steadier, and towards the close rose to 30·30 inches.

Rain fell to the amount of 3·96 inches, and there were 10 dry days.

No frost was registered this month at Queen's Park, and the average maximum temperature was 53° and the average minimum 41°, as compared with 51° and 40° respectively for the same month of 1900.

The open weather of the month and the immunity from frost gave a longer lease of existence to outdoor flowering plants, and dahlias, chrysanthemums, &c., were still in bloom at the end of the month, while grass was fresh and green. Deciduous trees defoliated naturally, and the bulk were leafless before the month closed.

November.—This was a month during which the weather conditions were very changeable, embracing by turn some bright days, fogs, frosts, and storms of wind. The opening days were bright and pleasant, but on the 4th a thick fog hung as a pall over the City all day. Succeeding this were a few days of brighter weather. The 9th, the closing day of the Glasgow Exhibition, was dull and wet, and on the 12th there was experienced what was, perhaps, the most severe gale of the season, from the N.E., causing much damage throughout the country, and completely dislocating the telegraph system. Fog was again experienced on the 16th, accompanied by a keen attack of frost, and on the 17th the thermometer recorded the lowest reading of the year, 15° of frost being registered at Queen's Park. For the following few days the weather conditions were less severe, but on the 22nd there was a return of the frost, which held till the 25th. The closing days were milder and pleasant.

The barometric readings show a much higher range than usual. On sixteen occasions these were above 30·00 inches, and on no occasion did the barometer fall below 29·20 inches.

The rainfall for the month was 3·20 inches, and there were 17 dry days.

Frost to the extent of 58° was registered on 9 days, while for the corresponding month of 1900 there were 21° for 5 days. The average maximum temperature was 46° and the average minimum 36°, as compared with 46° and 38° respectively for the preceding November.

The sharp frost on the 2nd quickly ended the prolonged blooming of outdoor plants, and vegetation rapidly thereafter assumed its usual winter aspect.

December.—The frosty and foggy weather experienced during November gave place at the opening of this month to milder weather. On the 9th, however, these conditions changed, and boisterous and cold weather set in. Snow and sleet fell heavily till the morning of the 10th, and the frost increased till, on the 11th, the minimum thermometer showed 11° of frost. The following two days were milder, but on the 17th the frost again returned, and continued more or less severe until the 28th. On several days there was a slight thawing on the surface of the snow, which, freezing again, caused the roads in many places to be almost impassable. On the closing days of the year the weather was milder and pleasant.

The range of the barometer during the month was wide and erratic. From 29·90 inches on the 1st it fell to 29·30 inches on the 2nd, rising to 30·10 inches on the 4th; from that date until the 23rd the pressure was steadier, but low. On the 24th the barometer fell sharply to 28·25 inches, which is the lowest reading of the year.

The month's rainfall is the largest monthly total of the year, and measured 4·50 inches, which includes a considerable quantity of melted snow. There were 14 dry days.

Frost was registered on 16 mornings, and amounted to 76°, the greatest amount of frost being recorded on the 12th and the 22nd, which had each 11°. For December of 1900 no frost was recorded at Queen's Park. The average maximum temperature was 40° and the average minimum 33°; these figures for the previous December were 47° and 40° respectively.

In comparing the total rainfall of 1901, which amounted to 34·65 inches, with that of previous years, it will be seen that it is the lowest record since 1896, when the year's total was 33·90 inches, and that it is below the average for the last twelve years, which average is 37·12 inches. In marked contrast, too, is the rainfall of this year as compared with that of the previous year, which was the highest for a number of years, and measured 46·46 inches. The number of dry days during 1901 is 201, while for 1900 this total is 164, and the highest for the last twelve years is 212, in 1898. Another point of note is that for the last three months of 1901 the rainfall measured 11·66 inches, while for the same period of 1900 the rainfall totalled 18·96 inches.

The heaviest rainfall for one day in 1901 was 1·15 inches, on the 3rd of April, and in 1900 the wettest day was 1·42 inches, on the 25th June. The greatest total for one month was that of December, with 4·50 inches, and in 1900 the greatest monthly total was also in December, with 7·71 inches.

The driest month of 1901 was February, with a rainfall of 1·40 inches. For 1900 the driest month was March, when the rain measured only 0·28 of an inch.

The following table of rainfalls recorded in the various Public Parks of the City is interesting as showing the variation in different districts of the City. Due allowance must, of course, be made for exposure, altitude, and other local conditions, these being different in each case:—

RAINFALL DURING 1901 IN THE PUBLIC PARKS.

	Queen's.	Maxwell.	Kelvin-grove.	Spring-burn.	Alex-andra.	Glasgow Green.	Bella-houston.	Toll-cross.	George Square.
Height of Gauge above Sea-level.	145 ft.	69·1 ft.	48·3 ft.	361 ft.	141·4 ft.	34·7 ft.	160 ft.	85 ft.	40 ft.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January,	2·68	2·59	2·87	2·58	2·74	2·89	2·39	2·58	2·40
February,	1·40	1·19	1·45	1·90	1·39	1·32	1·67	1·43	1·29
March,	2·06	4·76	2·41	2·11	2·22	4·02	2·10	2·36	2·50
April,	3·30	3·66	2·50	2·51	2·33	2·71	2·64	3·09	2·67
May,	1·91	2·00	1·64	1·50	1·82	1·75	2·05	1·94	1·83
June,	2·81	2·89	3·47	3·22	3·33	3·41	3·33	3·32	3·58
July,	2·39	2·38	2·48	1·44	1·71	1·78	2·35	1·70	2·42
August,	3·59	3·83	3·42	3·85	3·79	3·61	3·08	4·08	3·91
September,	2·85	3·28	2·83	2·03	2·88	2·65	2·47	2·53	2·71
October,	3·96	4·16	3·81	3·92	3·95	3·96	3·45	4·50	3·44
November,	3·20	3·06	2·85	2·40	2·88	2·98	2·54	3·08	2·91
December,	4·50	4·09	3·99	2·98	4·10	4·74	4·11	4·67	4·14
Totals,	34·65	37·89	33·72	30·44	33·14	35·82	32·18	35·28	33·80

The following table of temperature may be of service for comparison:—

1901.	Queen's Park.	Maxwell Park.	Kelvingrove Park.	Springburn Park.
Thermometer (in shade 4 feet above ground level).				
Highest reading of year, ...	77°, 5th and 19th July	83°, 20th July	86°, 4th July	82°, 19th July
Lowest do. do., -	17°, 16th Nov.	13°, 16th Nov. and 23rd Dec.	21°, 16th Nov.	17°, 16th Nov.
Number of days on which thermometer fell to freezing point (32°), ...	78 days	154 days	76 days	95 days
Number of days on which thermometer did not rise above freezing point (32°),	2 days	12 days	3 days	— days
Degrees of Frost registered—				
January, ...	25° on 9 days	108° on 21 days	16° on 5 days	14° on 7 days
February, ...	97 " 20 "	204 " 24 "	73 " 17 "	93 " 19 "
March, ...	60 " 10 "	120 " 18 "	49 " 8 "	71 " 13 "
April, ...	11 " 6 "	72 " 12 "	16 " 7 "	26 " 8 "
May, ...	...	11 " 3 "	...	3 " 1 day
June, ...	...	...	...	...
July, ...	...	...	...	...
August, ...	...	...	...	...
September, ...	..	1° on 1 day	...	...
October, ...	...	50 " 13 days	...	2° on 2 days
November, ...	58° on 9 days	154 " 18 "	48° on 9 days	70 " 11 "
December, ...	76 " 16 "	200 " 25 "	55 " 12 "	126 " 21 "
Total frost registered,	327° on 70 days	920° on 135 days	257° on 58 days	405° on 82 days

Alexandra Park.	Glasgow Green.	Bellahouston Park.	Tollcross Park.	George Square.
79°, 18th and 21st July	87°, 8th July	83°, 21st July	84°, 5th July	80°, 9th June and 5th July
13°, 16th Nov.	14°, 16th Nov.	17°, 16th Nov.	16°, 16th Nov.	25°, 12th Dec.
131 days	134 days	94 days	113 days	30 days
8 days	21 days	1 day	3 days	...
79° on 20 days	88° on 21 days	40° on 10 days	46° on 13 days	...
157 " 22 "	170 " 22 "	106 " 19 "	144 " 21 "	13° on 5 days
106 " 16 "	119 " 18 "	75 " 11 "	76 " 13 "	14° " 6 "
45 " 11 "	55 " 12 "	23 " 8 "	27 " 8 "	...
6 " 2 "	5 " 2 "	...	3 " 1 "	...
...	...	...	...	...
...	...	...	...	...
...	...	...	..	...
...	...	..	...	...
26° on 8 days	11° on 6 days	...	16° on 8 days	...
107 " 13 "	123 " 16 "	80° on 13 days	90 " 15 "	10° on 3 days
147 " 21 "	172 " 21 "	104 " 20 "	109 " 20 "	15 " 5 "
673° on 113 days	743° on 118 days	428° on 81 days	511° on 99 days	52° on 19 days

With regard to the temperature, there are some interesting points of comparison with that of the preceding year. Six months of the year—viz., February, March, May, July, August, and October—had a higher average temperature than in 1900, while the average maximum temperature for July, 1901 (69°) is greater by 2° than the average maximum of any month of 1900, and has only been equalled once during the last eight years—namely, in June of 1899. Frost was registered on 70 occasions to the extent of 327°, although the thermometer was at or below freezing-point (32° Fahr.) 78 times. In 1900 the amount of frost recorded was 326° for 57 days, and the freezing-point was touched in all 64 times. The lowest reading of the thermometer in 1901 was 17° (15° of frost), on 16th November, while the lowest reading of 1900 was 9° (23° of frost), on 11th February. There were only two occasions on which the thermometer did not rise above freezing-point during 24 hours. In the previous year this happened on five occasions.

The coldest month of the year was February, when the frost totalled 97° for 20 days. July was the warmest month, with a mean temperature of 62°; in 1900 July was likewise the warmest month, but the mean temperature was 60°. The highest reading of the thermometer in the shade was 77°, occurring on two occasions, both in July — the 5th and 19th. In 1900 the warmest day was on the 15th August, when the thermometer rose to 75°.

The maximum thermometer was at or above 70° on 2 days in May, 2 days in June, 16 days in July, and 4 days in August—24 times in all—whereas in 1900 this point was touched 21 times, and occurred in June, July, and August.

During the year there was an unusual prevalence of easterly winds, as shown by the following records:—From the south-west, 218; west, 43; north-east, 4; east, 65; north-west, 6; south, 1; and south-east, 28 days, respectively. Thus, excluding the direct north and south, the western group shows 267 and the eastern group 97 times, against 290 for the western and 72 for the eastern in 1900.

From the barometric records it is seen that the range is higher than in the previous year. The highest reading of the year, 30·40 inches, was taken on the 25th, and again on the 26th, both in November, and the lowest reading, 28·25 inches, was taken on the 24th of December. In 1900 the highest reading was 30·38 inches, on the 14th of March, and the lowest, 28·40 inches, on the 19th of February. During 1901 the atmospheric pressure was 93 times above 30·00 inches and 16 times below 29·00 inches, whereas in 1900 it was only 50 times above 30·00 inches and 8 times below 29·00 inches.

In summing up these records, it may be noted that in many points the weather of 1901 showed marked contrasts to the weather of 1900. January was a dry and cold month, with a rainfall of only half that of the preceding January. February and March were both comparatively dry months, with a preponderance of low temperatures, and during the latter month there was a prevalence of easterly winds. Though April was somewhat cold and raw, May heralded the advent of bright and sunny weather, which was well sustained throughout the entire summer, and will long be associated with the success of the Glasgow Exhibition of this year. November and December were seasonable, cold, wintry months, the latter being showery and having the heaviest rainfall of the year.

Regarding the general effect on vegetation, the atmospheric conditions of 1901 were distinctly favourable, so far as the neighbourhood of Glasgow is concerned. Rarely, indeed, do we experience throughout such a genial, kindly season. Our cold, clay soil retains, in all conscience, sufficient moisture for most plants to withstand all the sunshine and heat we can get in these latitudes. Accordingly, while many districts suffered with the dry, sunny summer of this year, Glasgow did not.

It rarely happens that we get such a satisfactory growth on tree and shrub as that which was obtained during the past season. In the preceding year the average growth on trees was better than in most seasons, but the results of 1901 have far surpassed that. The vigour of growth was not only noticeable on the shoots, but the luxuriance and density of foliage was remarkable—for Glasgow. The display of bloom on deciduous trees and shrubs was in most cases above the average, and, having escaped spring frosts, were fuller and richer in colour. The bulk of evergreen plants escaped injury during the winter better than their condition warranted. Rhododendrons, though somewhat irregular, as many varieties did not set flower buds, made an excellent display, whilst the annual flower-bedding stuffs and hardy herbaceous plants were not only better but more prolonged in their blooming than usual.

Regarding annual vegetation, the same good results were general. The cereals, never having been checked, developed well, and were harvested under satisfactory conditions. Root crops, especially potatoes, were likewise fine and abundant. The dry weather tended to keep the grass back for a week or two, but on the whole there was an abundance of pasture throughout the season, and the hay crop was also good.

After such a sunny and pleasant year, the condition of trees and shrubs is such as to warrant us to look forward with lively anticipations, and, given genial conditions, there should be another fine floral display in park and woodland.

The hope expressed last year that the cycle of wet seasons had ended, and that we should be blessed with a series in which the sunshine would exceed the rain, having been amply fulfilled, we can only again reiterate the hope, and that the weather conditions may be such as tend to sweeten the atmosphere of our city and brighten the lives and benefit the health of its toiling citizens by enabling them to enjoy more fully the advantages and pleasures which are to be found in life out of doors.

Subjoined is the meteorological record for the past three years as kept at Queen's Park, and the averages for the last twelve years.

COPY OF METEOROLOGICAL RECORD KEPT AT QUEEN'S PARK, GLASGOW.

RAIN GAUGE 145 FEET ABOVE SEA LEVEL.

MONTHS.	1899. Rainfall. Inches.	1899. Thermometer. Average. Max.	1899. Thermometer. Average. Min.	1899. Dry Days.	1900. Rainfall. Inches.	1900. Thermometer. Average. Max.	1900. Thermometer. Average. Min.	1900. Dry Days.	1901. Rainfall. Inches.	1901. Thermometer. Average. Max.	1901. Thermometer. Average. Min.	1901. Dry Days.
January,	5·61	40	32	13	5·08	43	35	4	2·68	42	34	15
February,	1·84	43	32	20	2·68	38	26	20	1·40	42	30	21
March, ...	3·18	46	35	21	0·28	44	31	27	2·06	45	34	21
April, ...	4·11	52	37	14	2·14	55	38	16	3·30	54	37	13
May, ...	4·45	54	40	18	2·19	58	42	17	1·91	62	42	21
June, ...	1·55	69	50	22	4·04	65	49	13	2·81	63	47	19
July, ...	3·69	68	53	16	3·03	67	54	11	2·39	69	55	22
August,...	1·38	69	53	23	4·36	62	50	16	3·59	65	51	14
September,	3·71	59	46	5	3·70	61	47	18	2·85	61	49	14
October,	3·57	54	40	15	5·05	51	40	10	3·96	53	41	10
November,	5·64	51	42	10	6·20	46	38	9	3·20	46	36	17
December,	2·94	39	30	16	7·71	47	41	3	4·50	40	33	14
	41·67			193	46·46			164	34·65			201

AVERAGES FOR THE LAST 12 YEARS.

Years.	Rainfall. Inches.	Mean Temperature.	Dry Days.	Number of Days on which 1° or more of Frost was registered.	Degrees of Frost registered.
1890	38·04	47	170	74	273
1891	36·09	46	184	85	371
1892	33·84	45	194	101	798
1893	33·05	47	186	56	306
1894	41·48	46	169	55	256
1895	27·57	45	202	99	823
1896	33·90	47	209	63	331
1897	40·22	46	205	61	347
1898	38·44	48	212	42	190
1899	41·67	47	193	64	415
1900	46·46	47	164	57	326
1901	34·65	47	201	70	327
Averages,	37·12	46°	191	69	397°

Report on the State of the Alpine Flora in Breadalbane during the last Week of July, 1902.

By Peter Ewing, F.L.S.

[Read 26th August, 1902.]

For many years now it has been my habit to note the condition of our Scottish alpine flora in the field during the month of July, either in the Highlands of Perthshire or Forfarshire. This year my investigations were confined to the Breadalbane district, and it seemed exceptionally interesting, in view of the weather conditions, to make a comparison between the appearance of the flora of the uplands—especially the forms that come under the designation of alpine plants—and that of the valleys and low-lying country beneath.

Owing to the prevalence of easterly winds and the want of sunshine during the greater part of the spring and summer months, the growth of vegetation was very greatly retarded in the low country, and the same result, it was curious to observe, was generally apparent among the alpine forms also, in spite of the fact that the conditions requisite for their growth vary considerably from those required for low-country forms. For instance, the point at which many of them begin to grow is very near the freezing point of water, as in the case of *Saxifraga oppositifolia*, which may be seen flowering among the icicles at the Falls of Clyde, or the *Azalea procumbens*, before the snow has altogether disappeared from the ground on which it is growing. In the crevices of the rocks, or on the slopes sheltered from the cold wind, these plants might have been expected to be well advanced, but such was found not to be the case. All the plants were late; in fact, when the short period which these alpine forms have for flowering is taken into consideration, they were very late indeed. In many cases it seemed doubtful, indeed, if they would be able to ripen their seed this season.

It is not to be taken for granted, however, that these similar conditions resulted from exactly the same cause. As regards the alpine plants, my own opinion is that the general lateness was not due so much to the average low temperature as to the constantly recurring falls of snow. This snow was invariably melted by winds the temperature of which was not much above that of the snow itself, and this state of things continued even up to the last week of June, when the hills appeared white down to 1,000 feet above sea level. On the morning of 17th July, in the Killin district, the grass fields were white with hoar frost, and the pools showed a distinct covering of ice.

The proverbial oldest inhabitant's memory was taxed to remember so backward a season. *Primula vulgaris* seemed at its best, the hawthorn was just in flower-bud, and *Pteris aquilina* was just showing above the ground in the last week of June on the banks of Loch Tay—all at least five weeks behind their usual time—and the hill slopes and summits were in much the same state of backwardness.

Everything seemed to be awaiting the heat, for when, in the last week of June, a short-lived warm wave swept hurriedly over us, its effect was at once apparent in the sudden quickening of vegetation on every hand, so that before the first week of July the wild roses were showing their buds, many of the summer flowers had appeared by the roadsides, and in another week both spring and summer flowers were blooming together in great profusion.

In speaking of the alpine plants found in flower during the last week of July, it may be interesting, for the sake of comparison, to put on record a few details concerning their general appearance and condition. The leaves, on the whole, were well formed, but small, the flowering stems short, and the flowers also small, giving a rather bare appearance to the rocks and detritus, and even to the marshy ground. As regards their state of advancement, they were, as I have already said, very late. *Caltha minor*, for instance, usually in ripe fruit towards the end of July, was mostly in flower-bud. The *Cerastium* forms were three weeks late; *Arabis petræa*, about two weeks late; *Draba rupestris*, three weeks late; the alpine forms of *Cochlearia*, a week late; *Arenaria sulcata*, two weeks late;

Saginas, two weeks late; *Dryas octopetala*, three weeks late; the Saxifrages were all two or three weeks late; *Epilobium anagallidifolium*, up to date; *Cornus suecica*, not to be seen; *Erigeron alpinum*, three weeks late; *Gnaphalium*, not in flower; *Saussurea alpina*, which is often in flower about the last week of July, was not even showing flower-buds. All the alpine *Hieracia* were very late; only a few plants of *Hieracium holosericeum* were to be seen in flower. Of *Pyrola rotundifolia* no flowering stems even were to be seen, and of *Gentiana nivalis* only one or two flowers, while *Gentiana campestris* on the slopes seemed two or three weeks later than usual. *Myosotis alpestris* showed both plants and flowers very small and stunted. *Veronica fruticans* was two weeks late; *Narthecium ossifragum*, in flower-bud, also two weeks late; *Tofieldia palustris*, in good flower; *Junci* and *Carices*, two or three weeks late. Grasses all very late, but both *Woodsia* and *Cystopteris* seemed up to date, thus showing how very fast these alpine plants make up for lost time, or, in other words, how rapidly they mature in the short time at their disposal; also, how quickly a few warm and dry days will enable them to ripen their fruit. A record corresponding to this next year would be interesting. I should feel inclined to foretell a scarcity of annuals and a poor development of perennials next year. Yet the milder weather we have had during the last few days, and what we may yet have if the wind continues westerly, may make a great difference on the whole aspect of the alpine flora, and upset any calculations based on these observations.

Reports on Excursions.

Toward, 7th September, 1901.—This excursion was a joint one with that of the Andersonian Naturalists' Society, and was further augmented by a contingent from the Greenock Natural History Club. The party, seventeen in all, under the leadership of Miss S. B. Robbie, travelled, *via* Gourock, to Toward on a fine afternoon, and proceeded to Castle Toward, permission to visit which had kindly been granted by the owner of the estate. The first object of interest within the grounds was the old ruined castle once the seat of the Chief of the Lamonts. Like many other Scottish castles, it is said to have been visited by Queen Mary, who rode from Dunoon, whose castle she had also honoured with her presence. In 1646 the Campbells made a raid on Castle Toward, carried off the Lamonts, and hanged them on an ash tree in the kirkyard at Dunoon. Tradition says that "the Lord from heaven did declare His wrath and displeasure," on account of this cruel deed, "by striking the said tree immediately thereafter, so that the whole leaves fell from it, and the tree withered, which, being cut down, there sprang out of the very heart of the root thereof a spring like unto blood popling up, and that for several years, till the said murderers or their favourites did cause howk out the root." The old castle was burned at the time of the raid by the Marquis of Argyll, who was afterwards made to suffer for so doing, this deed in fact forming part of his indictment at his trial, which ended in his death.

The chief feature of the Castle Toward estate is the variety and fine quality of its timber. The late Mr. Kirkman Finlay, who purchased this estate, planted five million trees, covering nine hundred acres, in Dunoon Parish, besides thirty acres in the Parish of Inverchaolin, into which the lands of Castle Toward extend. Fine examples of nearly all our deciduous trees were seen—the One-leaved Ash, Magnolia, Walnut, Norway and Japanese Maples, and true Plane trees were especially interesting. Among shrubs, the Japanese Quince in fruit, the

Spindle trees, Mahonias, Barberries, the floriferous New Zealand shrub *Olearia haasti*, and many others, attracted attention, as did also the clumps of Bamboo.

After wandering over the beautifully kept grounds, the party entered the garden and hot-houses, where a wealth of colouring and delightful perfume regaled the organs of sight and smell. They next visited the modern castle, which stands on a plateau, and is considered one of the finest examples of modern Gothic architecture. It was designed by David Hamilton, who planned the Royal Exchange of Glasgow. By favour of Captain Williamson, who agreed to let a steamer touch at Toward that was not in the habit of doing so, the party had ample time to do justice to the beauties of the estate.

Arniston and Temple, 23rd September, 1901.—Mr. George Cleland acted as conductor of this excursion, which was undertaken, on the Glasgow Autumn Holiday, jointly with the Andersonian Naturalists' Society. Arniston and Temple are situated to the south-west of Gorebridge, along the Gore and the South Esk, and were part of the land on the South Esk, in Lothian, granted in the twelfth century to the Knights Templars by David I. The estate on the South Esk was the first settlement of the Knights Templars in Scotland. These lands were subsequently formed into the Barony of Ballintrodo, which was the principal seat of the Templars until the suppression of the Order, in 1309. At that time the Templars, stricken in Scotland as in every other country in Christendom, disappeared from Scottish history, and the name given to the parish of "Temple" is now the sole remaining link between that once mighty Order and the lands upon the South Esk, of which for nearly 200 years they were the lords. From the Knights Templars, Ballintrodo passed into the hands of the Hospitallers or Knights of St. John.

The morning opened threateningly after a night of rain, but, by the time Gorebridge was reached, the sun was shining brightly on the party, which numbered in all 38. The Rev. D. W. Wilson, M.A., Gorebridge, met the members, and guided them into the Arniston grounds. The route at first lay through the woods along the banks of the Gore. Near the entrance

Mr. Wilson pointed out the remains of one of the places where the manufacture of gunpowder used to be carried on, evidence of which was also to be seen in the number and variety of the Alders growing near, the Alder being used in the manufacture. He also gave some account of the birds of the district, though the birds themselves were exceedingly infrequent, and but few could be seen. He further spoke of the woods as being good ground for botanical work, but the slopes adjoining the Gore are mainly covered with "Dog's Mercury" and ferns. A search was made for fungi, but few were seen until the South Esk was reached, when a fairly good series was obtained.

The glen of the South Esk is deep and well wooded on both sides. At various points, where the ground was wet, *Stellaria aquatica* was growing in great profusion, trailing over the "Dog's Mercury" with stems one to three feet long. *Circaea lutetiana* and *Angelica sylvestris* were in great abundance, both in flower and fruit. The woods had fine representatives of Oak and Beech trees, and near the path were some large Geans and three or four beautiful Spanish Chestnuts, one of which measured 13½ feet at 4 feet 4 inches on south-east side. Some bushes of *Viburnum lantana*, *Euonymus japonicus*, and *Berberis vulgaris*, were very conspicuous with their highly-coloured fruits. The *Philadelphoris coronarius* (the False Orange) seemed to have been largely planted, and one bush of the Juniper was noticed growing on the banks of the stream. About noon Arniston House was reached, where the party were hospitably entertained by Sir Robert Dundas, Bart. A halt of twenty minutes for lunch was made, and then the way was continued to Temple, Arniston being left for inspection on the way back. In the glen opposite Arniston were a number of introduced, shrubs and trees, one or two specimens of *Abies nobilis* being very conspicuous with their silvery foliage. There was also a fine clump of Sea Buckthorn (*Hippophae rhamnoides*). The bushes seemed very healthy and well grown, but bore no fruit. On the side of the stream at Temple was a large Ash, 14 feet 1½ inches at 5 feet 3 inches on west side. In the centre of the fork, about 30 feet from the ground, a young Elm was growing.

The Rev. J. W. Blake, M.A., minister of Temple, now joined the party, and conducted the members to the old church. It stands on the sloping banks of the South Esk, and is now a roofless ruin. The style is the pointed early English. In the one end is a quaint little doorway, with trefoil arch cut from a single stone; in the opposite end is the prettiest of the windows, with a fine head of plate tracery with plain circles; on the south side are two pointed windows; on the north side one, the second having evidently been built up. The heads of these windows are also of plate tracery. The double sedilia in the south wall and the doorway are thought to date from the time of the Templars. A tomb in the north wall belongs to the fifteenth, and the belfry to the sixteenth, century.

A dozen of the party made a short detour to Edgelaw Reservoir, but, beyond observing six herons perched on the trees, and a large number of waterfowl, nothing of special interest was noticed, and the party retraced their steps, and soon rejoined the main body at Arniston.

The main interest at Arniston centred in the splendid avenues of trees. These were planted in 1736, and consist mainly of Beech, Elm, Larch, Maple, and Lime. Sir Robert Dundas has still in his possession the invoices of these trees, and offered to show them to anyone curious to see them. A Larch in front of the house measured 9 feet 8½ inches at 4 feet 4 inches on west side; another, 12 feet ½ inch at 4 feet 9 inches on east side; an Ash on north side of the road, near the gate in the park, measured 12 feet 7 inches at 5 feet 3 inches on south-east side; a Maple, on same side, 12 feet 3½ inches at 5 feet 6 inches on south-east; a Maple, on south side, 16 feet 1 inch at 4 feet 5 inches on north-west side; an Ash, on north side, 12 feet 8 inches at 5 feet 5 inches on south-east; and another Ash, also on north side, 15 feet 1½ inches at 4 feet 9½ inches on south-east side.

The party then made for Gorebridge, and travelled to Edinburgh. After a halt here for tea, Glasgow was eventually reached after a most enjoyable day's excursion.

The following list of fungi was reported by Mr. Johnston:—

Amanita phalloides, Fr.
rubescens, Pers.
vaginatus, Bull.

Lepiota clypeolarius, Bull.
granulosus, Batsch.
procerus, Scop.
Armillaria melleus, Fl. Dan.
Tricholoma terreus, Schaeff.
vaccinus, Pers.
Clitocybe laccatus, Scop.
Collybia dryophilus, Bull.
Mycena galericulatus, Scop.
polygrammus, Bull.
Pholiota squarrosus, Müll.
Flammula sapineus, Fr.
Psaliota campestris, Linn.
Stropharia aeruginosus, Curt.
semiglobatus, Batsch
Hypholoma fascicularis, Huds.
Panaeolus campanulatus, Linn.
Paxillus lepista, Fr.
involutus, Fr.
Hygrophorus conicus, Fr.
virgineus, Fr.
psittacinus, Fr.
ceraceus, Fr.
Lactarius blennius, Fr.
serifluus, Fr.
deliciosus, Fr.
quietus, Fr.
torminosus, Fr.
Russula emetica, Fr.
ochroleuca, Fr.
nigricans, Fr.
cyanoxantha, Fr.
Boletus badius, Fr.
flavus, With.
luteus, Linn.
subtomentosus, Linn.
Polyporus versicolor, Fr.
Hydnum rufescens, Pers.

Stereum hirsutum, Fr.
sanguinolentum, Fr.
Lycoperdon coelatum, Fr.
Peziza badia, Pers.
Reticulata umbrina, Fr.

Few Tipulidae were netted, the rains of the early morning having so damped the grass and undergrowth that no sweeping could be done. The following is a list of those taken:—

Dixa maculata, Mg.
nebulosa, Mg.
Dicranomyia didyma, Mg.
Empeda nubila, Schum.
Rhypholophus haemorrhoidalis, Ztt.
Limnophila senilis, Hal.
Trichocera annulata, Mg.
hiemalis, Deg.
Dicranota bimaculata, Schum.
Tipula pagana, Mg.
signata, Staeg.

Campsie Glen and Lennox Castle were visited on 28th September, 1901, and Cadder Wilderness on 19th October, but nothing deserving of special mention falls to be recorded. The excursions were under the guidance of Mr. Wm. Stewart, and were principally for mycological purposes.

Craigends, 19th April, 1902.—Mr. John Renwick, the conductor, has contributed the following report:—

"On this occasion the grounds of Craigends House were visited first, and thereafter the party proceeded by the village of Crosslee, up the side of the lade that supplies the mills there, and along the River Gryfe to Bridge of Weir.

"The lands of Craigends were, in 1479, given by the first Earl of Glencairn to his second son, William Cunninghame, and have since remained in the possession of his lineal descendants. Near the house is a very large Yew tree—the largest that we know of in the West of Scotland. On this occasion it was found to have a girth of 21 feet 11½ inches at the narrowest part of the short bole, on an irregular line about 1½ feet to 2½ feet from the ground. The trunk begins to divide, at about 3 feet up, into thirteen or fourteen large limbs, the largest of which is over 8 feet in girth at the base. The tree is situated on sloping ground near the river, and these figures refer to the lower side. In November, 1899, the height of the tree was 44 feet; the diameter of the spread of the branches was 85½ feet in a line parallel to the river, and 85¼ feet at right angles to the course of the river — an increase of 18 inches in each direction since our previous measurement in March, 1896. At this last date the circumference of the branches was 256 feet. In November, 1899, the figures were—girth, 21 feet 2¾ inches; spread, 81 feet 10 inches. In the *Highland and Agricultural Society's Transactions*, 1865, details are given—girth, 19 feet 6 inches; greatest spread of branches, 67 feet 6 inches; circumference, 205 feet; area, 3,330 feet. The height at which the girth was taken is not given, nor is it stated in which direction was the greatest spread of branches; but, assuming that these are the same as those to which our figures refer, the following comparisons may be of interest, although they cannot be definitely taken as strictly correct:—

Date.	Girth. Ft.	Girth. In.	Increase. Inches.	Years.	Rate per annum. Inch.
1863 or (1864), ...	19	6	...	...	...
Nov., 1889, ...	21	2¾	20¾	say 27	·77
Mar., 1896, ...	21	7	4¼	6	·71
Nov., 1899, ...	21	10	3	4	·75
April, 1902, ...	21	11½	1½	2	·75
			29½	39	·75
Our measurements, Nov., '89, April, '02,			8¾	12	·73

DIAMETER OF SPREAD.

	Ft.	In.	Increase. Ft. In.	Years.	Rate per annum. Inches.
1863 (or 1864), ...	67	6	...	...	...
Nov., 1889, ...	81	10	14 4	say 27	6·37
Mar., 1896, ...	84	0	2 2	6	4·33
Nov., 1899, ...	85	6	1 6	4	4·50
			18 0	37	5·84
Our measurements, Nov., '89, Nov., '99,			3 8	10	4·40

CIRCUMFERENCE OF SPREAD.

			Increase.	Years.	Rate per annum.
1863 (or 1864),	...	205 ft.	...	...	...
March, 1896,	...	256 ft.	51 ft.	say 33	1 ft. $6\frac{1}{2}$ in.

AREA.

1863 (or 1864), .. 3,330 feet.
1899, taking average diameter as 85 ft. = 5,674 ft., fully $\frac{1}{8}$th of an acre.

"A growth in girth of ·73 of an inch yearly is very great for a Yew, and is likely to be partly accounted for by the swelling under the division of the trunk on the one hand, and on the other by the enlargement at the roots. But the tree appears to be very healthy and vigorous, and in 1896 we were told that it always produced large quantities of pollen.

"A Horse Chestnut near the house was measured — girth, 13 feet 1 inch at 3 feet 6 inches from the ground—an increase of $6\frac{1}{4}$ inches in six years and 13 inches in twelve years = an average of 1·08 inch per annum. In 1899 it had a spread of 90 feet.

"Mr. John Paterson reports that the Swallow, the Sand-martin, and the House-martin were seen on the side of the Gryfe at Crosslee, and the Willow-wren was common."

MURROCH and AUCHENREOCH GLENS, 26th April, 1902.—This excursion, which was under the leadership of Mr. Wm. Armour, C.E., was a joint one along with the Geological Society, and the interest was mainly geological. Mr. John Renwick has contributed the following report:—

"Proceeding by rail to Dumbarton, the party walked by the highway to the lower end of Murroch Glen, ascended this valley into Auchenreoch Glen, and returned to Dumbarton across the moor and down the hill road.

"The rocks through which the two streams flow belong to the lowest division of the Carboniferous system—namely, the Calciferous Sand-stone series, or Cement-stone group. They are known as the 'Ballagan beds,' from being typically exposed in Ballagan Glen, near Strathblane, and consist of clays, marls, shales, sand-stones, and cement-stones. They appear to have been laid down in extensive lagoons, or shallow water basins.

"The streams have worn channels deep down into ravines, showing fine examples of river erosion, and affording, now on one side and again on the other, grand sections of the strata thus cut through. The most extensive section is a splendid cliff, variously estimated at 150 to 200 feet in height, in Auchenreoch Glen, a little above the point where that stream literally falls—over a little waterfall—into the main stream. Standing in the middle of the glen near this point is a column, known as 'Lot's Wife,' consisting of hardened rock, apparently altered by the action of heated water passing through the strata, long after they were formed. Evidence of the action of ice was pointed out in the rounded boulders of Highland rocks strewed in the glens, carried from the North during the glacial period.

"Botanically, many of the spring flowers were seen, but nothing of special interest was found.

"Among the summer birds observed (by Mr. W. A. Donnelly) were the Common Sandpiper, the Willow-wren, the Cuckoo, and the Ring-ouzel; and the Corn-crake was heard. The resident birds included the Carrion Crow and the Bullfinch.

"It may be of interest to mention that King Alexander II., in 1223 or 1224, 'gave and granted to the said burgh (of Dumbartane), and burgesses thereof and their successors, two parts of the lands of Murvaich (Murroch), for the common good of the burgh that may be made therefrom, as the said charter, granted the 13th day of the month of December and the tenth year of the reign of the said king, proports.' In 1240 the same king granted a charter 'to the said burgh and burgesses thereof of the third part of the lands of Murvaich, for the yearly payment of ten merks in name of feu farm.'—(Charter of James VI. and I., 1609, quoted by Joseph Irving, *Book of Dumbartonshire*).

"The burgh and burgesses of Dumbarton were rather fond of litigation, and it is to be feared that they have had at various times to dispose of most, or all, of their Murroch lands."

Neilston Pad and Harelaw Dam, 3rd May, 1902.—About thirty members and friends took part in this excursion, which was carried out, under the leadership of Mr. John Robertson, in fine weather.

The route taken was over Neilston Pad to Harelaw Dam.

From the Pad the Arran hills and the Firth of Clyde could be seen, although the atmosphere was rather hazy and unfavourable for an extended view. At Harelaw Dam most of the party were conveyed by means of a boat to the island, on which is the nesting-place of a well-known large colony of Black-headed Gulls. Nests were seen at all stages, many still without eggs, while a few had young birds hatched out. Most of the nests contained three eggs, but there were several with four. The colony still keeps up to its usual strength. There is little doubt, in fact, but that it would greatly increase were it not that the birds are not allowed to nest on the sides of the Dam. The eggs are taken by the keepers to prevent boys and other trespassers from being attracted to the place. On Harelaw were also seen a number of Tufted Ducks and five Great Crested Grebes. Some of the party returned direct to Neilston by road, others by the old road to the east of Neilston Pad, two sand pits near Neilston being visited *en route*. The ground passed over is a well-known locality for the Moonwort, which was observed during the afternoon. A Common Bat or Pipistrelle was obtained, and the following summer birds were noted:—Swallow, Sand-martin, Wheatear, Common Sandpiper, and Willow-wren.

Bishop Loch, 6th May, 1902.—This evening excursion, under the leadership of Mr. John Paterson, was sparsely attended, only six persons being present. The weather was cold and windy, but bright and comparatively favourable for observation of the bird life of the district, to which feature of its natural history attention was entirely devoted. Many Redshanks, Common Sandpipers, Swallows, and one Yellow Wagtail were seen at Bishop Loch, and on the loch or in its immediate neighbourhood were some Coots, Water-hens, Little Grebes, four Tufted Ducks ♂, several Mallards, several Pochards, and a pair of Mute-swans, the last-named nesting on an islet and having erected apparently a structure like a hay-rick in form and size. The conditions were not quite so favourable at Woodend Loch, but one pair of Tufted Ducks was seen there, and at Lochend Loch several Mallards and Teal. A Pheasant with no ring discernible on its neck is perhaps worth noting now-a-days, although the same claim cannot be urged for that common object of the country, a dead example of the Common Shrew, found on the road near Lochend Loçh.

Cambusnethan House and Dalziel House, 17th May, 1902. —This excursion was under the leadership of Mr. James Whitton. Mr. John Renwick has contributed the following report on the measurements which were taken of certain trees:—

Cambusnethan House.

English Elm, to north-west of house, near gate into glen—bole, 5½ feet; girth, 8 feet 10 inches at 2 feet 2 inches.

Spanish Chestnut, below house—bole, 15 feet; girth, 22 feet 4½ inches at 5 feet 4 inches. On 17th May 1900 girth, 22 feet 3 inches. Tree decaying. One of the largest Chestnuts in the West of Scotland.

Beech, near garden (outline of trunk, &c. resembles an elephant's head)—bole, 20 feet; girth, 12 feet 10 inches at 5 feet.

Black Poplar, opposite offices—bole, about 60 feet; girth, 11 feet 3½ inches at 4 feet.

At the root of this tree many fine specimens of *Lathräea squamaria*, L., were growing.

Spruce Fir, in glen—girth, 8 feet 6 inches at 5 feet 5 inches.

Dalziel House.

Oak, near house ("Covenanters Oak") *—bole, 7 feet; girth, 19 feet 6 inches at 2 feet 3 inches. Girth on 6th May, 1893, 19 feet 2 inches.

Beech, on side of river, planted 1721—bole, 12 feet; girth, 14 feet 4½ inches at 4 feet 8 inches. Girth on 6th May, 1893, 13 feet 8½ inches.

Yew, in glen—bole, fully 25 feet; girth, 8 feet 0¾ inches at 5 feet 6 inches. Girth on 6th May, 1893, 7 feet 9½ inches.

A Black Poplar measured in 1893, is said to have been blown down in 1899.

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*See *Transactions*, Vol. IV. (N.S), p. 102; and (*b*) pp. 250 and 259.

Ben Lomond and Luss, 22nd May, 1902 (Mr. Hugh Boyd Watt, Conductor).—The day was unfortunately wet, a soft rain falling almost continuously. Ben Lomond was the programme for the day, but a small party landed at Luss, and the results of their work are included in this report. The remainder of the party "took the hill," a considerable number reaching the top of the Ben (altitude, 3,192 feet).

Mr. John Paterson reported having seen the Squirrel (*Sciurus vulgaris*, L.) at Luss, where it is common. Only a very few common birds were seen on the Ben, amongst them a pair of Whinchats (*Pratincola rubetra*, L.) Willow-wrens (*Phylloscopus trochilus*, L.) were singing as high up as the small trees by the burn-side extended, and in the mist, about 1,600 feet up, a Sky-lark was soaring in song. From Luss Mr. Paterson reports the Garden-warbler (*Sylvia hortensis*, Bech.), Tree-pipit (*Anthus trivialis*, L.) and Wood-wren (*Phylloscopus sibilatrix*, Bech.) with the remark that they may fairly be described as quite characteristic birds of Luss. Longtailed Tits (*Acredula rosea*, Blyth) were also seen several times. On the lower slopes of the Ben, Mr. R. B. Johnstone captured a Blindworm (*Anguis fragilis*, L.), and a bottle full was seen in the possession of some tinkers at Luss, which had been got among the rubbish at the disused slate quarries in Luss Glen, where they abound; and they seem to occur over all the Loch Lomond district.

Tenthredinidæ, Mr. A. A. Dalglish reports, were very scarce at Luss, only three species being taken, namely, *Tomostethus fuscipennis*, Fall., *Pachynematus capreæ*, Pz., and *Dolerus hæmatodes*, Schrnk., all swept in marshy ground.

Among the Aculeata at Luss *Formica fusca*, Latr., *Lasius niger*, Linn., and *Myrmica rubra*, L., race *ruginodis*, Nyl., were all common. *Nomada alternata*, Kirby, was taken, and the only other species noticed was *Bombus terrestris*, L.

Lepidoptera—Mr. A. A. Dalglish took the following species at Luss:—*Lithocolletis quercifoliella*, Z., common at rest on oak; *L. heegeriella*, Z., single specimen; *L. alnifoliella*, Dup., fairly common on alders; *Acalla literana*, L., single specimen hybernated and in poor condition; *A. ferrugana*, Tr., hybernated and common; *Depressaria arenella*, Schiff., single specimen, hybernated; *Gracilaria syringella*, F., beaten from ash; *Xanthorhoe* *spadicearia*, Bhk. (=*ferrugaria*, Haw.); *Rœselia confuscalis*, H.S., single specimen from wall or roadside.

Tipulidæ.—Mr. Alex. Ross reports that the unfavourable weather prevented any large captures. Eighteen species were taken, and of these *Dicranomyia stigmatica*, Mg., was known previously only from Lochgoilhead and Colintraive; and *Idioptera trimaculata*, Ztt., from Drymen Road and Milngavie. These two species were the most interesting, and the others were *Dixa maculata*, Mg.; *Limnobia macrostigma*, Schum.; *L. nubeculosa*, Mg.; *Dicranomyia chorea*, Mg.; *Rhipidia maculata*, Mg.; *Empeda nubila*, Schum.; *Erioptera tænionota*, Mg.; *Rhypholophus nodulosus*, Mcq.; *Limnophila meigenii*, Ver.; *Trichocera regelationis*, L.; *Ula pilosa*, Schum.; *Amalopis immaculata*, Mg.; *A. unicolor*, Schum.; *Tipula hortulana*, Mg.; and *T. varipennis*, Mg.

Coleoptera.—The following species were collected or observed at Luss by Mr. Anderson Fergusson:—*Leistus fulvibarbis*, Dej.; *Nebria gyllenhali*, Sch. (red-legged variety); *Harpalus latus*, L.; *Pterostichus versicolor*, Sturm.; *P. madidus*, F.; *P. niger*, Schall.; *P. nigrita*, F.; *Anchomenus angusticollis*, F.; *A. albipes*, F.; *A. parumpunctatus*, F.; *Bembidium littorale*, Ol.; *B. punctulatum*, Drap.; *Trechus minutus*, F.; *Cercyon hæmorrhoidalis*, F.; *C. melanocephalus*, L.; *Bythinus bulbifer*, Reich.; *Adalia obliterata*, L.; *Aphodius fimetarius*, L.; *A. ater*, Deq.; *A. depressus*, Kug.; *Geotrupes sylvaticus*, Panz.; *Agriotes obscurus*, L.; *Rhagonycha limbata*, Thoms.; *R. pallida*, F.; *Chrysomela staphylea*, L.; *Crepidodera aurata*, Marsh; *Deporaüs betulæ*, L.; *Anoplus plantaris*, Naez.; *Balaninus salcivorus*, Payk.

Mr. John R. Lee reports that the following were the only plants of interest noted on Ben Lomond:—*Thalictrum alpinum*, L., altitude 2000 feet; *Anemone nemorosa*, L., and *Caltha palustris*, L., both in flower at altitude 2000 feet; *Rubus chamæmorus*, L.; *Alchemilla alpina*, L.; *Saxifraga stellaris*, L.; *S. oppositifolia*, L., in flower, altitude 2000 feet; *Antennaria dioica*, Gærtn.; *Vaccinium Vitis-Idæa*, L.; *Oxyria reniformis*, Huds.; *Empetrum nigrum*, L.; *Carex præcox*, Jacq.; *Aspidium aculeatum*, Sw. var. *lobatum*; *Lycopodium clavatum*, L.; *L. alpinum*, L.; *L. selago*, L. One specimen of *Myrica gale*, L., gathered by Mr. R. B. Johnstone, had catkins, with staminate flowers at the base and pistillate at the apex. This is very unusual, the species being generally distinctly diœcious.

Mr. John Paterson reported that the fine Black Poplar which stood at the side of the Luss Water, near the bridge, has been cut down. It measured 13 feet in circumference, at 5 feet, thirteen years ago (vide *Annals, Andersonian Naturalists' Society*, I., p. 60). It is stated to have been planted in 1804, but only fifty-four annual rings of growth could be counted at the base of the trunk. The apparent annual increase of wood was uniformly large throughout that period. There is much natural Holly in Luss Glen, some of it pretty old, and individual trees of large size are quite a feature of the place. The Tulip tree and curiously-shaped Larch, in the Hotel garden, the old Wych Elm, opposite the Hotel, the large Silver Firs, Great Maples, Limes, and Walnuts all received their due meed of attention and admiration, but no fresh measurements were taken.

Dungoyne, 7th June, 1902.—This excursion was undertaken jointly with the Geological Society, and was under the leadership of Mr. James Steel. Notwithstanding a wet forenoon, which did not promise well for an afternoon on the moors, nineteen members and friends assembled at Queen Street Station, and on reaching Dungoyne Station the number was swelled by the addition of several others. The fact that there had been so recently the terrible eruptions in the West India Islands induced the members to pay special attention to the signs of former volcanic energy around them. On the way to the summit of the hill several vents were noticed, from which the andesite lavas which cap the Strathblane hills were poured forth, which in turn at a later period were traversed by intrusive diabase. Dungoyne itself is the most conspicuous of the vents, but among others in the vicinity are Dungoil, Bin Bairn, and the Meikle Bin. According to Sir Archibald Geikie, there are fifty vents, large and small, between Dungoyne and Loch Lomond. There was a beautiful and extensive view from the top of the hill, and many quick-passing shadows varied with sunshine gave diversity to the scenery, making the visit a truly memorable one. Returning round the south face of the hill at a considerable elevation, a most enchanting view suddenly burst on the party, a change in the light giving the water of Loch Lomond such a brilliant effect that the islands were shown distinctly, and even the steamer was seen threading its way through them. On the way back one of the party came upon a half-grown rabbit sitting beside a tuft of grass, which actually allowed itself to be touched by the hand before scampering away! Quite a number of swallows were seen on the road busily gathering mud from the edges of the small rain pools to further the construction of their nests. The outing was thoroughly enjoyed by all those who took part in it.

Milton Lockhart and Carfin, 14th June, 1902.—Mr. R. Morton was the conductor of this excursion, and Mr. John Renwick has contributed the following report:—

"The party proceeded by rail to Carluke, and walked to Milton Lockhart, the property of Major-General David Blair Lockhart, D.L. The gardener met them, and accompanied them to the gardens and other places of interest in the policies. The company were hospitably entertained to tea, both at Milton Lockhart and Carfin House.

"The following measurements of trees were taken by Messrs. Renwick and M'Kay:—

Measurements of Trees.

Large-leaved Lime (*Tilia platyphyllos*, Scop.), to west of house—bole, 12 feet; girth, 12 feet 2½ inches at 3 feet 5 inches.

Large-leaved Lime, to west of preceding tree—bole, 12 feet; girth, 9 feet 3 inches at 4 feet 8 inches

Common Lime (*Tilia vulgaris*, Hayne) to south-west of house—bole, 15 feet; girth, 12 feet 3½ inches at 4 feet 9 inches.

Field Maple (*Acer campestre*, L.), near gatehouse at Clyde—bole, 5 feet; girth, 6 feet 8½ inches at 2 feet 6 inches.

Horse Chestnut, to south-west of house—bole, 6 feet; girth, 9 feet 2½ inches at 2 feet 11 inches.

False Acacia (*Robinia pseudacacia*, L.), near gatehouse at Clyde—bole, 5 feet; girth, 6 feet 8½ inches at 2 feet 5 inches

English Field Elm (*Ulmus surculosa*, Stokes), on Mill Hill—bole, 20 feet; girth, 14 feet $8\frac{1}{2}$ inches at 5 feet 4 inches. The largest English Elm we know of in Clyde area.

English Field Elm, on terrace to north of house—bole, 25 feet; girth, 10 feet $10\frac{3}{4}$ inches at 5 feet 4 inches.

English Field Elm, on terrace to north of house. Tree nearest house)—bole, 35 feet; girth, 9 feet $7\frac{1}{2}$ inches at 4 feet 10 inches.

Oak, on "Mount Pisgah"—girth, 10 feet 9 inches at 4 feet 10 inches.

Beech, on terrace to north of house. (Beech nearest house)—bole, 13 feet; girth, 10 feet 7 inches at 4 feet 10 inches.

Wellingtonia (*Sequoia gigantea*, Torrey.) near front of house—girth, at base, 8 feet 7 inches; at 2 feet, 5 feet $5\frac{1}{2}$ inches at 4 feet, 4 feet $6\frac{1}{2}$ inches.

"From Milton Lockhart the party walked by the highway, through Crossford, to Carfin House. On the side of the highway, half-a-mile above the entrance to Milton Lockhart, is a very fine oak, which in January, 1901, had a girth of 15 feet $3\frac{3}{4}$ inches at 5 feet up; bole, 9 feet; height, 61 feet; diameter of spread of branches, $88\frac{1}{2}$ feet from N.W. to S.E., and 86 feet at about right angles thereto.

"At Carfin House the party, accompanied by the gardener, visited the hothouses, the gardens, &c. Among the rarer trees was noted a Cork-barked Elm (*Ulmus suberosa*, Moen.), about fifteen years old—girth, 1 foot $11\frac{1}{2}$ inches at 4 feet; bole, 8 feet.

"From Carfin a hurried walk up the steep road leading to Braidwood brought the party to the station just in time for the train."

Tollcross Park, 17th June, 1902.—Mr. James Whitton, Superintendent of Parks, met the members at the West Lodge, and conducted them through the park. Proceeding by the south walk towards the glen, some comment was made on the dying condition of a number of the older trees in the vicinity of the mansion-house. The probable causes of this are the changed atmospheric conditions and the effects of underground workings, which frequently rack the roots as well as tap the natural supply of water. On several of the decaying trees huge specimens of *Polyporus squamosus*, Fr., were noticed. Though too early for a "fungus foray," even in a place well suited for it, several species were observed, the only one worth noting being *Agaricus* (*Hypholoma*) *sublateritus*, Schæff. Passing up the glen, remarks were made on the clean-stemmed Beeches. Though none of the trees were of great bulk, the group was an interesting object-lesson in economic forestry. The trees of this group are utilised as a nesting-place by hundreds of crows, and this rookery is now one of the largest in the vicinity of the City. The old kitchen garden, which is now used as a nursery for trees and shrubs, was next visited. In passing through the stable courtyard a large gnarled Elm was measured by several of the arboricultural section of the party. The collections of trees and shrubs created a considerable amount of interest, seeing that they are being got together for experimental planting, and many are new or little known in the district. The following list may be of interest, as all are apparently happy in their surroundings:—

Andromeda speciosa cassinefolia.
Prinos glaber.
Cerasus pumila pendula.
Kalmia angustifolia rubra.
Hamamelis arborea.
Sambucus racemosa serratifolia aurea.
Caragana ferox.
Weigela hortensis variegata.
,, ,, *nivea.*
,, ,, *Eva Rathke.*
Philadelphus Lemoinei erecta.
,, ,, *macrophyllum.*
Prunus Maximowiczii.
Xanthoceras sorbifolia.
Ribes Gordonianum.
,, *sanguineum.*
Cornus siberica alba spathi.
,, ,, *aurea* ,,
Phillyrea decora.

Cerasus virginica.
Amelanchier canadensis.
Populus Bolliana.
Fraxinus aurea.
,, *aucubæfolia.*
,, *monophylla laciniata.*
,, *Americana.*
,, *dimorphus.*
,, *Americana pennsylvanica.*
,, *spectabilis.*
,, *foliovariegata.*
,, *polemonifolia.*
,, *arbutifolia.*
Ulmus stricta.
,, *Dampieri aurea.*
,, *montana alba marginata.*
,, ,, *Smithi.*
,, *Campestris aurea.*
,, *Louis Van Houtte.*
,, *cornubiensis.*
,, *evicta.*
,, *nigrescens.*
Cratægus Douglasii.
,, *crus galli splendens.*
,, *Carrierei.*
,, *Korolkowi?*
,, *pyrifolia.*
,, *pyracantha Lelandi*, heavily fruited, in small [plants.
Salix acicularia.
Pyrus Sorbus.
,, *Americana.*
,, *cretica.*
,, *malus floribunda.*
,, ,, *atrosanguinea.*
Betula laciniata.
Liriodendron tulipifera.
Hypericum moserianum.

And larger quantities of better known shrubs, such as spireas, *Rosa rugosa*, rhododendrons, heaths, &c.

Attention was drawn to a curiosity in the form of a carnation which bears a double flower in the centre of the spike, whilst all the side flowers are single.

In crossing the glen towards the flower garden a large patch of *Podophyllum peltatum* (Linn.) was pointed out, which had naturalised itself in a damp, sun-shaded part of the grounds. The natural beauty of the grounds was much commented upon.

The new conservatories, which had recently been opened to the public, were next visited, and the collection of plants closely inspected. Though of varied interest, none of the subjects call for special notice, excepting a small collection of Tree Ivies grown in pots, which, when more fully developed, should form a feature of interest.

Galston, 5th July, 1902. — Mr. Renwick acted as the conductor of this excursion, in the unavoidable absence of Mr. A. Gilchrist, and has contributed the following report:—

"There were half-a-dozen present—three from Glasgow and three from the locality. The first place of interest visited was Barr Castle, an ancient fortalice standing in the town, about whose date and history we could learn nothing very definite. Near the castle is an old Elm tree, locally known as 'The Boss-Tree' (Hollow Tree). Aiton's *View of the County of Ayr*, 1811, quoted by Dr. D. Landsborough, *Contributions to Local History* (Kilmarnock), states — 'The largest Elm, and indeed the largest tree, in the County of Ayr, is near Barr Castle, Galston. It is 27 feet round at the root, and 16 feet round 6 feet above the surface. The trunk is not very long, and rather rough and knotty; but the branches are numerous, some of them very large, and cover a great extent of surface. One of them, broken off by the wind ten years ago, sold then at five pounds.' Mr. R. Hutchison, in the *Highland and Agricultural Society's Transactions* for 1883, states that in 1879 it was 27 feet in girth at 1 foot, 16 feet 4 inches at 5 feet, and 16 feet at 6 feet. The repetition of 27 feet and 16 feet in these two sets of measurements makes one doubtful of the accuracy of the later set. The first time I saw the tree was in May, 1899, when it measured 18 feet 4 inches at 6 feet from the ground; but the trunk was hollow, with large gaps, and was bound together with strong chains to prevent it from falling asunder. On our present visit the measurement at 6 feet gave 18 feet 11 inches, but, in addition to the gaps just mentioned, there is a large number of small branches springing out of the trunk, which renders it impossible to pass the tape round in a straight line. These branches have increased in number and size during the last three years, and the stem which springs from the decayed trunk seems higher and more vigorous. The veteran appears as if renewing its youth, and as Mr. Turner, the factor to the Duke of Portland, is taking care of it, we may trust that this relic may long be spared. Dr. Landsborough (*op. cit.*, p. 191) records a Great Maple at Barr Castle, girthing 13 feet 2 inches at 5 feet, in spring of 1879. Mr. Wright informs us that this tree was taken down about 1882.

"Leaving the town, we make our way in the direction of Cessnock Castle, along with many others—

> "For roads were clad, frae side to side,
> Wi' monie a wearie body,
> In droves that day."

"(Is it necessary to explain that 'wearie' does not mean 'tired,' but 'different' = with many a different person—farmers, cottars, swankies, lassies ?)

> The simmer "sun owre Galston muirs,
> Wi' glorious light was" shining :
> But few were "thinkin' on their sins,"
> Though likely "some upo' their claes."

"The occasion wasn't a Holy Fair, but a concert, with an address upon Burns.

"If the Glasgow Natural History Society made a poor show at Galston, the credit of the City was kept up by one of the Society's youngest honorary members, the Hon. the Lord Provost (Dr. Samuel Chisholm), who delivered an eloquent address. But we did not 'draw our tippence' (sixpence), and 'go to see the show.' Our way led round the outside of the policies of Cessnock Castle, southwards and upward, on the cultivated flank of Galston Muir. An oak plantation here was formed in 1839, Mr. Wright informed us. We 'slowly mount the rising steep' to about 450 feet above sea-level, when the Brown Carrick Hills, 940 feet high and 18 miles to the south-west, and Cairnsmuir of Carsphairn, 2,612 feet high, 23 miles to the east of south, are pointed out to us. Leaving the highway, we take a short cut across the fields, passing a farm where, we were told, the tenant is about 90 years of age, and still hale and hearty.

"The first stage of our journey ended at Mr. Wright's farm, Bruntwood Mains. Here we inspected his collection, of which he gives me the following note:—'One room is filled with fossils, the other with rock and mineral specimens. Being on the carboniferous strata, the greater part is from that series, principally from the Kilmarnock coal-field and limestone quarries of North Ayrshire, mostly my own collecting; many specimens of tertiary fossils from England. My palæolithic implements are mostly from the Thames Valley; extinct fauna from Cresswell Caves, Derbyshire; neolithic stone implements are mostly from this district. When a young ploughman I turned up a celt; this led me to become a collector. Mr. John Smith, in his *Prehistoric Ayrshire*, gives an account of my finds in this direction. I have also relics from the crannogs of Lochlea and Buisten, Scotch elks' horns, and so on.'

"At the farm is a Crack Willow, 68 years old, measuring 13 feet 1 inch at the narrowest part of the stem, about 3 feet up; bole, 6 feet.

"After discussing a good hearty tea, we set off for Craigenconner Glen, on the Cessnock Water. This stream rises on the high grounds in Sorn Parish, to the south of Galston Moors. At first it flows to the south-west, then due west, then south, as if to join the River Ayr; but, when within 1½ miles of that stream, it swings round to the north-west, and, after a very tortuous course, in which it boxes the compass, it falls into the River Irvine, two miles below Galston. The glen is a very pretty one, and we were quite pleased with our rather hurried visit. The stream fortunately was low, and we were thus able to walk down the glen with comparative ease. Among the plants which we saw were the Herb Paris (*Paris quadrifolia*, L.); the Beech-fern (*Polypodium phegopteris*, L., = *Phegopteris polypodioides*, Fée); and the Oak-fern (*P. Dryopteris*, L.,

= *Phegopteris Dryopteris*, Fée.) Besides these, Mr. Wright states there are found the Winter Green (*Pyrola media*, Sw.), the Bird's Nest Orchid (*Neottia Nidus-avis*, Rich.), and the Wood Melic Grass (*Melica uniflora*, Retz.).

"We emerge from the glen a little beyond the point where the railway is carried over it on a fine bridge, and after a walk of about 3½ miles reach Hurlford railway station, the total walk being between 9 and 10 miles at a low estimate."

Marine Biological Station, Keppel Pier, Millport, 23rd August, 1902.—The members of this excursion arrived in two detachments, the first and largest coming by steamer arriving at Keppel Pier at 10 a.m. They at once proceeded on board the "Mermaid," which was lying off the station, and under the guidance of Mr. Alex. Gray, were taken to the well-known dredging ground at the Tan Buoy. Here a short haul was taken with the square, iron-lipped dredge, which brought up a great quantity of gravel, shells, and *Melobesia*. The most interesting creature obtained here was probably the nest-building bivalve Mollusc, *Lima hians*, Gmel., with its pretty white shell and long fringe of scarlet tentacles. A good many Crustaceans and Brittle-stars were also obtained here, and, while examination of them was proceeding, the "Mermaid" steamed to the east side of Bute, near Mount Stuart House, where two hauls of the trawl were taken at depths of 15 and 25 fathoms. The ground here was very productive, especially in Echinoderms, the most abundant form being the ordinary Spiny Sea Urchin, *Echinus esculentus*, L., and the little green Urchin, *Echinus miliaris* (Gmel.) Several specimens of the Heart Urchin, *Brissopsis lyrifera* (Forb.), came up in the deeper haul. This species is a good type of the *irregular* Urchin, just as the *Echinus* is of the *regular* Urchin, and when both forms are placed side by side they make an instructive object lesson.

Many specimens of the common five-fingered Star were captured, also the handsome large spiny Star, *Asterias glacialis* (O. F. M.), together with both species of *Solaster*, viz., the many-rayed Sun Star, *S. papposus* (Fabr.), and the purple Sun Star, *S. endeca* (L.). The beautiful strawberry-coloured Cushion Star, *Goniaster Templetoni*, Forb., and the rather rare *Cribella oculata*, Penn., were also found.

Very few fishes were caught, owing to the "Mermaid's" trawl not being adapted for their capture, but a small Plaice and several very young Skate were taken.

Of Hydroids, the following were obtained:—*Antennularia ramosa*, Lmk., and *A. antennina*, L., *Plumularia Catherina*, Johns., and a species of *Diaphasia* and some Sertularians.

Many *Polyzoa* and other microscopic creatures came up adhering to stones and dead shells, but were not examined under the microscope.

Molluscs were plentiful, the chief Gastropod being *Buccinum undatum*, L., and the two species of *Fusus*, viz., *F. antiquus*, L., and *F. gracilis*, da Costa, and the most common Lamellibranch was *Pecten opercularis*, L.

Specimens of the Polychæte worms *Aphrodite aculeata*, L., and *Nereis pelagica*, L., were found, and one specimen each of the Sea-pen, *Pennatula phosphorea*, L., and *Alcyonium digitatum*, L., or "dead-men's fingers."

The afternoon being now well spent, the "Mermaid" steamed back to the station to land those members who wished to pay a visit to the tank-room, and to examine the fine collection of marine forms preserved in the Robertson Museum.

A number of members who arrived by the 4 p.m. steamer were then taken on board, and a course steered for Portincross Point, on the Ayrshire coast, where another haul of the trawl was taken, and an immense quantity of sea-weed lifted. This haul proved rather poor in animal life, the most plentiful creature being a species of *Eolis*, the specimens of which, with their coils of ova, literally covered all the great fronds of *Laminaria*. A little fish (*Lepidogaster*), with its ova, was found sticking to the inside of an empty shell. These fishes have the pectoral fins modified with a sucking disc, by which they firmly attach themselves to the hollows of shells, and mount guard over their hundreds of transparent little eggs, which are fixed beside them.

The "Mermaid" now returned to Keppel Pier, in time to allow members to catch the 6.20 steamer for Glasgow, after having enjoyed a very pleasant day.

Proceedings of the Society.

SESSION 1901-1902.

24TH SEPTEMBER, 1901.

The first meeting of the fifty-first session was held this evening, Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. James H. Lindsay, M.A., 37 Westbourne Gardens, Kelvinside, was elected an Ordinary Member.

Miss S. B. Robbie read a report of the Society's excursion to Toward (see page 333).

The Rev. G. A. Frank Knight, M.A., F.R.S.E., exhibited a small collection of about seventy species of North American Land and Fresh-water Mollusca. The majority were of the families *Unio* and *Anodonta*, which are found in extraordinary abundance and variety in many of the rivers and lakes of the United States. He remarked that the British Museum catalogue gives a list of over 1,200 species of *Unio* throughout the world, and that those from North America are noted for their weight, the thickness of their valves, their rich purple colour inside, their carination, and their excessive corrugation. He also gave a sketch of the manner in which the continent has been divided into molluscan regions, and concluded by a description of the natural means by which the *Unionidæ* have been dispersed and distributed over the country.

Mr. James Mitchell exhibited a similar collection of *Unionidæ* from North America.

Mr. John Renwick exhibited for Mr. Archibald Shanks a specimen of *Senecio erucifolius*, L., from Kilwinning. This plant is given in Hennedy's *Flora of Clydesdale*, all editions, under the name of "*S. tenuifolius*, Jacquin. Very rare. Woodhall, near Calderbank, a few miles from Airdrie (E.)," p. 7-8. In Mr. P. Ewing's *Glasgow Catalogue*, second edition, 1899, "Lanark" is the only county given, and "Hennedy" is the authority, a query being added. In the second edition of Hooker's *British Flora*, 1831, the station is the same as in

Hennedy, with "Dr. Dalgleish" as the authority. It would appear that Hennedy owed his information to Dr. Dalgleish's note to Sir Wm. Hooker. The late Professor King has not remarked editorially about the plant. The specimen exhibited was one of a clump of twenty plants growing within a square yard of space at the side of a road leading into a field, about 400 yards from the public highway. The farmer could give no information as to how it came to be there. A single plant is growing about three yards away from the rest in the clump. Mr. John Smith, Monkredding, forwarded a specimen to Mr. Arthur Bennett, who has confirmed its identity. In addition to the Lanarkshire station, it is also recorded for Berwickshire and Roxburghshire.

Mr. James F. Gemmill, M.A., M.D., read a paper on a genus and species of Nematode, new to science, which he had discovered at Millport, and to which he had given the name *Ichthyonema grayi*, Gemmill, and v. *Linstrow* (see page 299). Dr. Gemmill was heartily congratulated by the Society on his exceedingly important and interesting discovery, and on the careful and very complete manner in which he had carried out his investigations into the structure and life-history of the parasite.

29th October, 1901.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

This being the Fiftieth Annual General Meeting of the Society, the Hon. Secretary read the

Report of the Council (1900-1901).

Meetings.—Eleven meetings were held during the session, at all of which there was an average attendance.

Excursions.—A programme of thirteen excursions was drawn up—seven ordinary, four evening, and two mycological. The attendance at the evening excursions was in every case very small, but at the other meetings the attendance was fair. Three of the excursions were held jointly with the Andersonian Naturalists' Society, and one with the Geological Society of Glasgow.

British Association. — Mr. Alex. Somerville, B.Sc., F.L.S., President, represented the Society as its delegate at the meeting of the British Association in Glasgow, in September, 1901.

Membership.—During the session nine new Ordinary Members were added to the roll, and the register now stands as follows:—

Honorary Members, - - - - -		11
Corresponding Members, - - - -		41
Life Members, - - - - -	25	
Ordinary Members, - - - -	234	
		259
Total, - - - - - -		311

Associates.—One was added during the session, and the number on the roll now is fourteen.

Finance.—The Hon. Treasurer (Mr. John Renwick) submitted his Annual Statement of Accounts, duly audited. This was found to show a balance at the credit of the Ordinary fund of £103 14s. 1d., and of the Life Members' fund of £147.

Transactions.—The Hon. Editor (Rev. G. A. F. Knight, M.A.) reported that he was engaged in bringing out Part II. of Vol. VI. (N.S.), and he hoped that the Part would be in the hands of the Members shortly after the New Year.

Library.—The Hon. Librarian (Mr. James Mitchell) reported favourably on the condition of the Library and the circulation of books amongst the Members.

The Reports were all unanimously approved of and adopted.

The following Office-bearers were appointed to fill vacancies in the Council:—Mr. John Paterson, as Vice-President; Mr. Wm. Leighton, Mr. John Robertson, Mr. Peter Ewing, F.L.S., and Mr. Hugh Boyd Watt, as Members of Council. Mr. Joseph Sommerville and Mr. James Jack were appointed Auditors. The following were elected Ordinary Members of the Society:—Mr. David M. Russell, 73 Abbotsford Place, and Mr. John Albert F. Marshall, 5 West Regent Street.

Mr. James Mitchell, Hon. Librarian, placed on the table, as a gift from the Local Committee of the British Association Meeting in Glasgow, the three volumes which had been specially compiled in connection with the visit of the Association to this city. They were:—(1) *Fauna, Flora, and Geology of the Clyde*

Area—a work which owed its existence very largely to the members of the Natural History and Geological Societies of Glasgow; (2) *Archæology, Education, Medical, and Charitable Institutions of Glasgow*; and (3) *Local Industries of Glasgow and the West of Scotland.*

On behalf of Mr. Robert S. Houston, there was exhibited the Creeping Water Cress, *Nasturtium sylvestre*, R.Br., gathered in some abundance by Mr. Robert Smith near Johnstone, Renfrewshire. This is a rare species, doubtfully indigenous in Scotland. Mr. Alex. Somerville, B.Sc., F.L.S., who had brought forward Mr. Smith's specimens, for the sake of comparison, exhibited examples of the plant from his own herbarium, as well as *Nasturtium palustre*, DC., and *N. amphibium*, R.Br., (a) *indivisum*, DC., and (b) *variifolium*, DC., from various Scottish and Irish localities. Mr. Lawrence Watt also exhibited a very fine specimen of *N. sylvestre*, gathered on waste ground near a paper mill in Dumbartonshire

Mr. John Lindsay, M.A., M.B., C.M., exhibited some specimens of Double-headed Monsters, and by diagrams and blackboard sketches explained his theory of the causes which led to so many curious phenomena. Dr. Gemmill afterwards rather adversely criticised the positions which the theory advanced.

Mr. George Russell exhibited a beautiful specimen of *Rhipidopteris peltata*, Schott., a mountain fern from Mexico showing a large number of fertile fronds. It differs from the rest of the *Acrosticheæ* in having the sporangia on the upper side of the fronds.

Mr. Russell also showed a New Zealand caterpillar, a species of *Hepialus*, belonging to the same genus as the British Ghost-moth (*Hepialus humuli*, L.). The New Zealand species is attacked by a fungus, *Cordiceps robertsii.* The spores enter the caterpillar while alive, but the animal is gradually killed by the fungus living and growing upon its tissue. After a time the caterpillar is completely dried up and hardened, and thereafter a "stroma" grows up, on which fresh spores are produced, ready to enter any other *Hepialus* which may come in contact with them.

Mr. George Cleland reported on the Society's excursion to Arniston and Temple on 23rd September (see page 334), and

Mr. William Stewart reported on the excursions to Lennox Castle on 28th September, and to Cadder Wilderness on 19th October (see page 338).

26th November, 1901.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

On behalf of the Rev. J. E. Somerville, B.D., Mentone, France, there was exhibited by the President a living specimen of *Mantis religiosa*, L., the "praying insect," allied to the "walking leaves" and "stick insects," and belonging to the order *Orthoptera*. Entirely carnivorous, it does not pursue its prey, but, gifted with great raptorial forelegs, it waits patiently until a fly or other small creature comes within reach, when it instantly seizes it. The attitude of the insect while awaiting the approach of its prey has led to its receiving the names it bears.

Mr. Thos. Beath Henderson, M.D., exhibited (1) two epidermic castings of young *Boa constrictor*, L., at different periods, showing the rate of growth; (2) a specimen in spirit of *Dendrophis punctulatus*, Krefft, a colubrine snake from Australia. It is a typical tree snake, the ventral scales having a pair of suture-like lateral keels, and a notch on each side, by means of which it is enabled to slide up the branches of trees without having to twist its way up. It has no poison teeth of any kind; (3) a specimen in spirit of *Dipsadomorphus fuscus*, Gray, from Queensland, an "opisthoglyphous" snake—that is, having a few of the posterior maxillary teeth enlarged and furnished each with a groove in front, which conducts venom from the upper labial glands. These snakes are not very dangerous to man, as their poison is not strong, and the poison teeth are placed so far back that they do not readily inflict a wound. The venom is useful to the snake in paralysing its prey before it is swallowed.

Mr. Robert Brown, M.D., Hon. Secretary, read a paper entitled "Botanising on the Swiss Alps in Spring." He described the beauty of the Swiss valleys as the snow melts away under the influence of the sun and warm breezes, and a veritable carpet of flowers at once springs up. The district round Lucerne, with its combination of high mountain, gentle slope, and wide marsh, affords an ideal working ground for a botanist. Mount Pilatus was carefully scrutinized, and many exquisite plants were discovered. *Lonicera caerulea*, L., a small-flowered honeysuckle, was growing freely and in bloom in the hedgerows on the lower slopes. On the lower pastures of the Rigi were *Cephalanthera xiphophyllum*, Rchb., the White Helleborine, and *Orchis morio*, L., the Green-winged Orchis. Among the low shrubs was *Corinilla emerus*, L., closely resembling our Scotch Broom; while in the woods were several representatives of *Dentaria digitata*, Lam., one of the most beautiful cruciferous Alpine plants. Near melting snow *Primula elatior*, Jacq., was flowering profusely, and on flat rocks *P. auricula*, L., seemed to flourish better than in richer soil, alongside of *Erica carnea*, L., a pretty Alpine heath with a light pink corolla and dark anthers. *Smilacina bifolia*, Desf., a small liliaceous plant, and *Polygonatum verticillatum*, All., were growing side by side under trees near a stream on Pilatus. The latter, an Alpine "Solomon's Seal," with drooping flowers arranged on whorls, is a comparatively rare plant, generally found on calcareous soil. *Luzula lutea*, DC., blazed in abundance in the woods; *Daphne mezereum*, L., straggled near the snow line, while *Gentiana acaulis*, L., clothed the meadows. *Carex montana*, L., was found on all the high situations. After spending some time in the Lucerne district, Dr. Brown removed to Davos Platz, and resumed botanical work in this new locality, 6,000 feet above the sea. Most remarkable to observe, was the extreme rapidity with which plants grew up after the snow melted, as the edge of the snow line was frequently ablaze with flowering Alpines, such as *Anemone sulphurea*, L., and *A. alpina*, L., varied with the rose-tinted flowers of *A. narcissiflora*, L., and the blue-grey hairy blooms of *A. vernalis*, L. On dark damp patches recently covered with snow, was growing thickly *Crocus albiflorus*, Kit., a plant which apparently dies off as soon as the soil in any degree becomes dry. On high mountain cliffs where the sun shines steadily throughout the day, masses of *Primula viscosa*, All., were growing on rocky ledges, their red corollas giving a gorgeous colour to the precipices, and afforded a memorable picture of beauty. A single beautiful white specimen was also secured. A few small plants of *Viola sciaphila*, Koch., were obtained, which, on being pressed gave off a most powerful and fragrant aroma, perceptible for some distance around. The plant is rare and local. Various species of *Arabis* were found on rocks far up amongst the snow. The genus *Pedicularis*, of which there are upwards of twenty distinct Alpine species, varying in colour from light yellow to purple, and in height from small prostrate specimens to sturdy plants 18 to 20 inches high, was well represented by *P. foliosa*, L., *P. verticillaris*, L., and *P. recutita*, L., a rather rare species growing on the banks of a stream. Some plants whose habitat is the high mountain slopes were found flourishing on the sides of the torrents, having been washed down by the rush of melting ice and snow. Amongst these was *Primula integrifolia*, L. But perhaps the most striking feature was the presence of crocuses flowering through the ice. At the margin of the great snow slopes where they gradually thinned off at the base of the mountains, the snow became a firm, breakable sheet of ice, and through this clear, caked, solid mass, the white and blue flowers of the Crocus had penetrated, and were spread wide open, flowering under the bright sun. The films of hard ice were a quarter of an inch thick, and the ice-holes were found to be smooth, quite round, and capable of allowing a small sized pencil to pass through. Among the large boulders at the mouths of the passes were beautiful examples of *Soldanella alpina*, L., *S. pusilla*, Baumg., and *S. montana*, Willd., while sometimes the entire mountain slope would be dazzlingly blue with the brilliant colouring of *Viola alpina*, L. Dr. Brown illustrated his paper by the exhibition of many of the species named above.

SPECIAL MEETING TO CELEBRATE THE JUBILEE OF THE SOCIETY.

4th December, 1901.

The Jubilee of the Natural History Society of Glasgow was celebrated this evening in the Masonic Hall, West Regent Street. There was a large company of ladies and gentlemen, including many representatives from kindred societies and other bodies. The proceedings took the form of a conversazione, the guests being welcomed by the President, and tea being served between seven and eight o'clock. The hall was artistically decorated with a fine floral display, under the direction of Mr. Whitton, Superintendent of the Parks belonging to the Corporation of Glasgow. In the smaller hall downstairs there was an important and interesting exhibition of natural history specimens, which engaged the attention of the guests for a considerable time. Messrs. Charles Kirk, John Paterson, and Henry M'Culloch displayed a fine ornithological collection; the Marine Biological Association of the West of Scotland sent up from Millport a beautiful series of marine objects, under the superintendence of Mr. Alex. Gray, the Curator of the Robertson Museum; and Mrs. David Robertson contributed a fine exhibition of seaweeds from Cumbrae and elsewhere.

At eight o'clock the President, Mr. Alex. Somerville, B.Sc., F.L.S., took the chair, and among other ladies and gentlemen on the platform there were—Lord and Lady Kelvin; the Lord Provost of Glasgow (Mr. Samuel Chisholm, LL.D.); Sir John Murray, K.C.B., of the "Challenger" Expedition; Professor J. G. M'Kendrick, F.R.S., Glasgow University; Mr. C. E. Borchgrevink, the Antarctic explorer; Dr. James F. Gemmill, President of the Marine Biological Association; and Mr. Henry Coates, F.R.S.E., President of the Perthshire Society of Natural Science. At intervals during the evening music was rendered by several ladies.

Mr. Somerville then delivered an address as follows: — My Lord Provost, my Lord Kelvin, Ladies and Gentlemen,—It is indeed a pleasure to look upon the faces of so many invited guests who have come to-night to our gathering. I have already had the pleasure of welcoming you individually, and now do so again collectively. The Council desire me to say that they are much gratified at the warm response you have made to their invitation. A few weeks ago the idea occurred to some of us that the present would be a suitable occasion on which to invite local Societies to send representatives to join us on this auspicious occasion. That idea developed itself, and we went beyond the boundaries of the City, inviting guests from the north, south, east, and west. Representatives of twenty-two Societies are here this evening, no fewer than four of these Societies belonging to the sister city of the east. You will be interested to hear the names of those Societies that are kindly taking part in our celebration. They are as follows:—

Society.	Representatives.
Botanical, of Edinburgh,	Rev. David Paul, LL.D., *ex-President*. Dr. Arthur E. Davies, F.L.S., &c., *a former President*. Symington Grieve.
Edinburgh Field Naturalists' and Microscopical,	Archibald Hewat, F.F.A., &c., *President*. W. C. Crawford, F.R.S.E., *ex-President*. W. Williamson, *Secretary*.
Scottish Natural History,	Sir John Murray, K.C.B., F.R.S., *President*.
Royal Physical,	J. Barclay Murdoch, F.R.Ph.S.E.
Perthshire Society of Natural Science,	Henry Coates, F.R.S.E. S. T. Ellison.
Stirling Natural History and Archæological,	D. B. Morris. R. Kidston, F.R.S.E., F.G.S.
Berwickshire Naturalists' Club,	Rev. David Paul, LL.D.
Airdrie Natural History,	A. B. Motherwell, *President*.
Bute Botanical,	R. D. Whyte, *Secretary*.
Paisley Philosophical,	J. Woodrow, *Treasurer*. Dr. Joshua Ferguson.
Paisley Naturalists',	Dr. John Lindsay, *President*. Wm. Peattie. Robert Smith.
Kilmarnock Glenfield Ramblers,	Rev. D. Landsborough, LL.D., *Hon. President*. David Murray, B.Sc., *President*.
Greenock Natural History,	Dr. J. K. Robertson, *President*. J. G. Hyndman.
Cryptogamic Society of Scotland,	Rev. David Paul, LL.D., *Treasurer*.
Conchological, of Great Britain and Ireland,	Rev. G. A. Frank Knight, M.A., F.R.S.E.

GLASGOW SOCIETIES.

Society.	Representatives.
Royal Philosophical, - - -	Dr. Freeland Fergus.
Geological, - - - - -	J. Barclay Murdoch, F.R.Ph.S.E. Matthew Blair.
Andersonian Naturalists', - -	Walter Brown. Robert Brown. R. B. Johnstone.
Microscopical, - - - -	Dr. Jas. Rankin, *President.* R. L. Greig. John Hyslop.
Medico-Chirurgical, of Glasgow University, - - - -	John Muir, B.Sc., *President.* R. T. Leiper, *Hon. Secretary.*
Marine Biological Association of the West of Scotland, - -	Dr. Jas. F. Gemmill, M.A., *President.*
School Board of Glasgow, - -	G. W. Alexander, *Clerk to the Board.*
His Majesty's Inspectors of Schools. - - - - -	A. E. Scougal, *Chief Inspector.*
His Majesty's Science Inspectors,	F. W. Young, B.Sc.

On a recent occasion there was held in Glasgow a dinner to all who had been at any time members of Council of the now Royal Philosophical Society of Glasgow, to celebrate the fact that His Majesty had graciously given to the Society the name of "Royal." I was honoured on that occasion with the request to reply to the toast of "The Kindred Societies." On looking into the matter, I found that I personally represented the oldest of the Societies, viz., the Natural History Society of Glasgow, and also the youngest — the Marine Biological Association of the West of Scotland. It is very remarkable that there should have been a gap of no fewer than fifty years between the origin of the Philosophical Society and the institution of our own.

It is not my intention to-night to inflict upon you a presidential address. We have a number of friends who have come to be with us this evening, and to encourage us in the work we are doing. Still, it is expected that I should refer to a few names in connection with our Society. On the 2nd of July, 1851, there met in Glasgow nine gentlemen, who, with other two who joined them a week later, originated the Natural History Society. Of these eleven there are still three spared to us. The most prominent is the well-known Aberdeenshire proprietor, Dr. William Ferguson, of Kinmundy. He took an active part in the Society, and did much to foster it by reading papers and in other ways. The second name is that of Mr. Thomas Ferguson, his brother; and the third is that of Mr. Thomas Gray, a noted conchologist, now residing in Glasgow. We have held communication with those three gentlemen within the last ten days.

I have noted down the four things which this Society set itself to do. These were to meet (1) for the exhibition of specimens, native and foreign; (2) for the reading of communications; (3) for excursions for mutual improvement; (4) for the encouragement, in all its branches, of the pursuit of natural history. These are very much the Society's objects still.

You may well believe that in the course of so long a period as fifty years a large number of names come to the front that ought to be alluded to on such an occasion as the present, but it is impossible to furnish a complete list of even the more prominent who gave their time to the study of Natural Science. I have jotted down a few of the names. Let me ask you to listen to what they are:—Dr. John Grieve; Dr. David Robertson, who for forty years studied marine life, and whose papers in the *Transactions* of the Society are very numerous. With Sir John Murray he founded what is now the Millport Marine Station, and he has brought to the Clyde much renown in certain departments of scientific study. The next name is that of Mr. Roger Hennedy, who taught many of us now present, and whose *Clydesdale Flora* we in the West of Scotland could not get on without. Thomas Chapman, lepidopterist, the cutler of Buchanan Street; Robert Gray, the ornithologist; Dr. James Stirton, the cryptogamic botanist; Professor J. J. F. X. King; Peter Cameron; Mr. Harvie-Brown; Mr. Robert Kidston; Professor John Cleland; Professor Alexander Dickson; Professor I. Bayley Balfour; Professor Bower. It is deeply interesting to go back over these names, and to see what workers in certain departments have done during years now past. There is not time to do more than name the gentlemen who have been presidents of the Society during the last twenty years—Mr. Harvie-Brown, Dr. Stirton, the late Dr. David Robertson, Professor Bower, the late Professor King, and Mr. Robert Kidston. Amongst the secretaries are—Mr. Robert Gray, for twenty years at the outset; Mr. J. M. Campbell; Mr. D. A. Boyd; Mr. W. Goodwin; Dr. R. Brown; Mr. John Trotter; Mr. James Steel; Mr. John Cairns, Jun.; Mr. R. S. Wishart; Mr. R. D. Wilkie; Mr. S. M. Wellwood; and our two present secretaries, Mr. John James Robertson and Dr. Robert Brown.

I will ask this question before I conclnde—Has our existence as a Society been justified? In answer to this, will you allow me to read short extracts of letters from three members, who, it may be mentioned, are members also of the Royal Society of London? There is no man for whom Scottish botanists have a greater admiration than Professor Trail, M.D. He is unable to be with us to-night, but says—

"The Natural History Society of Glasgow has a record behind it of work of which any local Society may well be proud, and in that record lies the promise and pledge, I believe, of much more good work to follow. That its labours may do much to advance the study of natural science is my very sincere and earnest wish, and I would have greatly liked to be present."

The next is from Professor Brady, M.D., Newcastle—

"The interest" he says "which my old and dear friend the late Dr. Robertson took in the Society, and, indeed, in everything connected with natural history, would of itself be sufficient to assure to the Society my hearty good wishes, and I am glad to know that the Society is doing such a conspicuously good work in the encouragement of natural history study and research."

The third testimony is in a letter from Sir Joseph Hooker, who writes as follows:—

"The Camp,
"Sunningdale, Berks.,
"December 3rd, 1901.

"DEAR MR. SOMERVILLE,

"May I ask you kindly to express, at the forthcoming jubilee of the Natural History Society of Glasgow, my sincere regret at being prevented by advancing age from taking the necessary journey to your city, and making one of the company of hearty sympathisers in person.

"Glasgow was the home of my youth, and Lanarkshire and Dumbartonshire were the scenes of my earliest scientific aspirations and efforts, and this renders the prosperity of your Society dear to me.

"With cordial greetings, and good wishes to my fellow members.

"Believe me,
"Very sincerely yours,
"JOS. D. HOOKER."

Many of us looked upon Sir Joseph's face for the first time in June last, when he opened the new Botanical Buildings of Glasgow University, and delivered a delightful address on the life of his late father, Sir William J. Hooker, who at one time was Professor of Botany in our University. When we remember that this remarkable man, Sir Joseph Hooker, was the friend of Charles Darwin, and that he was for many years the Director of the Royal Gardens at Kew; when we think also of his earlier days, when he was one of a small exploration party which went to investigate the flora of the Himalayas, as recorded in his "Himalayan Journals," we cannot but congratulate ourselves on such a letter as this, which may well go into the Society's archives.

It is very gratifying that our own Society and the Geological Society were privileged to prepare and issue, in September last, in connection with the visit of the British Association, the admirable Fauna, Flora, and Geology Handbook, which contains seventy-six lists of groups of organisms, recent and fossil, to be found in the Clyde district. These lists were prepared, in the main, by members of our own and of the Geological Society.

Scientific societies for the promotion of the study of Nature are everywhere feeling the pressure of the counter-attractions of physical recreation—golf, cycling, football, &c., but it is to be hoped that there will always be found in every community a body of persons, small though their number may sometimes be, who will delight in devoting their leisure hours to the study of the beautiful and ever-interesting works of the Creator.

The Lord Provost (Mr. Samuel Chisholm, LL.D.), who was introduced by the President as the Lord-Lieutenant of the County of the City of Glasgow, spoke as follows:—Mr. Chairman, ladies, and gentlemen,—You will not, I am sure, question my statement when I say that I have not unfrequently been placed in considerably embarrassing circumstances—an embarrassment sometimes arising from one cause and sometimes from another—and you will still less question the statement, I think, that I never found myself in circumstances so supremely embarrassing as the present. I have understood that no one was admitted to speak save those who have given up a considerable part of their lives to the study of natural history. However, if the

Sir JOSEPH DALTON HOOKER,

G.C.S.I., C.B., M.D., LL.D., D.C.L., F.R.S., &c., &c.

study of human nature comes within the scope of your subject, then I also, to some extent at least, have been a student of natural history. If anyone asks why I have come to this meeting, I have honestly two very good reasons, one official and one personal. My official reason may be described thus— I have laid it down as a principle, on which I have consistently acted during the past two years, that wherever I found a body of my fellow-citizens who were pursuing some unselfish object for the good of the city, for the good of the citizens, there it was—if I were permitted—my duty as Lord Provost to go, and to put myself alongside those who were thus pursuing a high end. My personal reason was something like this—I remember the advice of my good old mother — "Always, if possible, keep company with people wiser than yourself;" and I rejoice to join for a little time the company of ladies and gentlemen who are engaged in pursuits outside my proper sphere. Will you allow me to join *viva voce* with the multitude of those who have sent congratulations on the past history and the present position of the Natural History Society of Glasgow? I rejoice to have had the little glimpse into its past history which the Chairman has afforded us. We are happy to think that the little seed planted fifty years ago has grown so vigorously, and that so much good, honest work has been done from year to year. I think it is eminently desirable, in a great city like Glasgow, that we should have societies and agencies which take their members away from the city into some of the fairest and brightest scenes, where they may visit Nature, and drink in all the sweet, invigorating influences which she is continually exerting upon us. I desire to express the very great pleasure and satisfaction with which I look on the existence and the success of such a Society as this. I am proud to hear of the great names that have been connected with the Society in the past, and I rejoice to think that, though modesty on his own part and a respect for the modesty of others may have hindered the Chairman from naming many other men still living, there are in the Society to-day names which those who come after them will look upon with the highest respect. I shall not longer detain the company from the things that are still in store for it, but I desire to offer my congratulations to the Society, and my best and warmest wishes for its continued success.

Professor M'Kendrick, F.R.S., of Glasgow University, the next speaker, said—It gives me the greatest pleasure to accede to your Chairman's kind invitation to be present this evening. I come here as a naturalist, although I have not for many years worked in the special province of what is usually spoken of as natural history; but I am sure that Lord Kelvin will agree with me that all scientific men are naturalists, inasmuch as they study nature. Although for many years my life-work has been in one particular branch — that of physiology — I have always taken a deep interest in the kindred studies, and more especially in those relating to the life-history of plants and animals. I may say that I would never have entered the medical profession had it not been through the door of natural history, because it was the love of plants and animals which first excited in me the desire for scientific knowledge. I remember years ago, in the Pass of Ballater, scrambling up the rocks in eager search, and there, in a cleft of the rock, I saw a rare fern, the *Asplenium septentrionale.* Nothing short of a wild cheer to my friends below at the discovery could give expression to the joy I felt. At a time when it was not very common for anyone to give attention to marine biology, I found great pleasure in gathering some of the rarer animals and plants on the coast of Aberdeen, and I showed the fern I have referred to, in the Museum of Aberdeen, at the first meeting of the British Association in that city in 1857. I come to you, therefore, not altogether as a pure physiologist, but as one who takes a deep interest in plant and animal life.

I have often thought that the naturalists of the future—I mean such as are assembled in this room—will not limit themselves so much to the collecting of specimens, or to noting the habitat of plants or animals, but will be more disposed to study the life-history of many of these specimens. The establishment of the Aquarium at Cumbrae has given a new start to this side of natural history, because it has taken us away from mere collecting to the study of the life-history of many marine forms. And here it is that your studies merge into mine, for physiology gathers information from all quarters.

It is not the physiologist's business to devote attention merely to the higher forms of life, and there can be no doubt that in the far-off future there will be a comparative physiology—one of every species of plant and animal—and then we shall be able to deduce the great laws of vital action as we cannot do at present. Therefore, while I congratulate you on the splendid work which the Society has done, I do so specially because you have made the Catalogue of the Plants and Animals of the Basin of the Clyde almost complete.

To study the works of Nature is not only a great delight, but gives a kind of certificate of sincerity to character that nothing else can communicate. If we approach the study of natural history in a true spirit, we shall do the ordinary work of the world far better than would otherwise be the case. Let me once again congratulate you on the success of your Society. I hope it will continue to prosper, and that new fields will open up for it as time goes on.

The Chairman next said — This Society is not a body that can confer degrees, but there is one thing that is left to us to do, and the Council have authorised that it shall be done to-night—and that is, to elect a small group of ladies and gentlemen to the honorary membership of the Society; and you are asked to approve of the Council's proposal that the several names I put before you shall be added to the roll of members of the Natural History Society of Glasgow. The names are—Mr. Samuel Chisholm, LL.D. (the Hon. the Lord Provost of Glasgow); Professor John Cleland, M.D., F.R.S.; Professor J. W. H. Trail, M.D., F.R.S.; Mr. J. A. Harvie-Brown, F.R.S.E., F.Z.S., M.B.O.U,; Mrs. Robertson, widow of Dr. David Robertson, the "Naturalist of Cumbrae;" Mrs. Robert Gray, widow of the author of "The Birds of the West of Scotland and Outer Hebrides;" and Mr. Andrew Carnegie, LL.D.

The proposal was most cordially received, and the names were added to the roll of Honorary Members.

At this stage the Chairman drew attention to various volumes on an adjoining table, which had been received in gifts by the Society in recent years. These included (1) several volumes representing the forty volumes of the "Challenger" Reports, presented by Government—a very valuable series. The Society had greatly to thank Sir John Murray for his kind influence in obtaining this gift. (2) The two volumes of the *Index Kewensis*, the preparation of which had been suggested and mainly paid for by the late Mr. Darwin. These had been given to the Society by Mr. Darwin's eldest son, Professor G. H. Darwin, F.R.S., of Cambridge. (3) Three volumes of Lord Kelvin's "Popular Lectures and Addresses," from the author. There were various other volumes.

The Chairman said that the Society, owing to the fact that its membership and income were not so large as they might be, was sometimes a little straitened in its financial circumstances, but a kind friend—Mr. James Coats, Jun., of Paisley—had that week sent a most generous donation of fifty guineas in aid of the Society's funds, for which the Council were truly grateful. Mr. Somerville handed over the cheque to the Hon. Treasurer, Mr. Renwick.

Sir John Murray, K.C.B., of the "Challenger" Expedition, was the next speaker. He said—Mr. President, my lords, ladies, and gentlemen,—I am here to-night in order to convey to you the congratulations of the Scottish Natural History Society, Edinburgh, on the occasion of your Jubilee, and I am also desired to express the hope that during the next fifty years you will be more prosperous still, and that you will take a much wider and larger part in the intellectual life of the West of Scotland than in the past fifty years.

I could wish that the ideals of education in this country, or even the aims of the higher education, were to turn our students into instruments for advancing scientific discovery. I often think that our present system of education tends to produce a static character among our people, rather than what Lord Kelvin might call a type which would exhibit a kinetic scientific efficiency. Very often it appears to me that if the tendency of our education were to produce men with inquisitive, mobile, and inventive minds, we would be able to do better than we have done—to lay the foundations of our commercial and industrial prosperity in the future upon the sure bed-rock of science. That, I think, ought to be the aim of education in this country, and until we arrive at a stage of that kind I cannot help thinking that societies like this fill a very great function in a community, because they keep alive the interest in all kinds of knowledge. They tend to impress on the public the importance of all new knowledge in all that concerns national greatness. Anyone who joins a society of this kind hopes, I believe, to aid in some way or other towards the advancement of learning, or to assist in discovering some pepper-grain of truth in order to augment the sum of human information. It often seems to me that societies like this might be developed, in many directions, along lines which would be of great benefit to individual members and to the city or community at large. In the Society with which I am more or less connected I have endeavoured to point out some of the directions in which that might take place, but I shall not attempt this evening to do so, lest I should lay myself open to the charge of being the wise man from the East! Therefore, I conclude by conveying to you the congratulations of the Scottish Natural History Society on this your Jubilee celebration.

Mr. D. B. Morris, Town-Clerk of Stirling, said—If I attempt to say anything this evening on the subject of "Nature Teaching," it is because I take a great interest in it in connection with School Board work. Perhaps you will bear with me if I suggest some considerations that will guide us in directing the young to the study of Nature. It seems to me that we should get some help if we enquire, What does the study of Nature mean to the ordinary grown-up naturalist? and ask if that will guide us in any way to teach the young. What does the study of Nature mean to us? What faculties of the mind does it bring into play? First of all, there is the *faculty of observation*. It is the old story of "eyes and no eyes," but as every speaker on the subject refers to this I need not dwell upon it. Did you ever notice that the young child using his eyes always sees the small objects, while larger objects are unnoticed? He will see the distant hill if it is pointed out to him, but he has no conception of landscape as a whole.

My second point is, *faculty of judgment*. This is what is often called the scientific habit of mind, and to many men this is the end of scientific training. But this is a faculty which, while it should be encouraged in the young, we cannot expect to find in any great degree.

My third point is the *faculty of imagination.* No scientific work of any value has been done in the past without some spark of imagination to kindle facts into the light of invention and discovery.

My fourth point is *the artistic sense.* I think that naturalists are too apt to ignore this, and not to appreciate to the full the artistic beauty of the landscape and the glorious loveliness of colour there is in an April wood, a July meadow, or a September wayside.

My last point is *the feeling of worship.* This is a matter on which I speak with difficulty, but you will understand what I mean, for there is something in Nature which appeals to the highest instincts in all of us.

Lord Kelvin then spoke as follows:—I would like to express my gratitude for several benefactions, and the first of them is when Mr. Somerville took me by surprise and quite unawares in suggesting to me that I might become a member of the Natural History Society of Glasgow. I feel myself quite unworthy to aspire to such a privilege and honour. Physical science and physical experiment lie so far from the work of "life," which is the subject of natural history, that I feel quite unable to contribute to the proceedings, or to join in the work of the Society in any effective way. I can only say I am very glad that Mr. Somerville did ask me to become a member, and that he succeeded in convincing me that my scruples might be overcome. It has been a great pleasure to me all these years to know that I was a member of the Natural History Society, and if I was not contributing to the work I was at least in hearty sympathy with it. I wish to thank your Chairman also, in the name of all present, for the trouble he has taken in giving us all such a pleasant evening, and I have to thank him for inviting me to be present, and giving me the great pleasure of meeting you all this evening.

Dr. James F. Gemmill, M.A., was the next speaker. He said—It is a great honour that I should be asked to join the representatives of other societies in congratulating the Natural History Society of Glasgow on the attainment of its Jubilee.

The Marine Biological Association, which I represent, is the baby, and our good wishes will not lack the warmth and spontaneity of youthfulness. I shall just ask you to pick out what was best and fittest in the speeches of the other representatives, and to credit them to the Marine Biological Association. With reference to the exhibits which our Association is displaying in a neighbouring room, I may say that they consist of a set of optical apparatus which include the most modern lenses and microscopes; there are also shown the plans of the new station that we are going to proceed with. It will be seen that they provide for an extension which increases the station to three times its present size. Regarding the objects which are shown, I hope they will command your interest, and that you will appreciate the skill which has been displayed in the preparation of the preserved specimens. A good deal has been spoken about education, and we are making a practical effort in the way of educating and giving facilities to foster the spread of that inquisitiveness which Sir John Murray referred to. We are aiming at the establishment of classes which shall, as far as possible, give to workers opportunities of acquiring their knowledge direct from Nature. The Marine Biological Association and the Natural History Society need not in any way conflict with one another, for the one is supplementary to the other. Indeed, amongst the membership of our Association we have the President and others of your Society; and the warmth of our good wishes is to some extent on a practical basis, for we realise that so long as such societies flourish the Marine Biological Association itself will not lack supporters.

Mr. Henry Coates, F.R.S.E., President of the Perthshire Society of Natural Science, next addressed the meeting. He said—I am here this evening to represent a Society which has not yet attained the dignity of its jubilee, but which is fast approaching the venerable age, and on behalf of that Society I offer to you their hearty congratulations on the wonderful record which you have to show during the past fifty years, and on the work you have been able to accomplish in that period. It seems to me that the very fact that your Society has continued in full vigour for half-a-century is an absolute proof that its affairs have been guided with energy and care.

and that the work which has been done is solid and valuable. There are some societies which follow the course of individual organisms; that is to say, they start life with a great deal of vigour, they grow rapidly, and exhibit a remarkable amount of vitality of a certain kind. Then a stationary period ensues, when very little energy is manifested, and after that they begin to show signs of senile decay. But I would rather compare the Natural History Society of Glasgow to another zoological collection—namely, the coral—for, while its individual members are continually passing away, the organism as a whole is being built up by new individuals, to last for ages and ages. While the Chairman was referring to the Natural History Society, I was reminded of the circumstances attending the formation of the Perthshire Society. That Society owes its origin to fourteen gentlemen, of whom only one is now alive. The objects of the two Societies are very similar, but the Perthshire Society, in addition, resolved to form a complete collection of the natural history of their district, and during the thirty-three years of the Society's existence its members have carried out that resolution with some considerable measure of success. I mention that fact because of the great interest which the collection has aroused in Perthshire, and because it has proved to be of considerable value to students and others. I should like to see the Natural History Society of Glasgow with a similar museum, for, while we in Perth have one of the richest counties in Great Britain as regards fauna and flora, you in the basin of the Clyde have one of the richest estuarian localities in the whole kingdom; and if you had a representative collection of the natural history of the Clyde basin, it would be something that Glasgow would be proud of for all time, and it would be of immense value to students all over the country. I hope you will pardon me, my Lord Provost, if I offer the suggestion that one of the buildings of your late Exhibition would be an excellent station for such a collection.

The Chairman intimated that in the course of the evening congratulatory telegrams had been received from the following gentlemen, representing kindred societies throughout the country, viz.:—

The Earl of Haddington, F.S.A.Scot.
Sir Joseph D. Hooker, M.D., G.C.S.I., C.B., D.C.L., F.R.S.
Sir T. D. Gibson Carmichael, Bart., F.R.S.E.
Sir George Hector Leith-Buchanan, Bart.
Prof. J. Cossar Ewart, M.D., F.R.S.
Prof. W. A. Herdman, D.Sc., F.R.S.
Colonel H. W. Fielden, C.B., C.M.Z.S.
Rev. Dr. Hugh Macmillan, F.R.S.E.
Robert M'Lachlan, F.R.S.
George R. M. Murray, F.R.S.
Frederick J. Hanbury, F.L.S.
William P. Hiern, M.A., F.L.S.
Rev. Dr. John Stevenson, F.R.S.E.
Rev. Dr. James Keith.
James E. Harting, F.L.S., F.Z.S., M.B.O.U.
Edgar A Smith, F.Z.S.
Arthur Bennett, F.L.S.
Rev. Edward S. Marshall, M.A., F.L.S.
James Groves, F.L.S.
J. T. Cunningham, B.A.
Thomas Scott, LL.D., F.L.S.
Dr. James Murie, F.L.S.
John T. Marshall, M.C.S.
James M'Andrew.
John Smith.
Dr. James Rankin, B.Sc.

Lord Haddington's telegram was as follows:—"Sincerely regret my inability to be present. I hope you will have a pleasant evening, and I wish continued success to your Society, in which I take a true interest."

After Mr. Borchgrevink, the Antarctic explorer, had made a few congratulatory remarks, Mr. John Paterson, one of the vice-presidents of the Society, proposed a vote of thanks to the gentlemen who had come from the kindred societies throughout the country, and also a vote of thanks to the musicians who had contributed so largely to the evening's enjoyment. Both of these were cordially responded to.

Dr. Robert Brown, Vice-President, proposed a vote of thanks to the Chairman.

Mr. Somerville, in reply, thanked the meeting for their hearty vote of thanks, and proposed a similar compliment to the Lord Provost.

In returning thanks, the Lord Provost said—I feel quite overwhelmed with confusion, but I thank you very heartily, not only for the kind expression of the Chairman, but for the distinguished honour you have conferred upon me in electing me to be one of the Honorary Members of the Society. I shall cherish that in my inmost heart, and I take this opportunity of thanking you for the altogether unexpected honour you have done me, and I trust to find some way in which to show my gratitude.

The meeting was then brought to a close.

19TH DECEMBER, 1901.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

The following gentlemen were elected Ordinary Members:—Mr. Keith Buchanan and Mr. Robert M. Buchanan, Fairholm, Giffnock, and Mrs. D. Maclachlan, 5 Grosvenor Place, Hillhead.

Letters were read from the following ladies and gentlemen, who had been elected Honorary Members at the Jubilee meeting of the Society on 4th instant: — Mr. Samuel Chisholm, LL.D. (the Hon. the Lord Provost of Glasgow), Belhaven Terrace; Professor John Cleland, M.D., LL.D., F.R.S., The University, Glasgow; Professor J. W. H. Trail, M.A., M.D., F.R.S., F.L.S., The University, Aberdeen; Mr. J. A. Harvie-Brown, F.R.S.E., F.Z.S., M.B.O.U., Dunipace House, Larbert; Mrs. David Robertson, Fernbank, Millport; and Mrs. Robert Gray, 56 George Street, Edinburgh—all giving expression to their high appreciation of the honour bestowed upon them by the Society.

The following specimens were exhibited by Mr. John Paterson, Vice-President, by favour of Mr. Charles Kirk:—(*a*) *Gallinago major* (Gmel.), the Great Snipe, shot in East Renfrewshire in September, 1901; (*b*) *Stercorarius crepidatus*, Gmel., Richardson's Skua, two examples from Shetland, illustrating two phases of plumage; (*c*) a group of Humming Birds from Ecuador. Their owner, Mr. Henry Coates, F.R.S.E., Perth, had had them most artistically arranged in a case, and in exhibiting them, Mr. Paterson enlarged on this remarkably distinct group of birds, especially referring to questions relating to their distribution, habits, flight, disposition, intelligence, nests, voice, food, and structure.

Mr. John Smith, Monkredding, Kilwinning, sent for exhibition a slide showing three species of *Difflugia*, viz.:—*D. pyriformis*, Carter; *D. urceolata*, Carter; and *D. globosa*, Carter. Mr. John Renwick read some notes descriptive of the genus.

A popular paper on "Mistletoe," by Mr. George Paxton, was read by Mr. John Renwick. The paper was illustrated by a number of lantern slides, which revealed some interesting aspects of the growth of Mistletoe, young and old, especially one large bunch on a Siberian Crab-Apple, 14½ feet in circumference (see page 301).

Mr. D. R. Somerville gave a very interesting and varied exhibition of lantern slides from photographs taken at excursions of the Society. He explained that many of them were the work of Mr. Alex. T. Brown. Upwards of ninety in number, they included views and scenes from the country districts on all sides of Glasgow, some far away and some near at hand. Amongst other localities depicted were Inchinnan, Cathcart, Torrance Glen, Castlemilk, Cadzow, Cadder Wilderness, Bardowie Loch, Campsie Glen, Overtoun, Eglinton Castle, "The Auld Wives' Lifts," Craigmaddie Loch, Mugdock Loch, Pillar Craig, Blanefield, "The Whangie," and Craigallian Loch. The pictures were exceedingly beautiful, and it was remarked that the excellence of the slides worthily inaugurated the new Lantern which had been subscribed for by members of the Society.

28th January, 1902.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. Henry Coates, F.R.S.E., Pitcullen House, Perth, was elected a Life Member of the Society.

On behalf of Mr. E. M. Holmes, F.L.S., F.R.H.S., Corresponding Member, several specimens of a Japanese Seaweed of the genus *Bonnemaisonia*, found naturalised and growing freely at Sandown and Falmouth. Notes descriptive of the specimens were read, and the points differentiating them from the British species of *Bonnemaisonia* were commented on. Mr. Holmes also sent for exhibition two illustrated Japanese books dealing with the subject of marine algæ.

Mr. John Paterson, Vice-President, on behalf of Mr Charles Kirk, exhibited the following birds :—(*a*) the Waxwing, *Ampelis garrulus* (L.), from Caldercruix ; (*b*) an Albino Hedge-Sparrow, *Accentor modularis* (L.), from Bellshill ; (*c*) the Greenshank, *Totanus canescens* (Gmelin.), from Islay.

Mr. Patersom also exhibited a specimen of the Glass-rope Sponge of Japan, *Hyalonema sieboldi*, (Gray.)

Mr Peter Macnair exhibited (*a*) a fine specimen of *Metacrinus rotundus*, P. H. Carpenter, a crinoid from Japan ; (*b*) a stalked young specimen of *Comatula rosacea*, Link. This, which is only a larval stage of *Comatula*, was originally believed to be a distinct species, and as such, was named *Pentacrinus europæus* J. Vaughan Williams ; (*c*) a case of Fossil Crinoids from silurian and local carboniferous strata.

Mr. James Rankin, M.B., C.M., B.Sc., Glasgow University, read a paper descriptive of a Mite, *Glyciphagus spinipes*, Koch., found infesting furniture, and illustrated his remarks with lantern slides and microscopic preparations. After an outline of the anatomy of the *Arachnida*, Dr. Rankin stated that a short time ago there had been sent to him at the University some specimens of a small animal which had been found in considerable numbers infesting furniture which had been recently purchased. The furniture was of oak, stuffed with horsehair, and covered with leather. These animals proved to be Mites, and he had identified them as *Glyciphagus ansor*, Gervais, and *G. spinipes*, Koch. The generic name was given to these Mites by Hernig, who found them on sugar-coated prunes. The Mites are about the fiftieth part of an inch in length, and may be recognised by the absence of a transverse groove on the body between the second and third pairs of limbs, by the fact that the limbs are the tint of an onion, by the spiny processes on the limbs, and by the numerous long hairs on the body, the posterior ones being specially long, and nearly all having closely adjusted secondary hairs. They are found on *Cantharidæ*, in collections of insects, in hay and straw, and in damp cellars, especially on moulds. Although the first-named is a domestic pest in many places, in the present instance the Mites were found in this furniture only. Afterwards they spread to other objects in the room, but were not observed in any other apartment in the house. Through a student engaged in the Zoological Laboratory, Dr. Rankin procured some samples of horsehair which had been hanging in a damp stable for some time, and also some combings taken directly from the manes and tails of the horses. In the latter no Mites were seen, but many of the same species were found in the former. As it is a common practice for farmers to preserve the combings of horsehair, and to dispose of them to itinerant dealers, who in turn sell them to cabinetmakers, Dr. Rankin thought there could be little doubt as to the source from which the Mites had come, more especially as they are said to feed on the animal fat adhering to uncleaned horsehair, and he urged that all horsehair utilised in stuffing furniture should be thoroughly cleaned before being used. He also stated that it seemed almost impossible to get rid of the Mites in furniture, fumigation and strong chemicals having been employed without success.

Mr. John Ballantyne, Hamilton, read a paper entitled "Notes on the Occurrence of *Sirex gigas*, L., and *Sirex juvencus*, L., in Bute and Arran" (see page 305).

25th February, 1902.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. John Paterson, Vice-President, on behalf of Mr. Charles Kirk, exhibited a very beautiful example of a Cream-coloured Woodcock, *Scolopax rusticula*, L.

Dr. T. B. Henderson exhibited two species of Lizards—(*a*) *Lacerta vivipara* (Duméril and Bibron), the common English Lizard, and (*b*) *Amphibolurus barbatus* (Wiegm), the Bearded Lizard of Australia. Details regarding the two species were given by Dr. Henderson, and several members referred to the frequency with which the English Lizard is met in different parts of Scotland.

Mr. John Ballantyne exhibited a Chicken with four legs, and made some remarks on its structure.

On behalf of Mr. George Paxton, a paper entitled "Notes on Forest Trees" was read by Mr. John Renwick. The paper, which was illustrated by lantern slides, was of a popular nature, giving a short general description of each tree as it was shown on the screen, reference being also made to the localities in which it grew, its girth, bark, leaves, and fruit. The following trees were thus passed in review:—The Scotch Fir, the Birch, the Beech, the Lime, the Ash, the Elm, the Sycamore, the Cedar, the Yew, the Spanish Chestnut, the Horse Chestnut, the Willow, the Poplar, and the Oak. The slides were very beautiful, those more especially which showed the different stems of the trees and the structure of the leaves meeting with the hearty admiration of the members.

The following additions to the Library were laid on the table, and thanks accorded to the donors:—"Science Gossip," 1898-1901, 4 vols., from Mr. A. Somerville, B.Sc., F.L.S.; "Natal Plants," by J. Mealey Wood, F.L.S., Vols. I. and II. and Parts 1 and 2 of Vol. III., from Colonel R. S. Harington-Stuart of Torrance, East Kilbride; "The Birds, Fishes, and Cetacea of Belfast Lough," by R. L. Patterson, from Mr. Duncan M'Kenzie; "Robert Dick, Geologist and Botanist," by Dr. Smiles, from a member; "A Bathy-orographical Map of the Clyde Basin" and "Programmes of Excursions Nos. 1 to 13," from the Local Committee of the British Association, Glasgow Meeting, 1901.

25TH MARCH, 1902.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

A letter was read from Mr. Andrew Carnegie, LL.D., thanking the Society for the honour it had done him in electing him an Honorary Member, and stating how greatly he appreciated the distinction.

Mr. John Paterson, Vice-President, exhibited the nest and eggs of the Lesser White-Throat *Sylvia curruca*, L., from Ealing, Middlesex, and gave details as to its distribution and habitat.

Mr. John Renwick, on behalf of Mr. M'Culloch, exhibited a specimen of the Greenland Falcon, *Falco candicans*, Gmelin, which had been shot at sea. He also showed a Polecat, *Mustela putorius*, L., caught near Dingwall.

Mr. John Lindsay, M.A., M.B., C.M., brought for exhibition the

From Photograph by *George Paxton.*

ASH (*Fraxinus excelsior*, L.),

at Hunterston, Ayrshire.

[With Rev. David Landsborough, LL.D., Kilmarnock, in the foreground.]

Girth, 14 feet 8¾ inches at 4 feet up; Bole, 8 feet; Height 60 feet (measured on 13th September, 1902, by Messrs. John Renwick and Richard M'Kay.)

(See page 382.)

From Photograph by *George Paxton.*

GREAT MAPLE (*Acer Pseudo-platanus*, L.),

at Auchans, Ayrshire.

Girth, 14 feet $8\frac{1}{2}$ inches, with Bole about 18 feet, spread about 80 feet (measured on Nov. 30, 1903, by Rev. Dr. Landsborough, Kilmarnock).

(See page 382.)

skeleton of a parasitic fœtus, and demonstrated by means of it the distinctive features of the parasitic connection. He gave at the same time a lucid description of the mode of the development, and the union, of twins.

Dr. T. Beath Henderson read a paper entitled "A simple method of preserving birds as specimens," and showed several examples of his handiwork as illustrations. The method consisted simply in the injection of carbolic acid by considerable force into the body cavity. The acid permeated the tissues of the animal, hardened the tissues, and practically mummified the creature. The method, he said, while useful for small specimens, was not so well adapted for large ones, and was not suitable for museum specimens.

29TH APRIL, 1902.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. John Renwick, read reports of the Society's excursions to Craigends and to Murroch and Auchenreoch Glens (see pp. 338 and 340).

Mr. J. J. Robertson, Hon. Secretary, read a paper by Mrs. David Robertson, Millport, Honorary Member, on *Lithothamnion glaciale* (Kjellm.), a calcareous alga, new to Britain. The authoress stated that the first specimen of this alga was obtained at Port-Bannatyne, Bute, in October, 1895. The late Dr. David Robertson sent it to Mr. E. A. L. Batters, who identified it as above, but, as there was still some doubt, refrained from inserting it into the list of the marine algæ of the Clyde which he contributed to the Fauna and Flora Handbook for the British Association in 1901. The specimens now exhibited had been kindly authenticated by M. Foslie, of Norway. Kjellmun says—"The species is dispersed over the greater part of the Arctic Sea. Only from the Kara and Siberian Seas it is not known. It attains its most vigorous development, as far as I know, at Spitzbergen and on the west coast of Novaia Zemlya, where it occurs also in the greatest numbers." He also says—"The present plant is a deep-water form. Most often and in the greatest number it is met with at a depth of 10-20 fathoms. The localities where it is known to exist are (1) the Norwegian

Polar Sea, (2) the Greenland Sea, (3) the Murman Sea, (4) the American Arctic Sea, (5) Baffin's Bay.

Mrs. Robertson sent for exhibition specimens of this alga, and along with them examples also of *Lithophyllum lenormandi*, Rosenv., and of *Lithothamnion Sonderi*, Hauck, both from Cumbrae.

The President followed with a short paper on the Corallineæ, the family of red seaweeds to which *Lithothamnion* belongs. He referred to their abnormal lime-encrusted habit, and to their wide distribution in time and space, for they are to be found as far back as the upper chalk beds, while we meet with them to-day in all seas, and very plentifully among coral reefs, where they often act as a kind or mortar in holding the reefs together.

Mr. James Mitchell exhibited some specimens of birds, mummified by a native process, from Basutoland, South Africa. The birds were in excellent preservation, and their condition was a demonstration of the efficiency of the method described by Dr. T. B. Henderson at the previous meeting.

Mrs. Peter Ewing read a paper entitled "Arctic Plants from the Dovrefjeld, Norway," and exhibited all the plants mentioned in the paper (see page 307).

Dr. James F. Gemmill gave a demonstration on "Different Modes of Movement among Echinoderms." He exhibited a number of living specimens of star-fishes, sea-urchins, brittle stars, and feather stars, and illustrated, by means of these specimens, as well as by a number of "living" lantern slides, the organs and methods of locomotion proper to each species.

Mr. James Whitton's paper on "Meteorological Notes and Remarks upon the Weather during the year 1901, with its general effects upon Vegetation," was held as read (see page 313).

27TH MAY, 1902.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr. John Robertson reported on the Society's excursion to Neilston Pad and Harelaw Dam (see page 341); Mr. John Paterson on that to Bishop Loch, etc. (see page 342); and Mr. James Whitton on that to Cambusnethan and Dalzell (see page 343).

Mr. J. G. Goodchild, F.G.S., F.Z.S., of H.M. Geological Survey, delivered a lecture entitled "Recent Changes of Animal Life in Britain," which he illustrated by a fine series of lantern slides. He first noticed the causes of the increase of certain species of birds, and of the decrease of others, dealing more especially with the cases which had come under his own observation. As a reason for the rarity of many species, he mentioned the enclosure of waste lands and the drainage of bogs and marshes, but he stated that a large proportion of the decrease in the numbers of certain birds was owing to the ravages of collectors, and especially of those given to bird-nesting. Passing on to the changes that have affected the mammals now living in Britain, he treated of the decrease of such animals as the Wild Cat, the Badger, and the Marten. Then, reviewing the changes of life that took place in times remote from the present, he discussed the causes which led to the introduction into our island of such animals as the Wolf, the Wild Boar, and other animals no longer resident here. This led to the consideration of the causes of the former existence in Britain of such animals as the Reindeer, the Arctic Fox, the Glutton, the Musk Sheep, and others which are now confined to the Arctic regions. Along with these were reviewed an interesting series of mammals whose remains are found in this country in a fossil state, but which are still living in Steppe regions where an arid climate prevails. The bearing of these occurrences upon the geographical conditions which formerly prevailed in the British Isles was discussed. Finally, the lecturer passed in review the causes which led to the former existence in Great Britain of such creatures as the Lion, the Leopard, the Spotted Hyæna, and other animals which are now generally confined to the warmer regions of the globe; and he concluded by pointing out the bearing of these facts upon the origin of the European fauna.

Mr. Baxter showed some dust collected in Barbadoes, which had fallen on that island as a result of the recent volcanic disturbances in the neighbouring West Indian Islands.

24TH JUNE, 1902.

Mr. Alex. Somerville, B.Sc., F.L.S., President, in the chair.

Mr Hugh Boyd Watt reported on the Society's excursion to Ben Lomond on 22nd April (see page 344), Mr. James Steel on that to Dungoyne on 7th June (see page 346), and Mr. R. M. Morton on that to Milton Lockhart and Carfin on 14th June (see page 347). Several photographs taken at these excursions were exhibited by Mr. J. W. Reoch.

Mr. James G. Johnston, 118 Eastfield Street, Springburn, was elected an Ordinary Member, and Mr. William West, F.L.S., Lecturer on Botany and Materia Medica in the Technical College, Bradford, was elected a Corresponding Member.

Mr. John Paterson, Vice-President, exhibited, on behalf of Mr. Charles Kirk, a specimen of the Black Tern, *Hydrochelidon nigra*, L., from Hawick, a species which had only once previously been brought before any meeting of the Society, and on that occasion from Possil.

Mr. Alex. Gray exhibited specimens of the marine wood-boring mollusc, *Xylophaga dorsalis*, Turton, found in submerged timber in Loch Fyne. In connection with this the President read a paper descriptive of the species, giving an account of the habits of the animal and of the peculiarities of the structure of its shell, the valves of which are not held together by a ligament. By its rapid boring action *Xylophaga* performs a useful function in ridding the seas of water-logged timber.

The President, Mr. Alex. Somerville, B.Sc., F.L.S., exhibited specimens of *Carex disticha*, Huds. (= *C. intermedia*, Good.) the Soft Brown Sedge, found by him on Great Cumbrae, near the Marine Station, and confirmed by Mr. Arthur Bennet, F.L.S. This species has not hitherto been recorded as occurring in Buteshire.

The thanks of the meeting were accorded to the President for his gift to the Library of the Society of *British Vegetable Galls, An introduction to their study*, by Edward T. Connold, 1901.

The following specimens of crustacea, &c., from Loch Fyne, were sent for exhibition by Mr. James Patience :—*Pandalus bonnieri*, Caullery, from 107 fathoms; *P. propinquus*,

G. O. Sars, from the same depth; *P. montagui*, Leach, from 20 fathoms; *Pandalina brevirostris* (Rathke), with parasitic isopod, *Pleurocrypta cluthae*, n. sp., from 20 fathoms; *Branchiostoma lanceolatum* (Pallas), the Lancelet or Amphioxus. *Aphia pellucida*, Collet., from the Firth of Forth was also shown.

26TH AUGUST, 1902.

Mr. John Paterson, Vice-President, in the chair.

Mr. James Whitton reported on the Society's excursion to Tollcross Park on 17th June (see page 348), and Mr. John Renwick on that to Galston on 5th July (see page 351).

Mr. John Robertson exhibited eggs of the Manx Shearwater, *Puffinus anglorum* (Temminck), from the island of Eigg, giving at the same time interesting details as to the nesting of the bird, and as to the difficulties connected with the gathering of the eggs.

Dr. T. Beath Henderson exhibited young specimens of the *Boa constrictor* (L.), and gave an anatomical description of their structure and life-history.

Mr. Peter Ewing, F.L.S., exhibited a large collection of plants principally alpine, which included the following:—*Caltha minor*, Syme; *Arabis petræa*, L.; do. var. *violacea*, Druce; do. var. *grandifolia*, Druce; *Cochlearia micacea*, Marshall; *Alsine rubella*, Whlnb., or *Arenaria sulcata*, Schleich.; *Sagina procumbens*, L.; *S. nivalis*, Fr.; *Saxifraga cernua*, L.; *Epilobium alpinum*, Lam.; *Filago montana*, L.; *Erigeron alpinum*, L.; *Hieracium holosericeum*, Backh.; *Pyrola rotundifolia*, L.; *Gentiana nivalis*, L.; *Rhinanthus Drummond-Hayi*, F. B. White; *Melampyrum montanum*, Johnst.; *Orchis incarnata*, L.; *Juncus trifidus*, L.; *J. castaneus*, Sm.; *J. biglumis*, L.; *Carex ustulata*, Wahl. from Scandinavia; *Alopecurus alpinus*, Sm., rare, from the Forfarshire mountains; *Aira pseudo-alpina*, Syme; *Poa alpina*, L.; *Woodsia hyperborea*, R. Br.; *Cystopteris montana*, Bernh.; *Asplenium adiantum-nigrum*, L.; *A. serpentini*, Koch.; *A. fontanum*, Presl.

Mr. Ewing also read a paper entitled "Report on the State of the Alpine Flora in Breadalbane during the last week of July, 1902" (see page 336).

Mr. Geo. Heriot exhibited some very beautiful photographs of Alpine plants taken in their natural situations.

A communication from Mr. Alex. Somerville, B.Sc., F.L.S., the President, was read by Mr. Renwick. It dealt with an exhibit of *Bromus giganteus*, L. (*Festuca gigantea*, Vill.), the Giant Brome Grass, with, for comparison, *B. ramosus*, Huds. (*B. asper*, Murr.), the Hairy Brome, from Ballantrae, Ayrshire. He remarked that he did not show these handsome grasses because of their rarity, for both are widely distributed, but because of the fact that the former at least, *Bromus giganteus*, is often overlooked, possibly from growing where there is much shade. *B. giganteus* is recorded from 98 out of the 112 Vice-Counties of Britain, and *B. ramosus* from 96. Both species are tall, the former said by Hooker to attain to 4 feet, and the latter to 6 feet. The inflorescence of both is a long, loose, drooping panicle, presenting, it might almost be said, a weeping aspect. The panicle of *B. giganteus*—the shorter grass of the two—attains a length sometimes of no less than 12 inches, while the panicle of *B. ramosus* is said to fall short of half that length. Both species have a smooth stem. Apart from minor distinctions, the point which readily distinguishes the two is that the leaf-sheaths of *giganteus* are smooth, while the lower leaf-sheaths, especially, of *ramosus*, are strikingly hairy, with down-directed hairs, this latter enabling the observer at a glance to determine the species. It may be mentioned also that, correspondingly, the ovary of *giganteus* is glabrous, while that of *ramosus* is hairy.

*ABSTRACT STATEMENT OF ACCOUNTS—SESSION 1898-99.**

1898.—Sept. 1.			
To Balance—Life Members' Fund,	£47 0 0		
Ordinary Fund, on loan,	£40 0 0		
Do., in Bank, and in Treasurer's hand,	35 4 5½		
		75 4 5½	
			£122 4 5½
1899.—Aug. 31.			
To 216 Members' Annual Subscriptions, @ 7s. 6d.,			81 0 0
,, 30 Members' Arrears,			11 5 0
,, 16 Associates' Subscriptions, @ 5s.,			4 0 0
,, 1 Associates' Arrears, @ 5s.,			0 5 0
,, Interest,			7 8 7
,, *Transactions* sold,			3 19 10
,, Donations to Illustration Fund,			9 12 0
			£239 14 10½

From Balance of £50 3s. 1d. fall to be deducted cost of *Transactions* for 1898-99, and of new Bookcases.

1899.—Aug. 31.			
By Rent and Attendance,			£10 4 6
,, Postage, Stationery, &c.,			16 3 10½
,, Printing Circulars,			10 10 0
,, Printing and Illustrating *Transactions*,			67 8 11
,, Carriage on *Transactions*,			1 16 11
,, Lecture and Lantern Expenses,			1 13 0
,, Printing Catalogue,			21 5 1
,, Library—New Books,		£7 8 3	
Binding,		4 4 4	
Insurance, 12s.; Postages, Stationery, &c., £1 4s. 11d.,		1 16 11	
			13 9 6
,, Balance—Life Members' Fund, on loan @ 4%,		*£47 0 0	
,, Balance, Ordinary Fund, on loan @ 4%,	*40 0 0		
,, Balance, Ordinary Fund, in National Security Savings Bank,	11 12 2		
	£51 12 2		
Less due to Treasurer,	1 9 1		
		50 3 1	
			97 3 1
			£239 14 10½

* On Security of Guaranteed Railway Stock.

Life Members' Fund—	
Invested in 2½ per cent. Debentures of the Modern Permanent Building and Investment Society, Melbourne,	£100 0 0
On loan at 4 per cent,	47 0 0
	£147 0 0

Glasgow, 24*th October*, 1899.—We have audited above Accounts, compared same with relative Vouchers and Securities, and find them correct.

(Signed) JAMES JACK, WM. LEIGHTON, } *Auditors.*

* By an error the Accounts for 1898-99 were omitted from the *Transactions* in Part I., p. 180, and those for 1899-1900 substituted: the error was continued in the next part, but is now corrected by the insertion of the missing Account here.

OFFICE-BEARERS.

SESSION LIII.—1903-1904.

President.

PETER EWING, F.L.S., The Frond, Uddingston.

Vice-Presidents.

JOHN PATERSON, 82 Cumming Drive, Mount Florida.
THOMAS BEATH HENDERSON, M.D., 155 Bath Street.
MALCOLM LAURIE, M.A., D.Sc., Clunaline, Lenzie.

Hon. Secretaries.

ROBERT BROWN, M.D., 1 Leslie Road, Pollokshields.
ALEXANDER ROSS, 2 Kennyhill Gardens, Dennistoun.

Hon. Treasurer.

JOHN RENWICK, 49 Jamaica Street.

Hon. Librarian.

JAMES MITCHELL, 222 Darnley Street, Pollokshields.

Hon. Editor of Transactions.

Rev. G. A. FRANK KNIGHT, M.A., F.R.S.E., St. Leonard's United Free Church, Perth.

Members of Council.

George Herriot.
William Leighton.
John Robertson.
James Whitton.
A. B. Motherwell.
J. W. Reoch.
J. J. Robertson.
J. Ballantyne.
Robt. Buchanan.
Robt. M'Lean.
Robt. Garry.
John Cairns, Jun.

Auditors.

JAMES JACK and JOSEPH SOMMERVILLE.

LIST OF BRITISH AND IRISH SOCIETIES, &c., WITH WHICH PUBLICATIONS ARE EXCHANGED.

Alnwick.—Berwickshire Naturalists' Field Club.
Banff.—Banffshire Field Club and Scientific Society.
Barrow.—Naturalists' Field Club.
Bath.—Natural History and Antiquarian Field Club.
Belfast.—Naturalists' Field Club.
 Natural History and Philosophic Society.
Birmingham.—Philosophical Society.
Bristol.—Naturalists' Society.
Cambridge.—The University Library.
Cardiff.—Naturalists' Society.
Chelmsford.—The Essex Naturalist.
Chester.—Society of Natural Science.
Dublin.—Royal Dublin Society.
 Trinity College Library.
Dumfries.—Dumfriesshire and Galloway Natural History and Antiquarian Society.
Dundee.—East of Scotland Union of Naturalists' Societies.
Edinburgh.—The Royal Society.
 Advocates' Library.
 Botanical Society.
 Field Naturalists' and Microscopical Society.
 Geological Society.
 Royal Physical Society.
 Scottish Geographical Society.
 Scottish Microscopical Society.
Glasgow.—Andersonian Naturalists' Society.
 Baillie's Institution Free Library.
 Faculty of Physicians and Surgeons.
 Geological Society.
 Glasgow and West of Scotland Technical College.
 Industrial Museum.
 Mitchell Library.
 Royal Philosophical Society.
 Stirling's Library.
 University Library.

Hull.—Scientific and Field Naturalists' Club
Innerleithen—Alpine Club.
Inverness.—Scientific Society and Field Club.
Kilmarnock.—Glenfield Ramblers' Club.
Leeds.—Naturalists' Club and Scientific Association.
    Yorkshire Naturalists' Union.
Leicester.—Literary and Philosophical Society.
Liverpool.—Naturalists' Field Club.
    Biological Society.
London.—British Museum Library.
    British Museum (Natural History Department).
    British Association.
    Entomological Society.
    Geologists' Association.
    Hampstead Naturalists' Club.
    Linnean Society.
    Quekett Microscopical Club.
    Royal Geographical Society.
    Royal Microscopical Society.
    Royal Society.
Manchester.—The Botanical Exchange Club of the British Isles.
    Field Naturalists' and Archæologists' Society.
    Geological Society.
    Literary and Philosophical Society.
    Microscopical Society.
Marlborough.—The College Natural History Society.
Millport.—Millport Marine Biological Station.
Newcastle-on-Tyne.—Tyneside Naturalists' Field Club.
Northampton.—Natural History Society.
Norwich.—Norfolk and Norwich Naturalists' Society.
Oxford.—Bodleian Library.
Paisley.—Free Library.
Penzance.—Natural History and Antiquarian Society.
Perth.—Perthshire Society of Natural Science.
Peterhead.—Buchan Field Club.
Plymouth.—Plymouth Institution, and Devon and Cornwall Natural History Society.

Ramsey.—Isle of Man Natural History and Antiquarian Society.
Stirling.—Natural History and Archæological Society.
Stoke-upon-Trent.—North Staffordshire Naturalists' Field Club.
Truro.—Royal Institution of Cornwall.
Warwick.—Naturalists' and Archæologists' Field Club.
Watford.—Hertfordshire Natural History Society and Field Club.

LIST OF COLONIAL AND FOREIGN SOCIETIES, &c., WITH WHICH PUBLICATIONS ARE EXCHANGED.

Adelaide.—Royal Geographical Society of Australasia (South Australian Branch).
Agram.—Societas Historico-Naturalis Croatica.
Albany, N.Y.—New York State Museum.
Amsterdam.—Koninklijke Akademie van Wetenschappen.
Basel.—Naturforschende Gesellschaft.
Bautzen.—Naturwissenschaftliche Gesellschaft.
Bergen.—Museum.
Berlin.—Gesellschaft Naturforschender Freunde.
Museum für Naturkunde.
Berne.—Schweizerische Entomologische Gesellschaft.
Bonn.—Naturhistorischer Verein.
Niederrheinische Gesellschaft für Natur-und Heilkunde.
Bordeaux.—Société Linnéenne.
Boston, Mass.—Society of Natural History.
Bremen.—Naturwissenschaftlicher Verein.
Brisbane.—Queensland Branch of Royal Geographical Society of Australasia.
Queensland Museum.
Brünn.—Naturforschender Verein.
Brunswick.—Verein für Naturwissenschaft.
Brussels.—Société Entomologique de Belgique.
Société Malacologique de Belgique.
Société Royale de Botanique de Belgique.
Buda-Pesth.—Magy. tud. Akadémia palotája.
Bureau Central Ornithologique.
Buffalo, N.Y.—Society of Natural Sciences.

Cambridge, Mass.—Museum of Comparative Zoölogy at Harvard College.
Cherbourg.—Société Nationale des Sciences Naturelles et Mathématiques.
Chicago.—Field Columbian Museum.
Academy of Sciences.
Cincinnati.—Society of Natural History.
Córdoba.—Academia Nacional de Ciencias.
Danzig.—Naturforschende Gesellschaft.
Davenport, Iowa.—Academy of Natural Sciences.
Dresden.—Naturforschende Gesellschaft.
Elberfeld.—Naturwissenschaftlicher Verein.
Florence.—Società Entomologica Italiana.
Frankfort.—Senckenbergische Naturforschende Gesellschaft.
Gera.—Der Deutsche Verein zum Schutze der Vogelwelt.
Ghent.—Natuurwetenschappelijk Genootschap.
Giessen.—Oberhessische Gesellschaft für Natur-und Heilkunde.
Gorlitz.—Naturforschende Gesellschaft.
Gothenburg.—Göteborgs Kungliga Vetenskapsoch Vitterhets Samhälle.
Granville, Ohio.—Denison Scientific Association.
Gratz.—Naturwissenschaftlicher Verein für Steiermark.
Greifswald.—Naturwissenschaftlicher Verein von Neu-Vorpommern und Rügen.
Hague, The.—Nederlandsche Entomologische Vereeniging.
Halifax.—Nova Scotian Institute of Natural Science.
Halle.—Naturforschende Gesellschaft.
Kaiserliche Leopoldinisch - Carolinische Deutsche Akademie der Naturforscher.
Hamburg.—Naturwissenschaftlicher Verein.
Heidelberg.—Naturhistorisch-medicinischer Verein.
Helsingfors.—Societas pro Fauna et Flora Fennica.
Indianapolis.—Indiana Academy of Science.
Kassel.—Verein für Naturkunde.
Kiel.—Naturwissenschaftlicher Verein für Schleswig-Holstein.
Kiev.—Société des Naturalistes.
Königsberg.—Physikalisch-ökonomische Gesellschaft.
La Plata.—Museo de La Plata.

Landshut.—Botanischer Verein.
Lawrence.—University of Kansas.
Leipsic.—Naturforschende Gesellschaft.
Liège.—Société Royale des Sciences.
London, Ontario.—Entomological Society of Ontario.
Luxemburg.—Verein Luxemburger Naturfreunde.
Société Botanique du Grand-Duché de Luxembourg.
Lyons.—Société Linnéenne.
Macon.—Société d'Histoire Naturelle.
Madison.—Wisconsin Academy of Science, Arts, and Letters.
Wisconsin Geological and Natural History Survey.
Madrid.—Sociedad Española de Historia Natural.
Magdeburg.—Naturwissenschaftlicher Verein.
Meriden, Conn.—Scientific Association.
Mexico.—Sociedad Científica "Antonio Alzate."
Instituto Geológico.
Milwaukee.—Public Museum.
Wisconsin Natural History Society.
Minneapolis.—Minnesota Academy of Natural Sciences.
Montevideo.—Museo Nacional.
Moscow.—Société Impériale des Naturalistes.
Munich.—Ornithologischer Verein.
Münster.—Westfälischer Provinzial-Verein für Wissenschaft und Kunst.
Neuchâtel.—Société des Sciences Naturelles.
New Brighton.—Natural Science Association of Staten Island.
New Haven, Conn.—Connecticut Academy of Sciences and Arts.
New York.—Academy of Sciences.
American Museum of Natural History.
Linnæan Society.
Nuremberg.—Naturhistorische Gesellschaft.
Odessa.—Société des Naturalistes de la Nouvelle-Russie.
Osnaburg.—Naturwissenschaftlicher Verein.
Ottawa.—Geological and Natural History Survey of Canada.
Department of Agriculture.
Padua.—La Nuova Notarisia.
Società Veneto-Trentina di Scienze Naturali.

Palermo.—Reale Orto Botanico.
Paris.—Société Entomologique de France.
Société Zoologique de France.
Passau.—Naturhistorischer Verein.
Philadelphia.—Academy of Natural Sciences.
American Philosophical Society.
Commercial Museum.
Wagner Free Institute of Science.
Portland, Maine.—Society of Natural History.
Poughkeepsie.—Vassar Brothers Institute.
Prague.—Königl.-Böhm. Gesellschaft der Wissenschaften.
Raleigh, N.C.—Elisha Mitchell Scientific Society.
Rio de Janeiro.—Museo Nacional.
Rochester, N.Y.—Academy of Science.
Journal of Applied Microscopy.
Rome.—Società Romana per gli Studi Zoologici.
St. John.—Natural History Society of New Brunswick.
St. Louis, Missouri.—Academy of Science.
St. Petersburg.—Comité Géologique.
Musée Zoologique de l'Académie Imperiale des Sciences.
Societas Entomologica Rossica.
Russisch-Kaiserliche Mineralogische Gesellschaft.
Salem, Mass.—Essex Institute.
San Francisco.—California Academy of Sciences.
Santiago.—Sociedad Científica Alemana.
Société Scientifique du Chili.
Somerville, Mass.—Tufts College.
Stockholm.—Société Entomologique.
Stuttgart.—Verein für Vaterländische Naturkunde in Würtemberg.
Sydney.—Australian Museum.
Tokyo.—Imperial University of Japan.
Toronto.—Canadian Institute.
Entomological Society of Ontario.
University.
Trentschin.—Naturwissenschaftlicher Verein.
Trieste.—Museo Civico di Storia Naturale.

Upsala.—Geological Institution of the University.
Urbana, Ill.—Illinois State Laboratory of Natural History.
Venice.—La Notarisia.
Victoria, B.C.—Natural History Society of British Columbia.
Vienna.—Zoologisch-botanischer Verein.
Naturwissenschaftlicher Verein an der Universität.
K. K. Naturhistorisches Hofmuseum.
Wanganui, N.Z.—Public Museum.
Washington, C.D.—Smithsonian Institution.
Bureau of American Ethnology.
United States Department of Agriculture.
United States Geological Survey.
Wellington, N.Z.—New Zealand Institute.
Winnipeg.—Historical and Scientific Society of Manitoba.
Western Horticultural Society.
Zurich.—Naturforschende Gesellschaft.

GENERAL INDEX.

TOPOGRAPHICAL.

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