Extracts from *Proceedings of the Geological Society of Glasgow*

Session 8 (1865-1866)

Extracts from the Proceedings for 1865-1866 (Session 8)

Meeting held on March 22, 1866

Mr. JAMES FARIE, the Secretary, exhibited a specimen of "Wulfenite," or Molybdate of Lead, from the Lochantyre mine, near Gatehouse, Kirkcudbrightshire, a mineral which he believed to be hitherto unknown in Britain. Mr. Farie exhibited also, from the same mine, a specimen of Vanadiate of Copper, new to Britain, and stated in recent works, such as Bristow's and Dana's, to be found only in the Urals.

The SECRETARY read a communication from Mr. James Croll "On the reason why the Change of Climate in Canada since the Glacial Epoch has been less complete than in Scotland". (*This paper can be seen at https://geologyglasgow.org.uk/archive/james-croll/.*)

In the Proceedings for the year 1866-1867 (Session 9) it was recorded that, at the meeting of February 7 1867, James Croll was elected an honorary associate.

Session 9 (1866-1867)

Extracts from the Proceedings for 1866-1867 (Session 9)

Meeting held on February 7, 1867

It was remitted to the Chairman and the Secretary to draw up a minute expressive of the great loss which the Society had sustained by the death of the late President, James Smith, Esq., of Jordanhill; and of the value of his scientific labours in the science of Geology, that it might be recorded in the Society's Minute-book; and that the Secretary should transmit a copy of it to Archibald Smith, Esq., of Jordanhill, son of the late President.

The CHAIRMAN delivered an Address on the scientific labours of the late President of the Society, James Smith, Esq., of Jordanhill. (*The text of this address can be read at https://geologyglasgow.org.uk/docs/017_070__address_in_memory_of_james_smith_1484409180.pdf.*)
It is interesting to note that the minutes of the meeting on February 7, 1867 also record that it was on that date that James Croll was elected an honorary associate of the Society. The minutes of the meeting which took place just over two months later, on April 18, 1867, record that the following was one of the papers read:

On the change in the Obliquity of the Ecliptic; its influence on the Climate of the Polar Regions and Level of the sea. By Mr. James Croll. The reading of this long and valuable communication was followed by some observations by the President and the Rev. H. W. Crosskey. (*The President referred to was Dr. John Young, Professor of Natural History at Glasgow University, who was elected on March 7, 1867 following the death in January 1867 of James Smith. More information about James Croll can be found at https://geologyglasgow.org.uk/archive/james-croll/ and his paper can be read at https://geologyglasgow.org.uk/docs/017_070__james_croll_obliquity_1484409182.pdf.*)

Session 10 (1867-1868)

Extracts from the Proceedings for 1867-1868 (Session 10)

Annual General Meeting held on October 3, 1867

The Secretary read a report on the state and progress of the Society for the past year, which showed that the members on the roll were, for 1867, 233— a satisfactory increase over the preceding year. The library had been largely increased by exchanges with Foreign and British societies; and, among other donations, Archibald Smith, Esq., of Jordanhill, had, with great liberality, presented the Society with one hundred volumes of geological works from the library of his late father, sometime President of the Society.

Meeting held on October 31, 1867

The PRESIDENT [Dr. John Young] paid a high tribute to his predecessor in office, the late Mr James Smith, of Jordanhill, and expressed his gratification at the erection of the Geological Survey of Scotland into a separate branch, under the directorship of one so competent as Mr Archibald Geikie.

James Smith of Jordanhill was President of the Geological Society of Glasgow from 1864 until his death (aged 84) in January 1867. A biography of James Smith can be found at https://geologyglasgow.org.uk/docs/017_070__smith_1550942852.pdf and a link to the account given to the Society by Rev. Henry W. Crosskey of his remarkable life can be found in the entry for Session 9 in this document.

Meeting held on February 6, 1868

Mr. J. WALLACE YOUNG exhibited sections of pitchstone from Arran by means of the microscope. Pitchstone to the unaided eye appears like a piece of bottle glass, but when sections are examined under the microscope beautiful needle-shaped crystals of pyroxene are observed in a colourless felspathic base.

Mr. JOHN SMITH exhibited a remarkably well-preserved crinoid from the carboniferous limestone, Beith. The specimen, evidently belonging to the genus *Phodocrinus,* showed the stem, calyx, and fingers all in position, a state of preservation in which crinoids are very rarely obtained in the carboniferous limestones of Scotland.

John Smith (1845-1930) was an active member of the Geological Society of Glasgow for 65 years. He devoted much of his life to the study of the geology, natural history and archaeology of Ayrshire. An account of the life of John Smith, written by Dr. Murray Macgregor, can be found at https://geologyglasgow.org.uk/docs/017_070__johnsmith_1509017687.pdf.

Meeting held on February 27, 1868

Sir WILLIAM THOMSON, D.C.L., read a paper on "Geological Time". (*This paper can be seen at https://geologyglasgow.org.uk/docs/017_070__on_geological_time_1509969125.pdf*.)

Meeting held on March 28, 1868

ARCHIBALD GEIKIE, Esq., Director of the Geological Survey of Scotland, read a paper on "Modern Denudation". (*This paper can be seen at https://geologyglasgow.org.uk/docs/017_070__on_modern_denudation_1509969128.pdf*.)

[There followed] an animated discussion, in which Sir William Thomson, Professor Allen Thomson, Mr. John Young and the President took part, after which the Society adjourned till April 2nd.

Session 11 (1868-1869)

Extract from the Proceedings for 1868-1869 (Session 11)

Meeting held on November 5, 1868

Mr. JOHN YOUNG exhibited a vertical section of the strata in Gilmorehill Quarry, which he has constructed out of the pounded material of each stratum. The section is enclosed within a long wooden box, with a glass front, and is constructed on a scale of one-half inch to the foot. It exhibits in a clear manner the comparative thickness of each stratum, their natural colour, and the gradations they assume. It has been placed in the Hunterian Museum as a memorial of the quarry.

Mr. JOHN YOUNG read a paper, "On the section of strata at present being worked in the western portion of the Gilmorehill grounds, for the purpose of obtaining building-stone for the erection of the new Glasgow University." The paper was illustrated by specimens of the sandstone, &c., and by vertical and horizontal sections of the strata in the quarry.

This paper was published in the society's Transactions for 1869 (Volume 3). It can be found at https://geologyglasgow.org.uk/wp-content/uploads/2019/04/017_070__gilmorehill_quarry_1541792035.pdf.

Meeting held on April 1, 1869

Mr. ROBERT CRAIG, Langside, Beith, exhibited several species of arctic shells, recently discovered by Mr. Yates, junior, coalmaster, Kilmarnock, in sinking a pit, on the farm of Woodhall, near Kilmaurs. The shells were found in a thin bed of sand, one foot three inches in thickness, which in this new pit underlies fifty feet of boulder clay and upper drift, and overlies the bed in which the remains of the mammoth and reindeer were formerly found. Among the many shells found, the following species had alone been preserved, many having been broken during the process of extraction from the matrix, viz.:- Leda oblonga, Tellina calcerea, Pecten Islandicus, Cyprina Islandica, Astarte sulcata, A compressa, Natica Groenlandica and fragments of a large species of Natica and a Littorina.

Mr. JOHN YOUNG exhibited a collection of upwards of 300 seeds of freshwater plants belonging to five or six species, the more abundant being a species of Potamogeton and a Ranunculus, recently obtained by him from the washing of a small piece of sandy clay, which had lain in the Hunterian Museum since 1829, being part of the matrix in which the tusk of the mammoth and horns of the reindeer found in the old Woodhill quarry, Kilmaurs, were embedded. Mr. Young said he had failed to discover any trace of marine organisms in the clay in question, and he was therefore of opinion that it was an old estuarine deposit, which at one time had partly filled up the Carmel Valley.

A fuller account of the above presentations was given in a paper published in Volume 3 of the society's Transactions (published in 1869). It can be found at https://geologyglasgow.org.uk/wp-content/uploads/2019/04/017_070__young_and_craig_1869_1541792802.pdf.

Meeting held in April, 1869

Professor Sir WILLIAM THOMSON, read a paper on “Geological Dynamics”, in the course of which he replied to the criticisms of his views contained in the anniversary address to the Geological Society of London, by the President, Professor Huxley.

This paper was published in Volume 3 of the society’s Transactions (published in 1899). It can be found at *https://geologyglasgow.org.uk/wp-content/uploads/2019/04/017_070__geological_dynamics_1541792220.pdf*.

Summer excursions, 1869

April 17.—Hurlet. Mr. Hull, F.R.S., Conductor. Train to Nitshill. Sections of carboniferous limestone, with intrusive trap dykes.

May 1.—Crofthead. Mr. Robert Craig, Conductor. Train to Crofthead. Lacustrine deposits and boulder clay.

’’ 15.—Thornton Quarries. Mr. James Thomson, F.G.S., Conductor. Train to Eaglesham Road Station on Kilbride Railway. Section of trappean ash in railway cutting—Sections of carboniferous limestone, trappean ash and boulder clay.

’’ —(Queen’s birth-day).—Bathgate. Dr. John Young, *President*, Conductor. Extensive sections of carboniferous limestone and shale, rich in corals and other fossils.

June 5.—Spout of Ballagan, Campsie Glen, and North Hill. (Joint Excursion with Edinburgh Geological Society). Mr. John Young, Conductor. Spout of Ballagan—natural sections of thin-bedded limestone capped by sandstone and trap. Campsie Glen—Ballagan Beds, overlaid with trappean ashes and trap. North Hill—sections of carboniferous limestone and eruptive traps.

A report of the June 5 excursion to Campsie Glen can be found at *https://geologyglasgow.org.uk/wp-content/uploads/2019/04/017_070__summer_excursions_1869_1541792982.pdf*.

Session 12 (1869-1870)

Extracts from the Proceedings for 1869-1870 (Session 12)

Meeting held on December 2, 1869

Mr. J. WALLACE YOUNG read a paper “On the application of the Microscope to the examination of Rock Structure and Composition.” The author stated that although a mineral or rock might appear to the naked eye quite amorphous, yet when sections were prepared and examined by the aid of the microscope they presented a well-defined crystalline structure. By this method geologists would be enabled to distinguish rocks of igneous from those of sedimentary origin, or, as it sometimes happened, rocks originally sedimentary, which through metamorphism by water or atmospheric changes have had crystals developed in their mass. According to competent observers all volcanic products are crystalline; even lava, taken from a flowing stream and quickly cooled, shows this structure when submitted to the microscope. The geological description of a rock or mineral, therefore, is but half done without a microscopical and chemical examination. In illustration of his paper Mr. Young exhibited sections of basalt, greenstone, claystone, pitchstone, slate, limestone, lava, and various other rocks.

Meeting held on January 13, 1870

Mr. D. CORSE GLEN read a paper on the "Zeolites which occur in the Trap Rocks in the neighbourhood of Glasgow," illustrated by a large collection of these interesting minerals from the author's cabinet, consisting chiefly of *Analcime, Natrolite, Stilbite, Heulandite, Chabasite, Laumonite, Thomsonite, Prehnite,* etc. These minerals are all aluminous hydro-silicates, and their analysis has found them to consist chiefly of silica, alumina, lime, soda, potash, and water. They are found most plentifully in the trap rocks at Bowling, Kilpatrick, Port-Glasgow, Kilmalcolm, Fereneze, and Gleniffer hills. Several of them were first discovered in these districts, and named in honour of local mineralogists; *Thomsonite*, after the late Thomas Thomson, Professor of Chemistry in the University: *Edingtonite*, discovered by the late Thomas Edington, of the Phoenix Iron Works, near Kilpatrick, in 1823, and *Greenockite*, after Lord Greenock, now Earl Cathcart, who first found this rare and beautiful mineral in the Bishopton Tunnel in 1842. (*The Bishopton Tunnel was part of the Glasgow, Paisley and Greenock Railway, an early Scottish railway which opened in 1841.*) Some of the *Analcimes* and *Prehnites* which occur in the trap of Boylestone quarry, near Barrhead, are coloured by the copper which exists in a native state in the same rock, some examples of which were exhibited. Several specimens of the rare and valuable *Greenockite* were shown, which, although only about one-tenth of an inch across, are well formed and typical crystals. It is a sulphuret of the metal *Cadmium*, has a beautiful yellow lustre, and is pyramidal in form. This mineral has not been found anywhere except in the trap at Bishopton, the only known specimens having been obtained during the cutting of the tunnel, and from its great rarity is much prized by mineralogists, £20 having been paid for good crystals. An interesting specimen of *Thomsonite* from Magdala was exhibited, obtained by a soldier during the late Abyssinian war. (*The Abyssinian war, which began in December 1867, ended when the Fortress of Magdala, or Maqdala, was captured by the British in April 1868.*)

Session 13 (1870-1871)

Extracts from the Proceedings for 1870-1871 (Session 13)

Meeting held on December 1, 1870

Mr. D. C. GLEN, C.E., laid before the meeting several slabs of oil shale from near Collingwood, on Lake Huron, Canada; and also some samples of the petroleum distilled from it. The slabs were from the Silurian formation, which is of great extent in North America, and remarkable for the regular succession of its strata. When examined, these blocks of shale were found to be stratified horizontally with layers of Trilobites, Entomostraca, and other marine organisms. It was from the prodigious abundance of these creatures over this track of the ancient sea-bottom that the slabs now referred to had derived their bituminous properties.

The oil shown was distilled from the shale in the usual manner, by heated retorts. The pure, clear spirit is taken from the oil, leaving a thick residuum which is used for tarring outside work, and also for burning in steam-boiler and other furnaces. Another sample of oil on the table was pumped up from a bored well at Bothwell, C.W. *(Canada West, the former name for Ontario)*, where the oil occurs at a depth of from 100 to 500 feet from the surface. When pumped out, it is mixed with three or four times its bulk of salt water. It is then allowed to settle in large tanks, and when the water is drawn off from below, it leaves the oil in very much the same state as that distilled from the shale. In all probability, therefore, this oil is derived from a similar stratum, impregnated with organic animal matter.

Meeting held on February 2, 1871

A collection of phosphates from Charleston, U.S., was exhibited by Mr. Potts and Mr. Naismith, together with some large fossil teeth, vertebrae &c, from the same locality. Mr. Potts stated that large quantities of these phosphates are being used in America, and also imported into this country, for the manufacture of artificial manures. The specimens on the table had been

collected from some cargoes lately brought to the Clyde. The deposit from which they are taken is found along the banks of many of the rivers in South Carolina, and immediately under the surface soil of the land lying between; and is supposed to underlie a large portion of the coast and sea-island region of that part of America. It consists of layers, varying from six inches to several feet in thickness, of irregularly rounded nodules, mixed up with an immense quantity of bones—ribs, vertebrae, tusks—of various species of animals, all more or less petrified. The nodules yield 50 to 60 per cent, of bone phosphate; while from some of the bones as much as 80 to 85 per cent. of this fertilising substance had been obtained. The deposit, which only came into notice a few years ago, has already given rise to an important commerce both in the raw and manufactured article. Numerous companies have been formed in Charleston and its vicinity for phosphate digging and manufacture, and the planters have found the use of the manure, which is about one-third cheaper than guano, exceedingly profitable. The export of the raw material has also assumed considerable proportions ; and altogether this remarkable deposit is contributing in no small degree to the prosperity of South Carolina and the neighbouring States. Immediately below the deposit is a bed of white limestone marl of great thickness, which has been recognised as underlying all the country round. Mr. Potts then read several analyses, which he had obtained of these phosphates, showing the high percentage of fertilising matter which they contained. He also called attention to the large size of some of the teeth and vertebrae exhibited. It was evident the deposit was of comparatively recent age; but the precise geological period to which it belonged, and the nature of the organisms of which it was composed, he would leave to be elucidated by others.

The CHAIRMAN *(Mr. John Young, Vice-President)* said there could be no doubt this remarkable deposit of phosphates belonged to the *Tertiary* period, and probably its earlier division, the *Eocene*. The tertiary formation is largely developed along the southern coast of North America, stretching in a belt of considerable breadth from North Carolina to the Gulf of Mexico, and leaving the coastline only at the delta of the Mississippi. The thick bed of limestone marl, which had been referred to as underlying the deposit, probably belonged to the immediately preceding formation, the *Chalk*, which is found in New Jersey and North Carolina, and crops out at intervals farther south, from beneath the tertiary strata, between the Appalachian Mountains and the sea. The deposits in Britain most closely resembling these Charleston beds are those known as the “Bagshot and Bracklesham beds,” occurring in Surrey and Sussex. They belong to the *middle-Eocene* division of the tertiary, or more recent than the “London clay.” They contain numerous remains of fishes, some resembling the sword fish, teeth of sharks of various species, bones of crocodilian forms allied to the gavial, and some that were considered to belong to an extinct order of huge serpents. The whole series of fossils, like those before them, indicated a much warmer climate than now prevailed in that part of the world, and showed that the waters of the sea were teeming with large and powerful forms of life. Some of the sharks’ teeth found in these Bracklesham beds closely resembled those on the table from the Charleston deposit; but one or two of the latter, measuring about five inches long from root to point, and four inches broad, implied a species of shark of extraordinary magnitude, certainly not less than 60 feet in length. The largest living species, the white shark, sometimes attains a length of over 30 feet. Some interesting questions arose as to these thickly-strewn fossiliferous beds, which are found in all formations, restricted often to one particular “horizon,” but they are due, no doubt, to the circumstance of the creatures whose remains are found in them having frequented certain banks or stretches of coast, as we find is the case with the marine animals of the present day. Mr. Young concluded by conveying the thanks of the meeting to the exhibitors.

Session 14 (1871-1872)

Extracts from the Proceedings for 1871-1872 (Session 14)

Meeting held on January 11, 1872

Mr. THOMAS NAISMITH exhibited a fine collection of Corals, Crinoids, &c., chiefly from the Carboniferous limestones of the West of Scotland, and gave some interesting notes on the nature and affinities of these organisms, and their representatives in the Polypi, Sea-Anemones, Sea-Urchins, and Starfish of the present seas.

Mr. JOHN BURNS submitted a specimen of Fossil Wood from Auchinlee Quarry, being portion of a trunk which was found embedded there, under 60 feet of sandstone. He called attention to the fact of the woody structure being very perfectly preserved in this specimen, and stated that portions of it when burnt emitted a little flame. He had pleasure in intimating that Mr. Yates, the contractor, from whom he had received the specimen, had kindly presented it to the Society's Museum.

The CHAIRMAN [Mr. John Young, Vice-President] said Mr. Naismith's collection was of much interest, as illustrating several extinct groups of Radiated animals which abounded in the seas of the ancient world. The Crinoids, or "stone lilies," which were fixed to the sea bottom by a jointed or flexible stalk, were especially abundant during the Palaeozoic period, but are now represented by only a very few living forms, one of which had recently been discovered in the course of the deep-sea explorations that had been made in the bed of the North Atlantic. With regard to the fossil wood brought under their notice by Mr. Burns, although remains of plants were not uncommon in our Carboniferous strata, yet specimens showing the original woody structure were so rare as to make it desirable that every such one that was found should be preserved for microscopical examination. The one before them would be carefully examined in this way; but meantime he was inclined to regard it as belonging to the Coniferae, which were the only exogenous trees yet discovered in our coal measures. These Coniferae seem to have grown upon more elevated tracts of ground than the Lepidodendra, Sigillariae, &c., found in connection with our coal seams, and to have been carried down by floods, and so embedded in the sandstone strata, where they are now found. Whether they all belonged to the same genera or species, could only be determined by carefully-prepared microscopic sections. He conveyed the thanks of the meeting to the exhibitors and to Mr. Yates.

Meeting held on January 25, 1872

Mr. CHARLES LAPWORTH, of Galashiels, read a paper on "The Silurian Bocks of the South of Scotland." The paper was illustrated by a map and sections, and a copious collection of fossils. At the close, a cordial vote of thanks was awarded to Mr. Lapworth for his kindness in reading the paper to the Society.

The paper (published in Transactions, Vol. 4, 1874, pp. 164-174) deals with the rocks and fossils of the Lower, Middle and Upper Silurian in southern Scotland; the following extract is the outline of Charles Lapworth's introduction to the paper:

The author began by calling attention to the fact that the geological framework of Scotland is essentially composed of rocks of Silurian age, which occupy almost the whole of the northern and southern divisions of the country, and form in the centre a comparatively small synclinal hollow or basin, which is filled up by deposits belonging to the later systems of the Old Red Sandstone and Carboniferous. It thus becomes one of the first problems in Scottish Geology to ascertain the order of succession among these Silurian strata, to endeavour to read the history of its life system, and in general to obtain means for a comparison of the formation with the Silurian of other countries. To this problem the crystalline and metamorphic rocks of the Highlands can never furnish the key, which must therefore be sought among the comparatively unaltered and more fossiliferous deposits of the Southern Uplands. Here, however, we are at once brought face to face with what seem at first to be insurmountable difficulties. There is an almost complete identity of mineral character throughout the whole series; there are great thicknesses of strata from which fossils appear to be wholly absent; and, to crown all, the beds have been thrown into such a multitude of wrinkles and plications, so disturbed and inverted,

that it is impossible to say on physical evidence alone, in a traverse of any distance, whether we are ascending or descending in the order of the strata. With these obstacles in the way of their thorough investigation, it becomes at once evident why so little, comparatively speaking, is known concerning them.

Nevertheless, a certain general arrangement of the strata may be said to be clearly ascertained. The lowest beds appear to form an axial or central mass of rocks, probably composed of strata of Cambrian and Lowest Silurian age, which dip N.W. and S.E. from an axial line running S.W. from Jedburgh to Kirkcudbright. To the north of these succeed a series of carbonaceous shales, of Llandeilo and Lower Caradoc age, which, together with an overlying mass of Upper Caradoc and Llandovery strata, undulate over the whole of the country lying between St. Abb's Head and the Mull of Galloway; while the district stretching from the central Cheviots to Kirkcudbright is composed of Upper Silurian strata, the northern equivalents of which pass up conformably into the Old Red Sandstone, in a few inliers that protrude through the Carboniferous of the Central Basin.

Mr. Lapworth then traced the history of discovery among these rocks, from the time of Dr. Hutton to the date of Professor Geikie's exhaustive paper on the whole subject, read before this Society in 1867. [Published in Transactions, Vol. 3, 1871, pp. 74-95.] Since that paper was published the fossiliferous districts of Girvan and Wanlockhead have been mapped and described by the Geological Survey, the Pentland beds have been more fully investigated, and the rocks of the eastern districts, comprising the Gala Group, Riccarton Beds, Hawick Rocks, &c., have been examined and described by the author and his friend Mr. James Wilson.

Meeting held on March 21, 1872

The Rev. WILLIAM FRASER, LL.D., of Paisley, corresponding member, read a paper on "Some Recently-exposed Sections in the Paisley Clay-beds, and their Relation to the Glacial Period."

Mr. JOHN YOUNG, Vice-President, agreed with the author as to the general succession of the beds described, with the exception of the so-called overlying bed of upper boulder clay. He would suggest that, in the centre or neighbourhood of a town like Paisley, where excavations had been going on for a long time past, it was possible that diggings into the lower boulder clay may have been removed and laid down over more recent deposits; or former excavations into the hillside, flanked by the deposits in question, may have produced a slip of the boulder clay forming the crown of the hill, down over these more recent beds. He had seen an analogous instance during the excavations at Gilmorehill; and it was well known that geologists of eminence had sometimes been misled by surface deposits in the vicinity of towns, and the conclusions based upon these had afterwards been proved to be fallacious. He therefore urged caution in the acceptance of the view that this upper boulder clay had been laid down by ice subsequent to the formation of the shell-bed, which appeared to be of such recent origin. Mr. CRAIG was inclined to hold that the overlying boulder clay had been formed as Dr. Fraser had suggested. Other members having made a few remarks, Dr. Fraser briefly replied, and received a cordial vote of thanks for his paper.

An abstract of Rev. William Fraser's paper appears in Transactions, Vol. 4, 1874, pp. 178-181; it is here quoted in full:

AFTER alluding to the progress which had been made of late years in the study of the glacial deposits, and to several important papers on the subject which had appeared in the Transactions of this Society, Dr. Fraser said he was persuaded that observers in this department were in the way of collecting data which would yet be of the greatest service in discussions as to geological time. He believed that a useful paper in that direction might be given, based on facts that had already been ascertained and classified. At present, however, he avoided these more important general questions, and confined himself to the statement of a few recent observations. The Paisley clays presented the following general order:—(1) Underlying all was the old boulder clay or till, the conditions of which were altogether

unfavourable to life. It represented a cold, bleak, and in part tumultuary period. (2) Immediately above this was a laminated clay, whose texture was in every way distinct from the preceding. It was generally shell-less and stoneless, and in many instances beautifully and delicately laminated, the structure being at times so regular as to resemble the edge of a closed book, and specimens kept for a year or two had shown a texture and taken a polish like jasper. (3) Above the laminated clay, which was also useful in brickmaking, there occurred a thick bed in which shells of arctic and boreal types were found—Tellina proxima, Panopaea Norvegica, Pecten islandicus, Cyprina islandica, and others too numerous to specify. Geologists loved the layer for its shells, while the brickfield proprietors regarded it with an intense dislike. (4) Next in order was the clay chiefly used in brickmaking. In it the glacial shells are not to be found; the last which disappears is the Cyprina islandica. But in these clays, indeed in all above the laminated clay, small and large stones, up to boulders of several tons in weight, were abundant. In some instances they bear longitudinal scratches, but they are deposited so irregularly that their lines lie in every direction; showing that while the origin of the lines or striae may be ascribed to the period and the processes of the boulder clay, the transport and distribution of the materials were probably connected with subsequent movements, and especially with the melting of floating masses of ice. At the close of the formation of this clay series, and on its surface, appeared patches of a well-known shell, Mytilus edulis, the common mussel. (5) Terminating the series was a covering of varying thickness, and composed of various materials. There sometimes appeared near the surface a coarsely-laminated clay, which had occasionally been mistaken by observers for the more finely-laminated clay to be found at the commencement of the series. A long period, however, must have intervened between the two, and he suggested a careful scrutiny as to the phenomena connected with these two distinct clays.

Dr. Fraser then called attention to some facts which had recently come under his notice, showing, as he believed, that long after the period represented as glacial, and after the last of the clays had been deposited as the resting-place of the common mussel, there were, occasionally, in the valley of the Clyde, agencies at work which have since ceased to operate, at least to the same extent, in our now milder climate. It had been generally supposed that the rounded heights or knolls in the Clyde valley, where the rock was not immediately beneath the surface, were composed of boulder clay, and that when the surrounding masses were swept off and the valley was scooped out, the hollows had been left to be gradually filled with the later clays. In at least one instance this theory could be shown to be erroneous. Oakshaw Hill, on which part of Paisley is built, and on the crest of which the Neilson Institution rises with its dome, well known by many of our seaward travellers, was understood to be formed in this way. Its summit is about 106 feet above the sea level, and it stretches in a gradual slope for about 800 yards from west to east. When digging a foundation on the side of this hill or ridge for the Free Library and Museum which Sir Peter Coats had so generously granted to the town, a section was laid bare of what appeared to be the true till or boulder clay; but, very unexpectedly, underneath it was found the brick clay common to the Clyde district, with a bed of Mytilus edulis resting on its surface. The shells were in a perfect state of preservation, and he [Dr.Fraser] had dug into the clay to a depth of 4 or 5 feet, satisfying himself that it was identical with the brick clay now occupying the highest place in the Clyde series. This shell bed was 64 feet above the mean sea level, and the height rising over it was 42 feet of what in ordinary circumstances would have been accepted as genuine till or old boulder clay. The question which immediately suggested itself was, how came this superincumbent mass of clay —boulder clay apparently—to be placed there? It must have been at a comparatively recent time, and by gentle movements, for the mussels that lived there had been undisturbed. He thought it probable that, as the shell bed lay on the verge of a slope which passed into a hollow or valley, on the one side between Oakshaw and Castlehead, and on the other between Oakshaw and Woodside, and which had evidently been occupied by the sea to a considerable depth, masses of ice, carrying portions of the boulder clay, had been stranded on that ridge, and melting, had left what constituted the new height of very much the same material as that which was deposited by the great ice-sheet at an earlier stage of the glacial period. Dr. Fraser then traced a gradual descent in the mussel beds from the height of 64 feet referred to, down to similar beds in Glendaruel, Kyles Of Bute. He had found one such bed under the late steeple

at the Cross of Paisley, at a height of 40 feet above the sea level; another at the head of St. Mirren Street, at 32 feet; another in James' Street, at 23 feet; and another in Causeyside, at a height of only 12 feet; while out in the plain, and nearer the Clyde, he had found a fringe of shells, sea-weed, &c., which marked the tidal limit, subsequent, of course, to the time when the lowest of these beds was formed. Taking these facts into account, and assuming that Professor Geikie was correct in his inference of a certain elevation of the district since its occupation by the Romans, he thought they might be able to estimate approximately the length of time which had elapsed since the mussel beds were formed at a height of 64 feet above the present sea level. He concluded by submitting the opinion that intermediate between the isolated and incidental formation which he had described, and the primary boulder clay, there was evidence of what might be called a secondary boulder clay. He had been confirmed in this opinion by a careful examination of what seemed to be the old or primary boulder clay in Arran, in the valley between Lamlash and Slaodridh [Sliddery]. When searching there for glacial shells, in that section specially described by Dr. Bryce in his excellent work on Arran, he had found two or three specimens of Astarte borealis, and a few fragments of others, in circumstances which rendered it improbable, he might say impossible, that they could have lived there. The texture and appearance of the clay led him to infer that it must have been formed during the glacial period, probably near its termination, but certainly long after the true or primary boulder clay had taken its place. He respectfully submitted these facts, in the hope that light might be thrown by other observers on points which were as yet confessedly difficult and obscure.

Session 15 (1872-1873)

Extracts from the Proceedings for 1872-1873 (Session 15)

Meeting held on January 20, 1873

Professor EDWARD HULL, M.A., F.G.S., Director of the Geological Survey of Ireland, read some notes on "Signs of Earthquakes," and on "Colliers' Strikes." In treating of the first-named subject he referred to various theories that had been propounded regarding the origin of earthquakes, and dwelt at some length on that which had been put forth by Mr. Mallet, to the effect that they resulted from the secular cooling of the globe, and the consequent shrinking of its outer crust. This theory seemed to him the most probable he had yet met with, and accounted for several geological facts, such as the contorted condition of the older strata, &c.

With regard to the second subject, Professor Hull referred to the great inconvenience, dislocation of trade, and loss to the nation which colliers' strikes were occasioning. He looked upon the gradual spread of education, and of some acquaintance with sound political economy, as the chief remedy for such unfortunate occurrences. He took occasion to say there was no reason for apprehension as to the supply of coal in our coal-fields, there being an abundant supply, with ordinary economy, for many centuries to come.

Mr. JOHN YOUNG, V.P., having made a few remarks, referring specially to what Professor Hull had brought forward on the subject of earthquakes, the CHAIRMAN [*Sir William Thomson (later Lord Kelvin) who was President of the society at the time*] examined at some length the statements which, at least till lately, geologists had generally made regarding the Earth having a molten interior throughout, covered by only a thin crust, and set forth the grounds on which he held such conclusions to be unwarranted and erroneous.

The following paragraph is an extract from a newspaper report, headed **Conversazione and Exhibition of Specimens in the Corporation Halls, 6th December, 1872***, which appeared in a supplement to the Proceedings*:

Mrs. Robert Gray, the wife of a well-known local ornithologist, excited great interest by a collection of Silurian fossils, which she had herself made in the Girvan district. It was as large as it was interesting, embracing many rare and new species, some of which have been named in honour of the discoverer by Mr. Thomas Davidson and other eminent Palaeontologists. There were drawers of Trilobites, Brachiopods, and Graptolites, all fine and well-preserved; in short, Mrs. Gray's collection of Girvan Silurian fossils is probably the most complete in the country. It is evidence of great diligence and research, and an excellent example of what a lady collector can do.

Mrs. Robert Gray (1831-1924), now better known as Elizabeth Gray, was a celebrated collector of fossils; she was made an Honorary Member of the Geological Society of Glasgow in 1900.

Session 16 (1873-1874)

Extracts from the Proceedings for 1873-1874 (Session 16)

Meeting held on October 30, 1873

The ELEMENTARY LECTURES were discontinued, owing to a full and excellent course on Geology being delivered by Dr. Robert Brown of Edinburgh to the Mechanics' Institution.

There had been two previous references to the Elementary (or "occasional") Lectures: the minutes of the meeting held on October 19, 1871 record that a series of lectures on Elementary Geology was delivered by some of the office-bearers of the Geological Society of Glasgow at the mid-monthly meetings of the Society, and that the lectures had proved "exceedingly useful and attractive"; furthermore, the minutes of the meeting held on October 31, 1872 record that "a few occasional lectures of a more popular cast than the papers read at the ordinary meetings were delivered during the Session, and received with much favour."

However, although no details were recorded in the Proceedings of either the topics of those lectures, or of the lecturers who delivered them, it is clear from The History of the Geological Society of Glasgow 1858-1908 (ed. MacNair and Mort, 1908, pp. 25-28) that lectures on Geology took place intermittently from as early as 1857 until 1871, the year when the courses given by Dr. Robert Brown began. Dr. Brown's courses then took place in the Mechanics' Institution during the three sessions between 1871 and 1874. Thereafter, John Young, LLD, FGS, Assistant Keeper of the Hunterian Museum, "began his course [in the Mechanics' Institution] in 1874-5, carrying it on successfully till its close in 1881-2." (ibid. p. 28)

Note. In 1881, the Mechanics' Institution, which had been founded in 1823, became the College of Science and Arts, offering a wide range of daytime and evening classes; subsequently, in 1887, the College of Science and Arts merged with several other educational institutions to form the Glasgow and West of Scotland Science and Technology College, which eventually, in 1964, became the University of Strathclyde. Further information about the Mechanics' Institution can be found at https://www.theglasgowstory.com/image/?inum=TGSS00015

Meeting held on November 13, 1873

The CHAIRMAN [Mr. E.A. Wünsch, Vice-President] exhibited some interesting specimens of the junction of granite and slate from the Island of Arran, and made some remarks on the position of the granite in that island, and on the various theories which had been propounded regarding its origin. He agreed with those who held that granite is a metamorphic rather than originally igneous rock; at the same time, he had no doubt it must have been subjected to great heat, probably at a considerable depth, and been in a partly fluid or pasty condition, when it was subsequently brought into contact with the ordinary sedimentary rocks against which it is now found. He described the junctions of the granite and slate in several parts of Arran, pointing out how the granite veins often penetrate the slate to considerable distances, altering the latter more or less along the lines of contact.

Meeting held on March 26, 1874

An interesting series of rocks and fossils from Canada was exhibited, presented to the Society by Alfred R. Selwyn, Esq., F.G.S., Director of the Geological Survey of Canada, and brought to this country by J. Morgan, Esq., of Montreal. The specimens were described by Mr. John Young, V.P., who stated that the collection embraced typical rocks extending from the Laurentian to the Carboniferous formation, and was of much interest, as enabling members to compare the older rocks of the West of Scotland with those of North America. He reminded the members of the order of succession which had been established by Sir Roderick Murchison in the older Paleozoic rocks of Scotland, viz., that the gneissose rocks of Ross-shire, Sutherland-shire, and the Island of Lewis, are the oldest stratified rocks in Britain, above which the Cambrian and Silurian formations, lower and upper, come in succession. This “fundamental gneiss,” as it had been called, seemed to be the equivalent of the “upper Laurentian” rocks of Canada. It had been shewn by the able investigations of the Canadian geologists that these Laurentian rocks in that country constitute a great series, more than 30,000 feet in thickness, and occupying an area of about 200,000 square miles. Also, that they are separated from the Cambrian formation by a great thickness of quartzite rocks, called the “Huronian series.” Their antiquity must therefore be inconceivably great. It was in the lower beds of this most ancient system of rocks that the *Eozoon Canadense*, believed to be a gigantic Foraminifer, the oldest organism yet known to geologists, had been discovered. Specimens of this interesting fossil were included in the collection; also well preserved examples of Brachiopods, Gasteropods, Cephalopods, and other Mollusca, as well as Trilobites and Corals. These were commented on *seriatim* by Mr. Young.

Mr. JAMES THOMSON, V.P., also remarked on some of the fossils, and pointed out the exact correspondence between many of the rock specimens and those which he had collected for years in the Western Highlands, particularly in Lewis and Islay.

Some discussion, in which the President [Sir William Thomson] joined, then took place upon the granites in the collection, as to whether they should be considered altered sedimentary strata or true igneous products. The granite veins in the gneiss were, however, held as giving evidence of complete fusion of the rock matter.

The PRESIDENT expressed the pleasure he felt in being present to receive this friendly gift and token of remembrance from their brethren of the Geological Survey of Canada. He remarked that these provinces, which are so closely connected with this country by ties of kindred and family, seemed also to be specially related to Scotland geologically. He pointed out how much

the study of science might be advanced by such friendly interchanges between those labouring in different parts of the world; and concluded by conveying the cordial thanks of the Society to Mr. Selwyn and the other officers of the survey for their valuable gift, and also to Mr. Morgan for his kindness in conveying it thither.

Meeting held on April 16, 1874

Dr. ROBERT BROWN, F.L.S., F.R.G.S., Ex-President of the Royal Physical Society of Edinburgh, read a paper "On the Noursoak Peninsula and Disco Island, North Greenland." The paper was illustrated by maps and sections, and some interesting specimens of the rocks and fossils referred to.

Dr. Brown's paper on this subject can be found in Transactions, vol. 5, 1877, pp. 55-112. He had been President of the Royal Physical Society of Edinburgh from 1870 to 1873. He was elected an Honorary Member of the Geological Society of Glasgow on January 18, 1883.

Robert Brown (1842-1895) was born in Campster, Caithness. He studied at Edinburgh University, excelling in botany; at the age of 19, he was appointed naturalist on a scientific expedition to several Arctic territories, including Spitzbergen, Greenland and Baffin Bay. Then in 1863, he was appointed seed collector on an expedition to British Columbia on behalf of the British Columbia Botanical Association of Edinburgh; during the following year, he led the Vancouver Island Exploring Expedition, on which the artist was Frederick Whymper, brother of the mountaineer and explorer Edward Whymper, whom Robert Brown joined in an expedition to Greenland in 1867. On his return to Scotland, he gave lectures in both Edinburgh and Glasgow on botany, zoology and geology. He also published extensively, and in 1876 he moved to London, where he continued to write on several aspects of natural science and geography, and where he also worked as a journalist for the Echo and the London Standard, among other publications. He died in London at the age of only fifty three.

In 1875 he had married Kristiana Augusta Maria Eleonora Rudmose from Demnark; they named their home in London "Ferslev", after the area of Frederiksborg where Kristiana came from. They had three children, all of whom studied for their first degree in Aberdeen University. Their eldest, Thomas Rudmose-Brown, became Professor of Romance Languages at Trinity College, Dublin. Their second son, Robert Rudmose-Brown, followed in his father's footsteps to some extent, studying botany and marine biology, and exploring widely in Arctic regions; he eventually became Professor of Geography in Sheffield University. Their daughter, Augusta Rugmose-Brown studied English literature, and started her career on the staff of Stockwell College of Education in London.

Excursion on May 9, 1874

Members of the Society travelled to Giffnock to view the carboniferous sandstone, cement limestone, and shale for which the district is remarkable. Mr. Dewar obligingly acted as conductor. On arriving at Giffnock station the party at once proceeded to the extensive quarries wrought for so many years by the Messrs. Stevenson, who very kindly had retained a number of the hands to give any assistance necessary. The managers, Messrs. Low, it is right to say here, were also in attendance, and in a courteous manner conducted the party through the workings, which, the general reader will note, are underground, and to some extent intricate, from their extent and the darkness which pervades them. The Giffnock quarries are unique in

their way, affording a field of study for the practical geologist. They consist of vast tunnellings underground. The arches, formed in the course of years by the removal of the sandrock, are 40 feet high or more in many places, and the mine resembles in outline the interior of so many cathedrals. The walls, right and left, go straight to the roof; the roofs take a hemispherical form, and, though rough to a degree, send forth an echo. Altogether the workings are very wonderful and full of interest. The mine requires to be lighted up while the men are working. This is done by means of large naphtha lamps, which on this occasion were carried by the men in attendance. This sandstone, extensively used, is well known for its white colour, its lasting quality, and its absence of stratification, from which latter circumstance it has been denominated the "liver rock". It is on that account capable of being cut with freedom in any direction when being taken from its native bed or hewn for building. This sandstone lies on the base of the upper carboniferous limestone series overlying the Possil group of coal and limestone to the north and west of Glasgow. The equivalent to the sandstone on the north of the Clyde is Kenmuir and Bishopbriggs sandstones, which have also been largely wrought for building purposes. The position of this group of sandstones lies upwards of 400 fathoms under the red sandstones of the Bothwell and Blantyre district visited by the Society on its former excursion; and the distance of this sandstone to the underlying Campsie and Hurlet strata will be upwards of 300 fathoms. It therefore occupies a middle position in the carboniferous basin. The thickness of the carboniferous strata in the Glasgow coalfield is nearly 800 fathoms. Mr. Young and Mr. Dewar further explained the position and the characteristic features of this sandstone; after which the party next proceeded to Mr. Dewar's Orchard Cement Works, which are contiguous to it. The limestone wrought here lies over the sandstone, the strata dipping to the south and east. The band of limestone is from 20 to 24 inches thick and of excellent quality, and has been long worked as a cement. Underlying this limestone is a thin seam of coal, from two to three inches thick, which is used for calcining the limestone, which is then ground into a powder before being sent to the market. The shale overlying the limestone contains an interesting group of fossils, many of which are in an excellent state of preservation. The principal fossils which have been found are *Productus costatus, Spirifera lineata, Actinoceras giganteum, Leda attenuata, Orthoceras subcentrale,* with other Univalves and Bivalves, Foraminifera, &c. The members applied themselves to the search for fossils with great energy; and having employed themselves very pleasantly in this way for upwards of an hour, they proceeded to examine an interesting group of flagstones, which is worked in the quarry to the westwards of Giffnock, and which lie under the position of the sandstone first visited. The flagstones are from three to twelve inches in thickness, and are separated at almost regular intervals by a thin layer of dark-blue sandy shale, which causes the beds of sandstone in the face of the quarry to have almost an artificial appearance, from the way the strata are built up layer above layer. On examining the various layers of flagstone, it is found that the upper surface has been penetrated vertically to the depth of from two to three inches by the burrows of Annelids. So numerous are these burrows on the surface of the beds that they produce a horny crust or riddle-like appearance. On some of the flagstones the traces and ejectamenta of other marine worms are left in high relief, presenting an appearance similar to that which is to be found on the sands of our shores at the present time. The burrows are filled up with dark-blue shale. Mr. Dewar and Mr. Young (V.P.) explained the position and nature of the beds, and a hearty vote of thanks was accorded them for the graphic and interesting descriptions given of the various localities.

Session 33 (1890-1891)

Extract from the Proceedings for 1890-1891 (Session 33)

Meeting held on January 16, 1891

Mr. JOSEPH SOMMERVILLE called attention to the death of a distinguished Honorary Associate of the Society, Mr. James Croll, LL.D., and paid a feeling tribute to the memory of the deceased gentleman. The Chairman said the members of the Society owed it as a duty to themselves, and to the memory of the deceased member, to adopt such a motion as that shadowed forth by Mr. Sommerville. Dr. Croll had done much special and original work which was not yet fully recognised and acknowledged as it ought to be by the world of science. Mr. John Young, F.G.S., corroborated the Chairman's remarks and spoke of Dr. Croll's early association with Glasgow, and his first connection with the Society. The Chairman then moved, and Mr. Dugald Bell seconded, a motion that an expression of deep regret at the decease of Dr. Croll should be recorded in the Society's minutes, from which an extract should be forwarded to Mrs. Croll.

Session 34 (1891-1892)

Extracts from the Proceedings for 1891-1892 (Session 34)

Meeting held on January 14, 1892

The HON. SECRETARY said that the Council had agreed that, subject to the approval of the members, a letter of congratulation to Sir William Thomson, President of the Society, on his accession to the peerage [under the title of Baron Kelvin], should be sent, and moved accordingly. The motion was unanimously agreed to.

A motion to devote £8 from the funds towards the purchase of books for the Library was made by Mr. James Thomson, F.G.S. Mr. John Wight, C.A., Hon. Treasurer, seconded, upon the condition that the expenditure should, if possible, be restricted to £5, and, with this alteration, the motion was agreed to.

Meeting held on February 11, 1892

Mr. JOHN MAIN, F.G.S., exhibited, by the oxy-hydrogen lantern, an extensive series of Photographs of the Moon's Surface, showing numerous evidences of Volcanic Action on a large scale, and also other views of corresponding terrestrial appearances. An interesting discussion followed, being taken part in by the Chairman (Mr. Young), Drs. Ross and Sloan, Messrs. Dunlop, Sommerville, and other members.

Meeting held on April 14, 1892

Mr. M. BLAIR exhibited specimens from two large boulders near King's Cross, Arran. He remarked that the erratic blocks in this neighbourhood are very numerous, but are nearly all local, being traceable to Goatfell, 10 miles north, from which they must have crossed two deep valleys and a ridge. The two large blocks referred to are totally different from any Arran rock. From a description given by Professor Judd, in a paper on " The Secondary Rocks of Scotland" in the *Quart. Jour. Geol. Soc,* of certain beds in the Island of Raasay, Mr. Blair thought that the rock might be found there *in situ,* and he had brought up the specimens in the hope that some of the members might be able to identify them. Prof.Judd's description is as follows :—"Conglomerates (formed of rounded or sub-angular fragments of white or purple quartzite, of Torridon sandstone, and of compact or sub-crystalline limestone) alternating with irregular lenticular beds of coarse micaceous sandstone, into which the conglomerates insensibly graduate." The CHAIRMAN said he would endeavour, through the good offices of the schoolmaster in Raasay, to obtain specimens of the rock *in situ,* so that they might be compared with these Arran boulders.

Session 35 (1892-1893)

Extracts from the Proceedings for 1892-1893 (Session 35)

Meeting held on December 8, 1892

The HON. SECRETARY (Mr. Murdoch) read a note "On the Life and Work of the late Mr. David Corse Glen, F.G.S.," since 1866 one of the Society's most active working members. His remarks were supplemented by Mr. John Young, F.G.S., who proposed a vote of condolence with the family of the deceased gentleman. This was seconded by Dr. Forster-Heddle, F.G.S., and unanimously agreed to.

David Corse Glen was a wealthy businessman and a keen amateur geologist who was a leading member of the Geological Society of Glasgow in the second half of the nineteenth century. He played an important role in the description and preservation of the fossil trees in what is now known as Fossil Grove. A brief account of his life and geological activities can be found at https://geologyglasgow.org.uk/docs/017_070__glen_1516656892.pdf and the paper on Fossil Grove of which he was co-author can also be found at https://geologyglasgow.org.uk/docs/017_070__notesonasection_1516659029.pdf.

Mr. DUGALD BELL, F.G.S., read a paper "On the Origin of certain Granite Boulders in the Clyde Valley." The author's remarks were illustrated by Nicol's and Geikie's Geological Maps of Scotland. At its close some discussion was taken part in by members, the speakers generally agreeing with Mr. Bell in the theory he had advanced. Mr. John Young, F.G.S., stated that most of the granite boulders found in the excavations made for the foundations of the New University Buildings at Gilmourhill were of the same type as the boulders described by Mr. Bell. About 25 years ago a Captain Littlejohn had brought some similar specimens from the Arrochar hills, which were now in the Hunterian Museum. Dr. Heddle complimented Mr. Bell upon his paper as being the model of what such a paper should be—calm, logical, and dignified.

This paper was published in volume 10 of society's Transactions (published in 1895). It can be found at https://geologyglasgow.org.uk/docs/017_070__bell_graniteboulders_1517844290.pdf.

Meeting held on April 13, 1893

Before beginning the regular business of the meeting, the CHAIRMAN briefly referred to the honour which had just been paid by the University of Glasgow to the Society's old and worthy member, Mr. John Young, F.G.S., by conferring upon him the degree of Doctor of Laws (LL.D.). Several members also remarked upon the occasion, and the meeting received the announcement with much enthusiasm. Dr. Young briefly responded, expressing his acknowledgments for all the good wishes he had been offered.

An account of John Young's life can be found at https://geologyglasgow.org.uk/docs/017_070__young_1516742098.pdf.

The CHAIRMAN (Mr. Smith) exhibited -(1) A specimen and microscopical section of Amygdaloidal Burnt Coal from Crosshouse. This Burnt Coal is a seam which has lost its volatile matter from being in contact with trap rock. Some parts are beautifully columnar, and where this is the case the amygdaloidal structure has not been developed, no doubt owing to the gases and steam having passed off from the coal along the divisional planes of the columns. Where the columnar structure is very faintly developed, or not at all, the amygdaloidal structure is best seen, and though a good deal dispersed through that part of the seam, still it is best developed in certain bands parallel with the original bedding of the coal. The

amygaloidal cavities run up to an inch in diameter, are very unequal in shape, and have often pointed ends. They are filled with calcite with highly polished surfaces from contact with the original polish of the cavities. After weathering they become brownish from oxidization, but still retain their polish. The coal has also bands and streaks filled with calcite.

(2) A specimen of Aporrhais pespelecani, or Pelican-foot shell, said to have been found at Lugar in a pit 600 feet above sea-level. Mr. Smith said he had possessed this shell for about twelve years, always expecting to get some more information about it. Not having found it himself, nor even having got it from the person who did find it, he had not succeeded in getting any further particulars. It is evidently a fossil, and has been preserved in dark mud. The species has been found in Scotland in four glacial-bed localities, at Gourock, Kilchattan, &c.

(3) A specimen of what might be described as "Nature-polished" Stones, from the Irvine Water, near Shewalton. At a point in the bed of the river at Shewalton a little iron-charged stream enters it, and for some distance downwards the stones in the bed of the river are highly polished. After a time the hydrated oxide is deposited, but the tops of the boulders, which stand well up in the water, still retain the polish, which appears to be a result of chemical action. As the Society visits this locality in the excursion arranged for the 5th of August, the members may have an opportunity of inspecting these polished stones if the water in the river is sufficiently low at the time.

Meeting held on May 11, 1893

Professor M. Forster-Heddle, St. Andrews, read a paper "On the Occurrence of Tachylyte at Loch Screden [*Scridain*], Mull," a new Scottish locality for this rare substance, which the author described as "the black bottle-glass-like selvage occasionally found upon the contact surfaces of basaltic dykes." The paper was illustrated by numerous drawings, made by the author on the blackboard with coloured chalks. An interesting discussion followed, being taken part in by several members.

Session 36 (1893-1894)

Extracts from the Proceedings for 1893-1894 (Session 36)

Meeting held on October 12, 1893

Dr. JOHN YOUNG, F.G.S., exhibited specimens of a White Vein-Quartz, enveloping crystallized calcite of a deep, reddish-brown colour. This is the Haematoconite of Hausman, a variety of red calcite seen in the Italian marble, “rosso antico.” The specimens exhibited were found on the Corrie shore, Arran, during last autumn, by Dr. Thomas Young, of Manchester, and were presented by him to the Hunterian Museum. They formed part of a small boulder, the great contrast in colour between the pure white of the quartz and the red of the calcite giving the rock a striking and handsome appearance. Such colour appears to be rare in Scottish calcite.

Meeting held on November 9, 1893

Sir Archd. Geikie, Bart., [was elected] as President; the CHAIRMAN proposed a hearty vote of thanks to Lord Kelvin, the retiring President, for his long-continued services to the Society, and this was warmly approved of.
Mr. James S. M‘Lennan read a paper entitled “A Ramble up the Maich Water, Ayrshire.” A short discussion followed.

This paper was published in Volume 10 of the society’s Transactions (published in 1895). It can be found here.

Meeting held on January 11, 1894

The HON. SECRETARY (Mr. Murdoch) exhibited, on behalf of Mr. John Smith, specimens of Serpentine from the Boulder-clay near Lendalfoot, Ayrshire, and read some notes by Dr. Forster-Heddle on the occurrence in Ayrshire of this particular variety of the mineral. The find is of considerable interest, as serpentine, with veins of chrysotile, crystals of pseudo-enstatite, and precious serpentine, all of which are contained in Mr. Smith's specimen, has only been known previously to occur in Scotland at Colafirth, in Shetland. Its presence in the Ayrshire Boulder-clay seems to indicate that it may be found at no great distance in situ from the same locality. (*See also March 8 extract*.)

Dr. JOHN YOUNG, F.G.S., exhibited several specimens, as follows :—

1. Pearlstone, which belongs to the pitchstone group of the felspars, has a pearly lustre, and is sometimes found in small spherules, as in spherulite.

2. Uraninite or Protoxide of Uranium, from Perth, Western Australia. This mineral is of much value in the painting of porcelain, as it yields an orange colour in the enamelling fire, and a black colour in the baking furnace.

3. A new species of Sigillaria found by himself, in 1864, during the sinking of a pit to the Possil ironstone at Robroyston, north-east of Glasgow. This species had been recently described by Mr. Robert Kidston, F.G.S., in a paper to the Royal Physical Society of Edinburgh, as being the first British example of the Ribbed Sigillaria which had been found in strata older than the millstone grit series. Mr. Kidston had named it, after its discoverer, *Sigillaria Youngiana*, its provisional name having been *S contracta*, Brongt.

Mr. JOSEPH SOMERVILLE exhibited, with remarks, specimens of Magnesian Limestone, with Oolitic Structure, from Somersetshire — the stone of which St. Paul's Cathedral is built — also specimens of Magnesian or Dolomitic Limestone from Roker, near Sunderland, on the coast of Durham. Dr. Young and other members took part in the subsequent discussion on the structure of these limestones.

Meeting held on March 8, 1894

The HON. SECRETARY (Mr. Murdoch) exhibited specimens as follows :—
1. Serpentine with Chrysotile, from Colafirth, Shetland, the only known locality for the latter mineral in Scotland until specimens of Serpentine containing it were found by Mr. John Smith in the Boulder-clay near Girvan.

2. Steatite from the "Klebber Name Rock," a huge mass of the mineral which stands out cliff-like in the north end of Fethaland, Shetland. The softness of the rock, which allows it to be easily cut with a knife, has induced visitors for many years past to carve their names and initials upon its face, and the present specimen is part of the inside circle of a large O in the name Victoria, which had scaled off and fallen down.

Meeting held on April 12, 1894

The HON. SECRETARY (Mr. Murdoch) showed some fine specimens of Barytes, and part of the root of a Carboniferous Tree (*Stigmaria ficoides*), from the highest part of Eaglesham, Renfrewshire, which had been sent for exhibition by Mr. Allan Gilmour younger of Eaglesham. The latter specimen, which must have been transported by ice to the place where it was found, contained a portion of the large central pith, with the characteristic markings. Its perfectly round form showed that the root must have been fossilized while in a growing position, and without being crushed.

Meeting held on May 10, 1894

Mr. JOHN SMITH, V.P., exhibited a specimen of prismatic Sandstone, from Saltcoats. When the Caledonian Railway was being made, a bed of very fine grained sandstone, rendered prismatic by its proximity to trap, was passed through. Thinking from its appearance that it would make a good whetstone, Mr. Smith took a specimen, but on attempting to work it into shape he found it to be exceedingly hard, taking a polish and glitter like a cut agate.

Meeting held on May 31, 1894

Mr. JAMES NEILSON exhibited specimens of Zeolitic Minerals from the new Lanarkshire and Dumbartonshire Railway, near Bowling, including Prehnite, Analcite, Thomsonite, Lamontite, &c, making some remarks upon their occurrence. He also exhibited (2) a portion of a Glass-pot, shewing radiated prehnite-like structure from excessive firing, and (3) a specimen of Red Stilbite, said to have been got at New Kilpatrick. Mr. Neilson also exhibited a number of Worked Flints, from the Raised Beach at Larne, Co. Antrim, and read some interesting notes on the section there. Photographs of the locality and of the flints were thrown on the screen.

Session 37 (1894-1895)

Extracts from the Proceedings for 1894-1895 (Session 37)

Meeting held on November 5, 1894

From the Report of the Council for 1893-1894. With the spread of photography and the facility it gives for the preparation of slides, the use of the lantern has become so general and so useful for the purpose of illustrating papers and lectures that it is a question whether the time has not now arrived when the Society should, like many others, possess a lantern of its own, so that on any evening the apparatus might be at hand for the exhibition of photographs taken by members.

Mr. JOHN SMITH exhibited a number of specimens, including:

Antimony Ore (Sulphuret of Antimony) from the brow of Hare Hill, New Cumnock. This hill rises to a height of 1950 feet, and the antimony mine is situated 300 or 400 feet below the summit, and at its mouth a large quantity of the ore is still lying. If we are to judge from this material the ore appears to be contained in a quartz vein of particular toughness and of a dirty-white colour. Through the quartz there are long slender prisms and minute particles of ore. In fact the ore appears to have mostly formed in long prisms, which appear as a rule to radiate from a point, and are of a bright silvery colour. The inter-spaces between the prisms are sometimes filled up with more amorphous-looking ore, but sometimes with a honey-coloured quartz. The prisms of sulphuret of antimony have in some cases been dissolved out from amongst the quartz, leaving hollow spaces; and occasionally the antimony only has been dissolved out, leaving the sulphur behind, partially filling the cavities. Antimony is used in medicine, also with lead forming an alloy from which type metal is made.

Further information on the history of antimony and its uses can be found at https://www.rsc.org/periodic-table/element/51/antimony.

Meeting held on December 13, 1894

Mr. JOHN SMITH exhibited a number of specimens, including:

Diatom and Sponge Spicule Deposit from Loch Doon, Ayrshire. About a hundred years ago the Loch was lowered by a mine being driven through the greywacke rock at the head of Glen Ness, and amongst other things exposed was a deposit which contained diatoms and sponge spicules, under a bed of peat. In the upper part of the bed the diatoms appear to have been destroyed by the iron which pervades it, though the sponge remains are abundant. The lower, and light-coloured, portion of the bed is a nearly pure mass of diatoms and spicules in splendid preservation. As it can only be reached when the water is very low the thickness has not been ascertained. When first laid bare a lot of it was used by neighbouring farmers as marl, and the inhabitants also soon found out that it makes a capital polishing material for metal-work.
Fine Gravel from the top of Ardeer blown sand-hills. Some of the quartz pebbles are 1/4-inch long, and flint chips, blown up from the implement-bearing gravelly hollows to the west, are nearly 1/2-inch long. That the action of the wind could raise these small heavy masses to such a height is wonderful. The Permian red sandstones of Mauchline, now so much used as building-stone, contain layers of gravel very similar in appearance to the above, and appear to have been formed from desert-blown sand.

Meeting held on April 11, 1895

Mr. W. H. G. CAMPBELL DICKSON exhibited specimens of Fulgurites, tubes formed by the passage of lightning through sand, from Witsand, Hill District, Griqualand, South Africa, and made some interesting remarks upon them. Mr. Joseph Sommerville said that, though an old member of the Society, he did not remember such forms having ever been shown at any of the meetings, and Dr. Young expressed himself to the same effect. Mr. John Smith said he had frequently examined the Ardeer sand-hills, and other likely localities, after thunderstorms, in the hope of finding similar forms, but as yet without coming across the slightest traces of them.

Session 38 (1895-1896)

Extracts from the Proceedings for 1895-1896 (Session 38)

Meeting held on October 17, 1895

Mr. R. W. DRON, C.E. and M.E., exhibited several specimens of Altered Dolerite, which had taken the place of a coal-seam, from a coalpit in South Ayrshire, where it occurred at a depth of 130 fathoms. Similar intrusions are found in the Lanarkshire coal-field, where the dolerite, from its colour, is known as “White Horse.” Protruding itself from some dyke it runs laterally above or below a coal-seam or other stratified rock, burning it more or less, and sometimes rendering it columnar. In the course of its progress it usually thins out, loses its crystalline appearance, and becomes white and soft, sometimes even assuming almost the character of a pipeclay, in which state the miners’ wives use it for their hearths and doorsteps.

Meeting held on November 14, 1895

Mr. JAMES NEILSON, *V.P.*, exhibited a number of specimens of *Pholas* and *Saxicava*, from Millport and other localities in the Firth of Clyde, with their chambers or burrows excavated in limestone and in volcanic ash, also one bored in calcite in volcanic ash, and as the latter rock had proved too tough for the art of the little mechanic, the result was that the excavation was quite lopsided. The question was afterwards discussed as to the means by which these boring molluscs make their excavations in the rock, whether mechanical or chemical, or a combination of both—and Dr. Young and Mr. John Smith gave their reasons for believing that the action is purely mechanical, the instrument employed being the foot of the animal probably with the help of sand-grains.

Meeting held on January 9, 1896

Mr. BELL spoke of the loss geological science had just sustained in the comparatively early death from typhoid fever of Mr. Hugh Miller, an esteemed member of the staff of the Scottish Geological Survey, and son of the well-known author of "The Old Red Sandstone." In connection with, and outside of, the Survey work, the deceased gentleman had done much good solid geological work which gave promise of leading to still higher performance, a hope now unfortunately blasted.

Meeting held on April 9, 1896

Mr. JOHN YOUNG, LL.D., F.G.S, exhibited a series of Microscopic Slides mounted by a method which he had recently adopted, so as to show without much trouble the minute forms of crystalline structure which characterize the glassy Pitchstone Rocks of Arran, and which afford such beautiful and interesting objects for examination owing to their great and varied resemblance to minute forms of vegetable life. This method consists in crushing small portions of the rock between the jaws of iron pincers, and selecting the thinnest and most transparent fragments, which are afterwards neatly mounted on the usual form of glass slide, within a circle, and covered with Canada balsam, being then left for a time to harden and dry. They are then surrounded by a circle punched out of thin cardboard, which is gummed to the slide and furnished with a thin glass cover to protect the mounted flakes from dust. These fragments, if carefully selected, will appear under the microscope as little pictures of the various crystalline structures—each differing somewhat from the other, owing to the varying angles of fracture of the rock. The process is simpler and easier than the tedious old plan of cutting and grinding sections of the hard glassy rock to a thin transparency. Dr. Young also shewed in illustration of the above a number of drawings of the fern-like forms seen in pitchstone which were made by Mr. Samuel Allport, F.G.S., and published in the *Geological Magazine* for January, 1872.

Dr. Young then exhibited a specimen of Crystalline Quartz filling a Drusy Cavity in trap-rock, found in a quarry near Bridge of Weir, Renfrewshire. The specimen, which measures about 9 inches in length by 3 inches in width across its largest outer angle, has the inner walls of the cavity lined with numerous well-formed crystals of quartz, but its chief interest lies in the peculiar markings which stud the whole of the outer walls of the druse. These markings are imprinted over the surface of the quartz, and are seemingly the counterparts of a crystalline structure which once formed, or coated, the walls of the druse, but now no longer exist. They look very like the impressions which would be made by crystals of calcite, or carbonate of lime, of the hobnail variety. This would imply that after the formation of the cavity its inner walls were coated with a lining of calcite crystals, their place being probably then taken by thermal waters holding silica in solution. From this silica the quartz crystals now seen filling up the inner cavity of the druse would be afterwards developed, except at its wider end, till the silica had also ceased to be deposited within the druse before the filling up was completed. Long afterwards, during the decay and weathering of the traprock, the lime-crystals which had formed on the outer walls of the druse were dissolved away by eroding waters, leaving no traces of their existence beyond their impress on the base of the subsequently-formed quartz layer, which gave the outer walls of the druse a honeycombed appearance, the casts of the quartz standing out in relief with sharp edges between the lime crystals. This interesting specimen had been presented to the Hunterian Museum by Mr. George Barlas, a member of the Society.

Session 39 (1896-1897)

Extracts from the Proceedings for 1896-1897(Session 39)

Meeting held on October 15, 1896

Mr. JOHN R. STEWART exhibited a series of large Photographs of the Fossil Trees at Victoria Park, Whiteinch, which had been taken before the building was erected over them. As some injurious action was observed to be presently at work amongst these notable fossils, the Commissioners of the Burgh of Partick were very anxious to find its cause and a remedy, and had therefore sent an invitation asking the members of the Society to visit the trees, and if possible make a recommendation on the subject. A small committee was accordingly appointed to carry out the suggestion.

Four weeks later, the committee submitted the following report:

FOSSIL TREES AT WHITEINCH.

Report by the Committee appointed to advise as to the Preservation of the Fossil Trees within the Fossil House, Victoria Park, Whiteinch, belonging to the Commissioners of the Burgh of Partick.

Committee—John Young, LL.D., F.G.S., William Armour, C.E., Joseph Sommerville, and John Dansken, F.S.I., F.R.A.S., Vice-President, Convener.

As instructed at the October meeting of the Council of the Geological Society of Glasgow, the members of the Committee visited the Fossil House at Victoria Park, met Commissioners Bowie and Brown, and the Superintendent of the Park, heard them as to the preservation of the Fossil Trees, and, specially, as to the propriety of introducing artificial heat within the building. The Committee examined the Fossils and their surroundings and having fully considered the matter beg to report unanimously — (1) That no artificial heat should be introduced into the Fossil House. (2) That the preservation of the Fossil Trees would be best secured by adopting means to prevent the inflow of rain and underground water into the Fossil House. It is suggested that a trench should be dug on the north and south sides of the house, keeping clear of the foundations, and making it deep enough to prevent the inflow of water to the house, and with sufficient declivity to allow the water to run off immediately to the west. The Committee is of opinion that it would not be needful to cut the trench deeper than the bottom of the lowest bed that enters the house. Should the Burgh Commissioners entertain the above suggestions the Committee would be glad to advise with them as to the most economical method of carrying them out.

(Signed) JOHN DANSKEN, Convener of Committee. 11th November, 1896

There is no further discussion concerning this report recorded in subsequent Proceedings.

Meeting held on October 15, 1896

Captain CROWTHER, sailing-master of the “Windward,” the ship which lately had the privilege of bringing home [to Norway from Cape Flora, Franz Josef Land] the Arctic explorer, Nansen, was introduced to the meeting, and exhibited a number of specimens of rocks and minerals, which he had picked up about lat. 79 N. by long. 48 E. Some of Cone-in-cone, though larger than Scottish examples, were in other respects very similar to them.

More information on Nansen and the Fram expedition of 1893-1896 can be found on the Fram Museum website.

Meeting held on November 12, 1896

Mr. GAVIN M. PRATT, Assistant Hon. Secretary, exhibited, for Captain Crowther, sailing-master of the “Windward,” specimens of Rocks and Fossils from the Arctic regions, collected on her recent voyage. They comprised Silicified Pine-wood, Crystallised Carbonate of Lime, Rock

showing Cone-in-cone structure, from Cape Flora, Septariated Clay-nodule, Felstone Porphyry Boulder, Silicious Pebbles, Lead Ore (Galena) with Silver, from Cape Farewell, Greenland.

Meeting held on March 11, 1897

Mr. JOHN HORNE, F.R.S.E., F.G.S., of H.M. Geological Survey, and President of the Edinburgh Geological Society, read a paper on "Graptolites as Indices of Stratigraphical Horizons." At the outset, after briefly reviewing the recent researches of Lapworth, Ruedemann, Nicholson, and Marr, on the morphological development of graptolites, the author proceeded to indicate the distribution of the group in time. He referred to the physical and palaeontological evidence in the Silurian basin of Bohemia which led to the well-known doctrine of colonies advocated by Barrande, and showed how this theory failed to explain the anomalies — palaeontological and physical — of the Silurian uplands of the South of Scotland. The researches of Prof. Lapworth, based on the vertical distribution of the graptolites, had placed the order of succession of these strata on an impregnable basis. The subsequent discovery by the officers of the Geological Survey of a zone of cherts, charged with Radiolaria, and analogous to the Radiolarian ooze of existing seas, had likewise proved of great service in unravelling the complicated structure of the Southern Uplands. These cherts, which underlie graptolite shales of Upper Llandeilo age, rest upon a series of Arenig volcanic rocks. It has now been conclusively proved by Professor Lapworth's prolonged investigations that certain species of graptolites are restricted to certain definite horizons, and this has enabled geologists to correlate, more successfully than hitherto, the Silurian rocks of Great Britain with those of other regions. The lecturer paid a high compliment to the work of a member of the Society, the late Mr. James Dairon, amongst the Scottish graptolites, and expressed the hope that other members might continue the examination of the graptolite zones of the Southern Scottish Uplands.

The paper was illustrated by a large series of maps and diagrams, and by drawings and sections thrown on a screen by the oxyhydrogen lantern. At its close remarks were made by Dr. John Young, F.G.S., Mr. James Thomson, F.G.S., and the Chairman (Mr. Neilson), and a hearty vote of thanks was awarded to Mr Horne for his kindness in coming from Edinburgh to address the Society.

Meeting held on April 8, 1897

The HON. SECRETARY (Mr. Murdoch) referred to the recent death of Mr. William Kirkland, the first secretary of the Society, from the effects of an accident which he met with in Argyll Street. He was one of the four young men, members of a Literary Society connected with Free St. Peter's Church, who met on 10th May, 1858, and drew up an advertisement calling a meeting of those willing to join a society for the study of geology. A subsequent meeting held on 17th May resulted in the formation of this — the Geological Society of Glasgow. Mr. Kirkland did much arduous work in the launching and carrying on of the new venture. Though soon retiring from the secretaryship he, up to the last, took a warm interest in its welfare.

Mr. JAMES THOMSON, F.G.S., made some remarks upon his remembrances of the deceased gentleman, and proposed a motion of regret at his untimely death. He also proposed that an extract from the minutes should be sent to Mr. Kirkland's nearest relatives, and this being seconded by Dr. John Young, F.G.S., was unanimously agreed to.

Meeting held on May 27, 1897

Mr. JOHN SMITH read a paper on "The Exploration of a Rock-shelter and Shell-mound on the Carrick shore of Ayrshire." This natural sea-cave in the red sandstone has a level of 10 to 12 feet above storm-tides. It has a peculiar set of "seats" or benches on its floor, which have been hewn from the solid rock, having all their front faces segments of circles. The makers of these curious "seats" do not appear to be represented by any other traces of their occupation of the cave, but the subsequent inhabitants—the race which accumulated the shell-mounds

found at intervals all round our coasts—had made use of it for a long period of time, as may be seen from the debris which entirely covers the floor and "seats," in places to a considerable depth. Excavations yielded numerous bones of animals, including those of the ox, pig, sheep, rabbit, and various fishes, and shells of many edible molluscs. There were also fragments of hand-made and wheel-turned pottery. Except several broad-headed iron nails, and a fragment of sheet copper there was no metal, and there were no implements or articles of human use except a piece of pottery, the edges of which showed signs of its use as a "scraper," and a fragment of dogfish bone, apparently used as an awl. After discovering the stone "seats" Mr. Smith communicated with the late Mr. Cochrane Patrick, who said that in all his experience he had never met with a similar example. This feature of the Carrick cave may therefore be pronounced unique in Scottish archaeology. The paper was illustrated by some fine photographs taken by Mr. Robert Dunlop, and by the author's own drawings.

Session 40 (1897-1898)

Extract from the Proceedings for 1897-1898 (Session 40)

Meeting held on January 27, 1898

Mr. GOODCHILD, F.G.S., Curator of the Geological Survey Collections of Rocks and Minerals in the Museum of Science and Art, Edinburgh, delivered a lecture on "Geological Time." The paper was illustrated by a large series of slides shown by the oxyhydrogen lantern.

The lecturer dealt with some of the evidences which lead the geologist to consider that vast, if still indefinite, periods of time are implied in the development of events in the Earth's past history with which it was his special province to deal. He was emphatic in his statement that a period nothing short of several hundred millions of years was required to account for the changes which have taken place on the Earth since the commencement of the Cambrian period, and that the close of what has been termed the astronomical history of the Earth was remote from that time by a period perhaps equally vast.

One of the several illustrations in support of this view related to the rate of decomposition of rocks of eruptive origin, such as granite and dolerite. Under humid conditions these rocks wasted by the decomposition of the silicates of which they chiefly consisted, and this was effected by the action almost wholly of surface waters charged with carbonic acid. Hornblende, augite, and allied minerals absorbed in the process of this decomposition about one-third of their weight of carbonic acid, so that three tons of any one of them, which represented the weight of a cube slightly more than a yard on each side absorbed about one ton of carbonic acid from the atmosphere. As the whole atmosphere over each square yard of the Earth's surface only contained about ten pounds weight of carbonic acid, and as the supply of this gas was never very high, it was obvious that the rate of decomposition could only keep pace with the supply of this essential agent, and therefore could never proceed at more than a very slow rate. Indeed, if it were not for the fact that carbonic acid was being returned to the atmosphere mainly through the action of volcanoes (at the bases of which the carbonates were undergoing conversion into silicates, with the consequent liberation of carbonic acid) the decay of the eruptive rocks would soon come to a standstill. Mr. Goodchild's other illustrations related to the rate at which marine limestones were being formed (one foot in 25,000 years) and to the rate of general denudation, the latter being considered at some length in connection with the subject of unconformities.

Session 41 (1898-1899)

Extract from the Proceedings for 1898-1899 (Session 41)

Meeting held on October 13, 1898

Mr. J. B. MURDOCH, Hon. Secretary, exhibited specimens of Minerals from Gloucestershire, obtained at several of the excursions of the British Association during the recent meeting at Bristol.

1. Crystallised Calcite taken from strong veins passing through the Lower Carboniferous Limestones, worked for industrial purposes near Wickwar, about 18 miles N. of Bristol.
2. Gypsum from beds exposed in a fine section on the shore of the Severn, known as Aust Cliff, and a few miles N. of the great railway tunnel into Wales. These beds belong to the Keuper Marls of the Triassic rocks. Associated with them vertical strings and veins of gypsum also cross and ramify, evidently filling old cracks in the surrounding rocks.
3. Celestite (or Celestine of the older authors) from a curious surface deposit of the mineral near Totworth, and not far from Wickwar. Such deposits are characteristic of the Keuper Marls of the Bristol district which fringe the rim of the coalfield. The Celestite occurs in large nodular masses, and very irregular beds, which vary from 3 feet to 15 or even 18 feet in thickness, and is got just under the surface clay of a few feet in depth, the probe being used to find them. When located they are bared and worked opencast.

The exact conditions of the generally coarsely crystalline form of this mineral are not well understood, but it is believed that the Celestite was probably precipitated in an amorphous form, and that it afterwards aggregated in more or less crystalline masses. Chemically known as sulphate of strontium, it is used industrially in the beetroot sugar refineries in Germany and elsewhere. It combines chemically with the sugar and effects complete discolouration, after which it is supposed to be separated out; but the question remains whether the Celestite is all extracted, or whether some portion of it does not remain in combination and find its way to the teacup with what is known to us now-a-days as “pure cane sugar.”

Meeting held on November 10, 1898

Mr. JOHN SMITH exhibited specimens of Ancient Lead Slag from the moor between Leadhills and Crawfordjohn, Lanarkshire. This Slag, dark or yellowish in colour, is found on a patch entirely bare of vegetation, and from the large proportion of the mineral it still contains, evidently the site of a very ancient smelting. In parts it shows strongly iridescent colour on the surface. Charcoal frequently found shows that wood was used for reduction, though no trees now grow anywhere near. The date of these old works is merely conjectural.

Meeting held on January 12, 1899

Mr. JOHN SMITH exhibited specimens of the Shale from which Gas was first made by William Murdock. He is said to have conducted his early experiments at Bell’s Mill, near Lugar, the material used, and now exhibited, being a black and extremely tough bituminous shale, giving much ash. It occurs in connection with a band of stratified fossiliferous clay-ironstone, and is still used by the people of the district as fuel. There are two qualities, the best having been probably that used by Murdock, though to outward appearance there is very little difference.

Mr. John Smith (1845-1930) was a very active member of the Society; a comment in the History of the Geological Society of Glasgow, 1858-1908 states that “No worker in geology during the last forty years has done more for the science than Mr. John Smith.” (ed. MacNair and Mort, 1908, p.78). A link to an account of his life, written by Dr. Murray Macgregor, can be found in the entry for Session 10 (Meeting held on February 6, 1868) in the ***extracts from the Proceedings for previous anniversary years*** *at https://geologyglasgow.org.uk/wp-content/uploads/2019/04/gsg-proceedings-extracts.pdf.*

Meeting held on May 25, 1899

A paper entitled “Lord Dundonald, Ninth Earl, the Discoverer of Coal-gas as an Illuminant,” by Mr. Robert Craig, of Beith, was, from the author’s absence through illness, read by the HON. SECRETARY (Mr. Murdoch).

The following is an abstract of Mr. Robert Craig’s paper (Transactions, vol. 11, 1900, pp.290-291):

LORD DUNDONALD, 9TH EARL, THE DISCOVERER OF COAL-GAS AS AN ILLUMINANT. By ROBERT CRAIG, Honorary Member.

When Mr. John Smith exhibited, in January last, “specimens of the substance from which William Murdock first made gas,” my intention was to have attended the meeting, and to have pointed out that he (Murdock) was not the discoverer of coal-gas but that Lord Dundonald was. Being, however, prevented from coming that evening through illness, I now send this note on the subject.

I have no wish or intention of detracting from the merits of William Murdock, who if not a man of genius was at least a man of talent, and one who knew how to use both his head and his hands. Of late years it has become the fashion to put him forward as the discoverer of coal-gas, and also as the assistant of James Watt in perfecting the steam-engine, but these are both pure fictions.

The real discoverer of coal-gas as a product from coal, and its first application as a powerful illuminant, was Lord Archibald Cochrane, 9th Earl of Dundonald [1748-1831], a man of transcendent genius. First joining the navy, he then went into the army, but not finding either profession to his mind he settled down to devote his life to science, principally chemistry, at a place, I believe, called Annsfield, near Glasgow.

Amongst his other discoveries was the production of gas-tar – as it is now called – from coal. When working at this at Culross Abbey, in Fife, he observed an easily ignited blue vapour being given off, and fixing an old gun barrel to one of his condensers he lighted the escaping gas at the outer end. This was the first introduction of gas as a curious lighting experiment, but he does not seem to have tried to bring it into practical use, as he was intently pushing his newly discovered coal-tar as a preservative of the bottoms of wooden ships, at that period usually destroyed in about three years by a marine boring worm. To prevent its ravages the timbers were thickly studded with flat-headed nails, but this was done only in the case of the larger ships.

To manufacture the tar he took out a patent and started works at Muirkirk, Ayrshire, where he lighted a shed with gas conveyed through an old gun barrel from a condenser, as he had previously done at Culross. Unfortunately, this work was not long in operation, when someone invented copper sheathing for covering ships’ bottoms, and this quite superseded Lord Dundonald’s patent tar.

Mugdock, who had been employed in the erection of the tar works at Muirkirk, or in some other capacity about them, saw the use the gas was put to, and when he afterwards got into the Soho Works at Birmingham, under Boulton and Watt, he put his previously acquired knowledge to practical account, by first lighting the place he worked in with gas which he made, and then, with the assistance of Boulton and Watt, he erected the first gaswork, from which the whole of the Soho Works were lighted, and which was very much on the lines of those of today.

Lord Dundonald was using gas as an illuminant as early as 1782, at Culross Abbey, and on his way to London about that time he called on Watt, and explained his gas discovery. One writer says that perhaps Murdock may have afterwards got his knowledge of gas from Watt, but I believe that, as already stated, Murdock learnt the use of gas for himself at the Muirkirk tarworks.

In any case, as the inventor of the gaswork, who brought gas into practical use as an illuminant, Murdock's fame is sure, though probably Watt's knowledge as a chemist must have assisted him – for instance, in the purification of gas by passing it through lime and water. Lord Dundonald, the 9th Earl, the real discoverer of coal-gas, was a chemist of profound knowledge, though not a man of business tact, and hence he failed to benefit himself and his family by many of his inventions and discoveries which were far in advanxce of his time. This is perhaps not the place, nor the opportunity, to say more than that I believe his discoveries deserve an exhaustive paper beyond those of any neglected genius whom I at present remember.

Mr. John Smith was not present at the meeting at which Mr. Robert Craig's paper was read by Mr Murdoch, and, as there is no further record on the subject in the Proceedings, it is not known whether Mr. John Smith responded to Mr. Robert Craig's paper.

By 1899, Robert Craig was elderly and infirm, so it is understandable that he was seldom able to travel from his home in Beith to Glasgow to attend meetings of the Society. He had been born in Langside Farm, near Beith, about 1822, but as there are no OPR records in existence for that area at around that time, the exact date of his birth is not known. A Biographical Notice (which includes a photograph) of Robert Craig, "the famous quarrymaster-geologist of Beith", is published in the History of the Geological Society of Glasgow, 1858-1908 (ed. MacNair and Mort, 1908, pp. 208-210); it includes the following information: "He went to learn the business of quarrymaster at an early age, and turned his attention to the quarrying and burning of limestone on the lands of Broadstone and Langside, carrying on this trade for over forty years. Mr. Craig joined the Geological Society of Glasgow in 1867, and contributed a number of papers, several [around twenty] of which are printed in the Transactions. [. . .] As well as giving attention to the Carboniferous rocks of his district, he devoted some of his spare time to glacial geology, and has given us some interesting information concerning the great ice age. [. . .] During Mr. Craig's active working years as a quarrymaster, no place was more frequently visited by members of the Society than Beith. There was a double attraction, Mr. Craig's own personality, and the large store of duplicate fossils to which visitors were always welcome to help themselves, so that members visiting Beith brought back two loads, one of added knowledge and another of highly prized specimens."

Robert Craig was elected an Honorary Member of the Geological Society of Glasgow on December 10, 1896. He died on January 14, 1901, at around eighty years of age.

Session 58 (1915-1916)

During 1916, two papers were presented on the controversial topic of The Auld Wives' Lifts, a sandstone feature situated north of Glasgow; an excursion to the site also took place. The archive shows that the debate about The Auld Wives' Lifts continued within the society beyond 1916.

Extracts from the Proceedings for 1915-1916 (Session 58)

Meeting held on May 11, 1916

Mr. MACNAIR exhibited a series of specimens got from the ancient bed of the Clyde in the course of digging the foundations of the new Dalmarnock Power Station. The specimens consisted of hazel nuts, twigs, and timber, and the epidermis of pearl mussels. The pearl mussels had lost all trace of the calcareous shell, through the action of percolating water, and only the chitinous epidermis remained, resembling dead leaves in brittleness and form. Mr. Macnair pointed out that the occurrence of such relics had been recorded about half a century

ago in proximity to the present course of the Clyde, and there could be no doubt that they came from the same bed, which also contained human relics in the shape of dug out canoes.

Professor J. W. GREGORY then read a paper on " The Auld Wives' Lifts: a Pseudo-Megalithic Tor."[1] He described the position of the well-known stones and referred to the traditional explanation of their origin, which ascribes them to a trial of strength between three witches of the district. For long the stones had been regarded as an example of a cromlech erected by the race which has dotted the country with megalithic structures. Careful examination, however, had shown that the group is purely the result of natural processes of denudation isolating a portion of the gritty sandstone of the district which had been dismembered, and the fragments thrown into their present attitude by slipping along joints and bedding-planes. It was shown that this could be proved by the fact of the existence, on the lines of fracture, of prominences corresponding with hollows on the opposite block.

Mr. LUDOVIC M'L. MANN pointed out that although the erection of the blocks could not be ascribed to man and the structure differed in some respects from the typical cromlech, there could be no doubt that it had been adopted by the early inhabitants of the district. He believed that the upper surface of the capstone had been levelled by the prehistoric process of "knapping," and had then been sculptured, the traces being quite evident to the trained eye. Other evidence also showed that the district had been one of special interest to the early inhabitants, and was now of importance to the archaeologist.

1. Scot. Geog. Mag., vol. xxxii., pp. 279-82,1916. (*This paper can be seen at https://geologyglasgow.org.uk/wp-content/uploads/2021/04/auld-wives-lifts-1916.pdf*.)

The second paper on the The Auld Wives' Lifts was presented at the December 1916 meeting of the society (during Session 59) by James Neilson, a council member. This paper was discussed at the February 1917 meeting and, as late as 1920, James Stark (another council member) published a paper which took the discussion further. Both of these papers were published in "Transactions of the Geological Society of Glasgow".

Excursions in 1916

To the Geological Department of the University and the Hunterian Museum on Saturday, 18th March. The party was conducted through the Museum by Professor J. W. Gregory and Mr. W. R. Smellie, and numerous interesting specimens, including the type-specimen of *Apractocleidus teretipes*, were exhibited. The Laboratory of the Geological Department was also visited, and the methods of slide-making and the uses of various instruments such as the Goniometer, the Sclerometer, the Westphal Balance and so forth were demonstrated.

To Dalry, on Saturday, 15th April—Mr. G. V. Wilson, conductor. The volcanic neck near Holmbyre was examined. The material of the neck is a dark grey ash containing abundant crystals of biotite, fragments of various types of basalts and specimens of *Euphemus* and brachiopods such as *Productus*. The sections of the Upper and Lower Limestones on the Caaf Water were also visited.

To the Kames of Carstairs, on Monday, 24th April (Spring Holiday)— Professor J. W. Gregory, conductor. The party proceeded from Cleghorn to Stonebyres, where the pre-glacial valley of the Mouse Water was indicated, and then walked along the Kames to Carstairs. Sections, showing fluvio-glacial gravel and sand, were examined and the super position of the Kames on the boulder clay was pointed out.

To Bridge of Weir, on Saturday, 13th May — Mr. H. R. J. Conacher, conductor. The general structure of the district was explained by the leader, and then a visit was paid to a glacial pit north-east of the station, where Mr. Ludovic Mann discussed the probable origin of the gravels and their points of archaeological interest. The sections of volcanic rocks of Calciferous

Sandstone age and the sediments of the Lower Limestone series, exposed in the Gryfe as far down as Crosslee, were afterwards examined and their leading features indicated.

To Dunfermline, on 23rd May (King's Birthday) — Messrs. R. Dunlop and P. Macnair, conductors. The party proceeded from Dunfermline Station to Woodmill for the purpose of examining the outcrop of highly fossiliferous shales which have been described by Mr. Dunlop (*Transactions*, vol. xv., p. 167, 1915). The party then visited the fine section in the Lower Limestone series exposed at Charleston and Mr. Macnair explained his correlation of the different strata with the Hurlet sequence in the West of Scotland.

To Gourock, on Saturday, 3rd June — Messrs. P. A. Leitch and J. L. Begg, conductors. Craigmushet Quarry was first visited and the keratophyric rocks noted, a number of minerals, including fluorspar, barytes, quartz, and tourmaline, being collected from the geodes. The section westwards along the shore, comprising Calciferous Sandstone sediments and Old Red Sandstone conglomerate, was then examined. Two volcanic necks near the Cloch were pointed out and also a fresh basalt of the Markle type in the quarry north of Lunderston Bay.

To the White Loch, on Saturday, 27th June — Dr. A. Scott, conductor. The dependence of the topography of the district on the underlying rocks was first indicated and then the party traversed the sequence of Calciferous Sandstone lavas from Patterton to the White Loch. The volcanic rocks seen included basalts of various types as well as more acid mugearitic and trachytic rocks. The basaltic plug of Duncarnock was examined and also the series of lavas south-east of Neilston.

To the Auld Wives' Lifts, on Saturday, 14th October — Professor J. W. Gregory, conductor. The party proceeded from Milngavie to the Auld Wives' Lifts, where Professor Gregory pointed out the evidence in favour of the view that the "tor" had been formed by the weathering, *in situ,* of a block of the local sandstone.

Session 59 (1916-1917)

Extracts from the Proceedings for 1916-1917 (Session 59)

Meeting held on February 1, 1917

For the background to the following extract, see the entry for Session 58.

The discussion of Mr. J . Neilson's paper on “The Auld Wives' Lifts “ was continued. Prof. J. W. GREGORY pointed out that the structure shows a much greater resemblance to a tor than to a cromlech. He admitted the glacial moulding of the surrounding surface, but held that the amphitheatre was pre-glacial, as the direction of its drainage was across that of the ice. Mr. J. RENWICK maintained that the "Lifts " could not be classed as a dolmen, as the latter were erected for use as burial places and had much larger chambers. Similarly it could not be likened to a menhir, as the top stone could not be raised in the way the latter are supposed to have been erected. While the legends and superstitions show that the trilith had been used for religious purposes, it probably originated through the action of frost in the joint planes of the local sandstone. The absence of other blocks in the immediate neighbourhood is probably due to their use in building dykes, as there is good reason to believe that a very large block near the "Lifts" was broken up for this purpose a number of years ago.

Mr. NEILSON agreed that the hollow was natural, but objected to a pre-glacial origin for it, as a tor would certainly have been swept away completely during glacial times. The stones themselves are not glacial, and were erected by human agencies. With regard to Mr. Macnair's suggestion that the problem of its origin might be settled by excavations, in order to determine whether the rock surface on which the trilith rests was glaciated or not, he did not

think that this was necessary, as it seemed a fair inference that the glaciated nature of the surrounding rock surfaces extended to that underlying the "Lifts."

Meeting held on April 12, 1917

Mr. G. V . WILSON read a paper entitled, " Notes on the Geology of Mull." A brief description of the structure of the island was given, and the distribution of the Pre-Kainozoic rocks pointed out. In Kainozoic times a great sequence of lava flows was poured out; in the north and west areas these are fresh olivine basalts, but in the south-east, within a circle passing through Salen, Craigmure, and Lochbuie, the basalts are much altered and baked. Within a smaller circle round the head of Glenmore lavas of the pillowform variety are also found. These are thought to have been deposited in the caldera of an old volcano. A few interbedded sediments occur sporadically through the whole lava series, and these include the famous plant-bed of Ardtun. This great series of lava flows has been folded into a set of anticlines and synclines in south and central Mull, but in the west it is flat, and gives rise to a terraced country. Large masses of gabbro and granophyre have also been intruded at various periods, some being probably connected with the folding, and others being definitely later. In central Mull large patches of volcanic breccia occur in the crater of the old volcano. Besides the large intrusive masses, central Mull is riddled with "inclined sheets," having a concentric arrangement, and dipping inwards at an angle of about 5 0 degrees. Two sets occur with slightly different foci, and the later can be seen cutting through the earlier. Another kind of concentric intrusion, "ring-dykes," is also found; these consist of vertical, circular dykes of gabbro and granophyre, which in some cases occur along fault-lines, good examples being seen near the head of Glenmore. In addition to the intrusions already mentioned, the whole area is cut by a great series of N.-W. and S.-E. basalt dykes, which may be regarded as the last phase of volcanic activity in the island. The paper was illustrated by a large number of lantern slides.

Session 60 (1917-1918)

Extracts from the Proceedings for 1917-1918 (Session 60)

Meeting held on January 10, 1918

Dr. R. KIDSTON, F.R.S., delivered the presidential address on "An Old Red Sandstone Plant: its Structure and Mode of Occurrence." (*A biography of Dr Kidston can be found at https://geologyglasgow.org.uk/docs/017_070__kidston_1479832419.pdf.)*

Dr. KIDSTON first referred to the discovery of the chert bed, containing plant remains at Muir of Rhynie, by Dr. W. Mackie of Elgin. So far, two vascular plants have been found in the deposit. These are Rhynia Gwynne-Vaughani and Asteroxylon Mackiei, but only the former has been examined in detail. The chert zone was originally formed of a series of peat beds, which, through periodic inundation, have been intercalated with thin layers of sand. In some cases, the plants can be seen growing vertically from the ancient land surface. In many places the silicified peat is made up almost entirely of the stems and rhizomes of Rhynia.

The plant, which is found with its structure excellently preserved, formed a pure growth with erect cylindrical stem, 8 inches high and 1 to 6 mm. in diameter. It had neither leaves nor roots, but was attached to the peaty soil by numerous rhizoids branching from rhizomes which occasionally become aerial. The stem was dichotomously branched, and bore small hemispherical projections. In both the rhizomes and stems the epidermis, outer cortex, inner cortex and stele can be distinguished. The narrow outer cortex in the aerial stems had the character of a hypoderma, while numerous intercellular spaces in the inner cortex occurred, apparently in relation to the stomata. The stele was cylindrical and composed of a solid mass of tracheides, the protoxylem and metaxylem being indistinguishable. The phloem of thin

walled, elongated cells surrounded the xylem. The sporangium, which was large and cylindrical, contained numerous spores, all of one kind.

This is the most ancient land plant whose structure is at all fully known. With regard to its position in the vegetable kingdom it is allied to Psilophyton princeps, the two making up the only known genera of the class Psilophytales, which belongs to the Pteridophyta, and which is characterised by the sporangia being borne at the end of certain branches of the stem without any apparent relation to leaves.

Meeting held on February 14, 1918

Mr. H. R. J. CONACHER read a paper, entitled “Notes on the Micrology of Coal.”

At the outset it was stated this work was incomplete, but as it was unlikely to be resumed for some considerable time, the results were brought together in the hope that they may be of some use to others.

Micro examination, which nearly a century ago had provided the first internal evidence as to the vegetable origin of coal, has been much neglected during the last twenty years, probably owing to the difficulties in producing satisfactory sections of coal.

The earliest plant structures to be recognised in coal were spores, shown by Bennie and Kidston, to be those of vascular cryptogams, and these often occur as closely packed masses of mega and microspores. Tasmanite is made up of the spores of an unknown plant, mixed with sand.

The two types of material in bright coal are—(a) jet-like layers with conchoidal fracture, and showing in thin section vegetable cell structure, and (b) dull cannel-like portions, enveloping the former and consisting of minute debris of spore coats, plant tissue, &c. Charcoal, often with an altered cell structure, occurs along with the above types. In the cannels are varying degrees of elimination of all recognisable plant tissues, while there is evidence of open water in the presence of fish scales and teeth, and even marine shells. Allied to the cannels are the Boghead coals or torbanites, and the "rhums" of Fife, and the hornie shales of Lanarkshire and Ayrshire. The formation of coal seems to be the result of the operation of numerous variable factors—the nature of the vegetation, conditions of accumulation, and the biological and geological processes which act on the vegetable deposits.

Meeting held on March 14, 1918

Mr. STARK read a paper, entitled "Geological Notes on Burma." The geology of Burma is especially interesting on account of the light it throws on the origin of the Scottish Old Red Sandstone. The basin of the Irrawady lies in soft new rocks, which are so rapidly eroded by the river that during the rainy season 340 million tons of yellow clay is removed and spread out in a thickness of 0.1" per annum round the river mouth. Twenty-five miles from the shore the depth is not twenty fathoms, so that we have here a great submarine plain of deposition. In this delta, which is about half the area of Scotland, numerous changes in the river channels, accompanied by the formation of banks and islands, occur in the rainy season.

Most of the rivers flow in synclives in Miocene and Pliocene rocks, the latter being 4000 feet thick, and containing vertebrate fossils similar to those of the Siwalik hills. Much silicified wood occurs, but marine organisms are absent. During the rainy season large temporary lakes form with the deposition of coarse boulder beds, twenty miles wide and 200 miles long, and closely resembling the Old Red Sandstone conglomerates.

The Burmese oil wells were also described, and it was pointed out that the oil is found in the anticlives, and water in the synclives. Numerous interesting lantern slides were shown.

Mr. C. R. COWIE contributed some additional facts relating to the oil wells and the underground water.

Session 61 (1918-1919)

Extracts from the Proceedings for 1918-1919 (Session 61)

Meeting held on December 12, 1918

Mr. JAMES STARK read a paper on "The Glacial Origin of the Auld Wives' Lifts," and a short paper on "The Whangie."

This paper was published in Volume 16 of the society's Transactions (published in 1920). It can be found at https://geologyglasgow.org.uk/wp-content/uploads/2021/04/auld-wives-lifts-1920.pdf.

Messrs. Dron, Macnair, Neilson and Tyrrell took part in the discussion, and Mr. Stark was warmly thanked for his interesting paper.

For information about previous papers and discussions on the subject of The Auld Wives' Lifts, and also about an excursion to the site, see the extracts from the Proceedings for Session 58 (1915-1916) and Session 59 (1916-1917) at https://geologyglasgow.org.uk/wp-content/uploads/2019/04/gsg-proceedings-extracts.pdf.

Meeting held on February 13, 1919

Mr. G. W. TYRRELL delivered a lecture, entitled "Modern Views on Volcanoes."

The older idea of volcanic activity was that steam escaping from magmatic solution was the chief agent in bringing about the ascent of the lava and the accompanying explosions. The essential features of volcanoes were the escape of lava and gases from a pipe or fissure. The gases observed, which differ in different volcanoes, were steam, hydrogen, methane, sulphur, sulphur dioxide, hydrogen sulphide, chlorine, boric acid and carbon dioxide.

In attempting to explain how volcanic vents are opened one had to consider the place of eruption and its persistence in one place, also its independence of neighbouring vents. Mr. Tyrrell then discussed the hypotheses put forward by Daly, Brun, Day and Shepherd. Prof. Daly's great contribution is the linking-on of volcanic activity with the vastly greater subterranean activity, and developed the gas-fluxing hypotheses of volcanic vents. Dr. Brun advocated the view that volcanic activity is essentially anhydrous; but this was disproved by Drs. Day and Shepherd, who actually collected the gases from the lava lake at Kilauea, and demonstrated the presence of water, although in comparatively small quantity. The other view of volcanic mechanism was that it was comparable to a steam engine; the more modern view is that the analogy is more with a gas engine actuated by internal combustion.

Meeting held on April 10, 1919

Mr. G. W. WILSON, H.M. Survey, read a paper on "The Millstone Grit Fireclays of North Ayrshire." These beds, when discovered by Mr. John Smith, were described by him as Volcanic Tuffs, but the discovery by Mr. Douglas of the highly refractory nature of the Monkcastle clay led to a reconsideration of the whole deposit of the Bauxitic clays. The outcrop has been traced from Saltcoats to Kilmarnock, and deposits of a similar nature occur at Mauchline, Sanquhar, Stranraer, and in Arran. The material is very black, hard and non-plastic, and contains many oolites. Its Al_2O_3content runs from 26 to 50 per cent. When exposed to high temperatures rosettes of sillimanite, coloured blue possibly by titanium, are formed. This, as

well as the oolitic structure, was demonstrated by a series of photomicrographs. With regard to the origin of those deposits the lecturer put forward the hypothesis of tropical conditions acting on the beds of lava, on which perhaps a hummocky surface permitted the formation of extensive pools of stagnant shallow water, with abundance of decaying vegetable matter giving rise to CO. $C0_2$ CH_4 gases. The gases, by reducing action, might render soluble the iron and alumina, and lead to their segregation in different parts of the deposit. The oolitic structure of the alumina particles seemed to suggest that this mineral might, under certain circumstances, pass into solution. The deposits elsewhere are regarded by Mr. Wilson as due to redistribution.

Mr. TYRRELL asked if any evidence had been noticed as to volume change, but Mr. Wilson said he had none, as the rock is non-porous. Mr. Macnair also took part in the discussion.
A hearty vote of thanks was accorded Mr. Wilson.

Meeting held on May 8, 1919

Mr. H. R. J. CONACHER read a paper on the "Micrology of the Oil Shale Series." It was pointed out that the most striking features of the sandstones was the angularity of the grains, and the occasional presence of fresh and angular particles of volcanic rock. The cement of these sandstones is generally calcareous, and frequently constitutes a very large percentage of the whole rock as seen in thin section.

Some clue is given as to the age of this cement by its relation to the oil which sometimes saturates the rock, and the age of which can be fixed by that of the igneous rock which distilled it from the shales. Occasionally the sandstone occurs as very thin ribs in blaes, or even as a single layer of sand grains along the bedding plane, as if strewn across the wet surface of mud by wind. The sandstones sometimes pass by imperceptible gradations into dense hard oolites. When a nucleus can be detected in the oolitic grain it is generally found to be a fragment of plant tissue still showing the structure, but signs of animal life are rare, except carbonised worm tubes, although an oolitic limestone may pass either upwards or downwards into an entomostracan seam. Spirorbis limestones occasionally occur, and the frequent ostracod beds present numerous interesting features under the microscope. Not the least interesting part of Mr. Conacher's notes was the very fine series of some fifty micro-sections by which it was illustrated. These were exhibited with the Society's micro-projector, and were demonstrated by Mr. Conacher. Mr. Conacher was complimented for the skill and industry in which his researches on the oil shales and their origin were being prosecuted, and a hearty vote of thanks was awarded him.

Session 62 (1919-1920)

Extracts from the Proceedings for 1919-1920 (Session 62)

Meeting held on October 9, 1919

Mr. JAMES NEILSON read from the Glasgow Herald of 8th October, 1919, the notice of the death of Miss Miller, daughter of Hugh Miller. Mr. Neilson drew attention to this as an interesting link with the memory of the great Scottish geologist.

Dr. GREGORY, F.R.S., thereafter gave a lecture on the "Rift Valleys of Africa." Dr. Gregory, who had recently returned from East Africa, where he revisited many of the scenes of earlier exploration, pointed out the difference between a valley formed by erosion and one formed by step faulting. The Jordan valley is a fine example of such on a grand scale, and from their resemblance to the well-known deep cracks or rifts which are a feature of the surface of the moon, Dr. Gregory has named such valleys rift valleys. By means of a series of photographs and maps shown by the lantern, the lecturer gave a detailed description of the features of the

great earthquake rifts that extend continuously from the Jordan valley down to the Red Sea, and end at the south of Tanganyika. The abruptness of the sides of parts of these rifts as well as the step faulting was well shown by the slides, and the lecturer explained the waterlessness of parts of the country as due to this drainage.

Professor GRENVILLE COLE, who took part in the discussion, suggested that these rifts had probably been formed rapidly enough to be catastrophic. Mr. STARK, referring to Dr. Gregory's remarks on the glaciation of many parts of equatorial Africa, asked the lecturer how this was reconciled with the view that the glacial period in the North Hemisphere was accompanied by a warm period in the south.

Dr. GREGORY, in reply, referred to the summit of Mount Kenia on the Equator being above the snow line, and that the extended ice cap of the glacial period caused such a disturbance of the prevailing winds as to lead to heavy precipitation of snow on the higher parts of Africa. In reply to Professor Cole, he gave some facts observed by the engineers of the Uganda Railway as to the instability of the floors of these great valleys.

Professor Grenville Cole (1859-1924) was known as "the cycling geologist" and published accounts of his cycling expeditions in Europe and Ireland. He was Professor of Geology and Mineralogy in Dublin from 1890, and Director of the Geological Survey of Ireland from 1905; he was President of the Geographical Association from 1919 to 1920; he also served as external examiner at times for several universities, including Glasgow. There is unfortunately no record in the Proceedings of the reason for his visit to Glasgow in 1919.

Meeting held on November 13, 1919

Mr. G. V. WILSON, H.M. Survey, read a paper on "Some Scottish Ore Deposits." Mr. Wilson discussed chiefly the occurrence of Lead Ore, and especially in the district of Leadhills. The earliest reference goes back as far as 1120, and Sir David Lindsay gave a charter to the monks of Wanlochhead about 1350. From that time the output of lead increased until in 1500-1600 the Leadhills were producing lead in considerable quantity, £100,000 worth having been recorded in three months. The ore worked at first was scattered in the moraine drift, where streams had washed away the finer matter. It was not until later that the veins were discovered. These originate in the igneous rocks, and do not travel far into the country rock. The district is cut by numerous parallel Felsite dykes, indicating a large reservoir of igneous rock. Mr. Wilson discussed at some length the different views as to the formation of the veins. The paper was illustrated by a large number of beautiful mineral specimens exhibited by Mr. Henderson and also by lantern slides.

Meeting held on January 8, 1920

Mr. G. W. TYRRELL delivered a lecture entitled "Recent Developments in Geology of Spitsbergen." After a brief account of the history of our knowledge of Spitsbergen, the discovery of which is generally attributed to the Dutch in 1596, and to whom the name Spitsbergen is due, the lecturer gave an account of the geology of the island, or rather archipelago. Whalers and trappers were early attracted to the island and its adjoining seas, but the present attraction of the country is its mineral wealth. The first coal-bed was discovered 300 years ago, and a British company began mining in 1904, near the mouth of Advent Bay, and Longyear City, opposite to the British mine, is American property, acquired in 1904.

The main geological features are the block-faulted mountains showing horizontal strata, and most of the systems are represented. In the western mountains no fossils have yet been found, but in Bear Island fossils of Silurian age have been dug. Broadly speaking, there are two geological divisions. Along the west and north lie old rocks thrown into folded mountains which show the sharp weathered peaks which give the island its name. (*"Spitzbergen", from the*

Dutch, means "pointed mountains".) The eastern part shows newer rocks faulted into the block systems already mentioned. The old rocks contain ores, and the later rocks contain coal. The coal belongs to three age — Carboniferous, Jurassic, and Tertiary. The latter coal is of excellent quality, and occurs in several seams from 31/2 to 7 feet thick.

Mr. Tyrrell described in considerable detail the main features of the rocks and their fossils, and in conclusion gave in a series of stages the main phases in the geological story of Spitsbergen, enabling his audience to watch the growth of the island from the period when sands and clays were laid down on an Archaen foundation to the last uplift which gave the present raised beaches, fjords, and crossed faults.

Dr. GREGORY and Mr. WORDIE took part in the discussion, which turned chiefly on climatic changes and the origin of the Spitsbergen coal, which Professor Gregory thought might be due to accumulated drift wood, such as is seen along the present shores of the island.

Later in 1920, James Wordie took part in the last expedition that William Speirs Bruce made to Spitsbergen.

James (later Sir James) Wordie (1889-1962) was born in Partick. In 1910, he graduated B.Sc. in geology from Glasgow University, and in 1912 he gained an M.A. from Cambridge University, where he subsequently had a long and successful academic career. He joined the Geological Society of Glasgow in 1912, and remained a member for the rest of his life. Among his many achievements were nine polar expeditions, the first of which was the Trans-Antarctic Expedition of 1914-17, led by Ernest Shackleton; Wordie was on the scientific staff of the Endeavour, and his diary records that "The worst part of the whole expedition was the open boat journey to Elephant Island."

Session 63 (1920-1921)

Extracts from the Proceedings for 1920-1921 (Session 63)

Meeting held on October 14, 1920

Professor GREGORY, D.Sc., F.R.S., delivered a lecture entitled "The Future of Oil Supply." Professor Gregory said the recent sharp rise in the price of petrol had been explained either as simple profiteering or as a warning that the demand for mineral oil was growing much faster than the supply. The temptations to reckless use were powerful. During the past twelve months the increase of the world's shipping was estimated at 9 per cent. on tonnage; but the increase in the number of ships driven by oil and motors had been 35 per cent. The United States before the war had 4,000,000 motor vehicles. It was estimated that next year the number would be 10,000,000, and that American shipping would require 60,000,000 barrels of oil. In 1918 the United States supplied 69.15 per cent, of the total world's production of mineral oil. The British Empire (including Egypt and Persia) produced 3.80 per cent.; but it consumed three times as much and was largely dependent on the United States. Experts said that the American present output could not be maintained for more than five years, that some of its chief oilfields would be exhausted within a couple of decades, and that its oil consumption was growing so fast that it would soon have to import instead of export oil. The prospects of increasing the oil supply were dependent on the development of existing fields and the discovery of new fields. The field from which the greatest increase might be expected was Mexico, and its yield was predicted to surpass that of the United States. Galicia was estimated to contain another 100,000,000 tons. The Russian yield was on the decline before the war, but the output had kept up remarkably. Among new fields Venezuela was the most promising, but little was generally known of the results of recent prospecting there. A second enlargement of the supply might come from the discovery of oil in areas where search had been discouraged by the predominant theory of the formation of oil pools. The most

convenient reservoirs occurred where the beds were bent into arch-like upfolds; but in some of the most productive fields the oil did not come from the arches or "anticlines," but from the downfolds (synclines). The search for oil had been in some areas on the wrong track owing to the predominance of the upfold theory. Aerial navigation would be seriously handicapped if in twenty years' time the petrol supply had been reduced by the reckless use of mineral oil. The geological prospects of the world's supply warned us that it would soon be necessary to consider the prohibition of the use of oil for purposes for which other fuels were available. The lecture was fully illustrated by lantern slides.

Meeting held on November 11, 1920

Mr. HARRY R. J. CONACHER, *Vice-President*, delivered a lecture entitled a "Sketch of Petroleum Geology." Mr. Conacher referred to the early oil drillers as priding themselves in their practical skill and despising the guidance of the scientific geologist, and that only in recent years has the geology of petroleum become well enough understood to enable the oil driller to benefit from the guidance of the scientist. The first oil wells, opened in Pennsylvania fifty years ago, were the start of what was now a gigantic industry. A rough guide in the early days in districts known to be oil-bearing was given by the fact that the oil fields were longer than broad, and that they had a certain orientation. But this proved of no assistance when new fields had to be found. Hunt's theory that anticlinal crests were the usual oil reservoirs had proved useful until the proper conditions had been determined. It is essential that a porous bed to act as reservoir be present with non-permeable beds above and below. The best containers are Sandstones, and the contained matter may be Gas, Oil, or Water. The Sandstone's capacity depends on the size and shape of the grains, and on the presence of Cement. Large grains give good storage spaces, and conversely. Limestone, with abundant cracks, are very favourable, but Shales are less satisfactory unless fissured. Oolitic limestones are good, and igneous rocks, if fissured, occasionally act as storages. Besides storage beds, there must be material suitable for conversion to petroleum. The theories that explained the mineral Hydrocarbons as due to the action of water on metallic Carbides had now been given up. It was now recognised that the Petroleum was due to the decomposition of vegetable matter, and also to some extent animal matter. It was also now recognised that the anticline theory did not fit every case. Some of the greatest wells were in mid-continental states, with strata almost horizontal. Some gushers occurred on the flanks of anticlines. In America attempts had been made to locate lenticular sandbanks at great depths which acted as storehouses of oil. In Texas drilling had been done on the tops of domes of salt, the drilling in certain cases being carried to great depths. In Mexico various great flows for a short time had been obtained from highly fissured limestone, whereas in sand there was a steady flow for a long time. The meaning of the association of Brine and Petroleum was not yet understood. The oil on the surface of the Brine was probably pressed up, and the coming of Brine indicated approaching exhaustion. In general only a fraction of the oil is recoverable. The lecture concluded with a reference to the mining of oil sands for extraction of Petroleum in Alsace.

See below (Session 88) for further information on Mr H.R.J. Conacher, who gave the above lecture.

Session 64 (1921-1922)

Extracts from the Proceedings for 1921-1922 (Session 64)

Meeting held on November 10, 1921

Mr. C. J. GREGORY read a paper on "Parallel Roads at Loch Tulla."

In the discussion Mr. DAVID KERR said that although he had been at Loch Tulla he had never seen any trace of parallel roads on the hill. Mr. ALEX. STEVENS pointed out that such traces on

a hill might be seen with difficulty unless one chanced to have the right angle and point of view. Mr. MURRAY M'GREGOR, on the other hand, referring to the coincidence of two papers on the same subject being read by Mr. Gregory and Mr. Bailey in Glasgow and Edinburgh within the same week, said that the "roads" were easily seen. Mr. Bailey had described two roads at 1041 feet and 830 feet. Mr. TYRRELL, referring to the enormous glacial lakes that had been traced over the present site of the great lakes of North America, said that conditions must have obtained at that time quite unlike the present day, because nowhere in glacial regions had we anything approaching the magnitude of these lakes. The President also spoke some words in compliment to Mr. Gregory, and congratulated him on his first paper to the Society. The talk given by C.J. Gregory (who was the son of Professor J.W. Gregory) appears in Transactions, Vol. 17, 1927, pp. 91-103. The following extract is part of the introduction to the talk:

The Parallel Roads of Glen Roy, for long a mystery to men of Science, have received so complete and natural an explanation, due especially to Macculloch, Agassiz, and Jamieson, that one was led to wonder whether water might not have been impounded by ice in a similar way elsewhere in the Highlands, with the formation of similar beaches. Many cases occur of alluvium laid down by glacial lakes, sometimes with the formation of low terraces, but hardly any high level beaches have been traced out comparable with those of Glen Roy. While passing along the west Highland line between Tyndrum and the Moor of Rannoch and along the road from Bridge of Orchy to Kingshouse, Professor Gregory had several times noticed three such terraces, and found beach material upon them. He suggested that I should determine their height and extension, and I had the opportunity to do so in April of 1921. During the very next month, Messrs. John Mathieson and E. B. Bailey undertook the same operation. With [certain] exceptions, our work is in agreement, but as they used a theodolite the heights they obtained by triangulation must be accepted as far more nearly correct than my aneroid observations. Their results have been presented to the Geological Society of Edinburgh.

Meeting held on December 8, 1921

Mr. G. W. TYRRELL gave an address on his recent work in South Arran. Mr. Tyrrell pointed out that south Arran is probably unique as a field for the study of igneous intrusive geology. As Harker has drawn attention to the occurrence in Skye of Basalt and Felsite, with Basalt in patches through the Felsite, and often the two rocks mixed to an intermediate type, so also in south Arran. This is well seen in the Ross and at Squiler, where the sequence runs—Basalt, Felsite, Basalt, Felsite, Dolerite, Sandstone, Felsite, Dolerite, Sandstone. Mr. Tyrrell believes that these great intrusions took place in successive stages, forming what is called a Cedar Tree Laccolite, well seen in Monamore Glen. On one aspect the thinned-out edges of the intrusion can be separately traced, whereas on the other aspect the intrusion is apparently in one mass. Examination in detail, however, shows an absence of the variation in size of crystals which one would expect in a massive intrusion. One of the interesting details of Mr. Tyrrell's lecture was the working out of the age of the intrusion at King's Cross, where there have been successive intrusions of Clauchland Sill, then Granite and Felsite, next Pitchstones, and lastly Basalt. Mr. DONALD PATTON, in congratulating Mr. Tyrrell, drew attention to the new light this work threw on such massive intrusions as Tinto, where for 2000 feet we have a fine-grained Felsite. Mr. BEGG, Mr. YOUNG, and Mr. M'LEAN complimented Mr. Tyrrell on his most interesting paper, and on Mr. Begg's motion a hearty vote of thanks was accorded.

Meeting held on January 12, 1922

Dr. ROBERT KIDSTON, F.R.S., delivered a lecture on "The Fossil Plants of the Rhynie Chert Bed," discovered by Dr. Mackie. Dr. Kidston had already given three lectures to this Society on the four plants of the Chert, so that a certain amount of the lecture had already become known to our members. Dr. Kidston, however, had many new section photomicrographs to show, and a good deal of new and highly interesting information with regard to fungal parasites of the plants. The preservation of the structure in most of the slides was almost beyond belief. One of the new photographs showed a stoma in plan, and the lecturer pointed

out how in all the vast time that has elapsed since the Middle Old Red Sandstone no perceptible change has taken place in the structure and appearance of the stomata. In proposing a vote of thanks, Dr. GREGORY referred to the distinguished researches of Dr. Kidston in palaeobotany, and said that the Rhynie work rounded up a long list of discoveries of which Scottish Geology was proud.

Dr. Kidston was President of the society during Sessions 60, 61 and 62. For an account of his presidential address, "An Old Red Sandstone Plant: its Structure and Mode of Occurrence", see Session 60, extract from the meeting held on January 10, 1918, which can be found in the extracts from the Proceedings at https://geologyglasgow.org.uk/wp-content/uploads/2019/04/gsg-proceedings-extracts.pdf.

Meeting held on March 9, 1922

Papers were read by Messrs. E. M. ANDERSON, M.A., B.Sc, and H. H. READ, B.SC, A.R.C.SC, officers of H.M. Geological Survey. Mr. ANDERSON'S paper dealt with his own observations of the Schiehallion Country. By means of a large coloured map and list of the rock sequences he explained in a lucid manner the general conclusions he had come to in regard to the build of that part of Perthshire, particularly in reference to the rock systems on the two sides of the great quartzite ridge of Schiehallion. In commenting on the paper, the President referred to the complexity of the subject and to the perennial interest of the problems presented by the geology of the Highlands.

Mr. READ'S paper, which was also highly technical in character, dealt with what he calls "Contaminated Magmas of Aberdeenshire." These are magmas which have incorporated sedimentary material as distinct from a true primary magma. Mr. Read was able to show that in north-east Scotland magmas of noritic character may by contamination give rise to abnormal rocks containing Cordierite, Spinel, Sillimanite, Biotite, Hornblende, Andesine, Orthoclase, Garnet, Quartz. Mr. Read has studied rocks, however, that show normal granitic structure, and he has put forward a hypothesis to show how the sedimentary Xenoliths may have been removed. The Xenoliths, while in suspension in the liquid magma while it is basic, gradually receive heavy material from the magma, hence the denser Xenoliths sink in the liquid, and a clean, apparently normal rock is left. He has put forward, after long chemical analysis, a principle of selective assimilation to group and generalise these changes. He is thus able to show that, starting with a primary basalt magma, we may conceive how by gravitation and assimilaton all the at present known igneous rocks may have been produced. In the discussion Mr. TYRRELL referred to the great importance of these new ideas in igneous geology put forward by Mr. Read, and remarked that these discoveries supported his contention that Scotland was a unique country for the study of igneous phenomena. Mr. Read's paper was illustrated by numerous lantern views and photomicrographs.

Session 65 (1922-1923)

Extracts from the Proceedings for 1922-1923 (Session 65)

Meeting held on November 9, 1922

Mr. W. H. HERDSMAN read a paper on "Problems of Ore Genesis." He is of opinion that subsidences of the ocean floor produce sudden blows on the crust, which cause fusion of the overlying rocks. He preferred the other theory of the sedimentary origin of ore deposits, notably Pyrites, in place of the more modern igneous theory.

Meeting held on February 8, 1923

Mr. TYRRELL exhibited a glaciated stone, brought by Sir Martin Conway from Horn Sound, showing very regular wavy lines incised on its surface. Dr. W. R. SMELLIE exhibited and read a paper on chipped flints from Iraq. They were found at a camping-place called Maher-ton, which name means House of Craft. Pieces of bottle glass, chipped in the same manner by natives of N. Australia, were shown by Mr. H. R. J. CONACHER. Mr. ROBERTS said that flints of this kind were common in Northampton. Mr. Stark, in Burma, had seen heat used to split flakes of jade.

Session 66 (1923-1924)

Extracts from the Proceedings for 1923-1924 (Session 66)

Meeting held on January 10, 1924

Mr. D. B. DUNCANSON introduced a discussion on "Recent Theories of Crustal Movement." Mr. Duncanson gave a comprehensive summary of Prof. Joly's theory, and an interesting general discussion ensued.

It is clear that Professor Joly's theory of crustal movement formed a significant part of the discussion at this meeting on January 10, 1924; in March of the previous year, Professor Joly had delivered, in Dublin, a lecture entitled "The Surface Movements of the Earth's Crust", and the May, 1923 edition of the journal Nature published the transcript of the lecture, which can be found at https://www.nature.com/articles/111603a0.pdf.

Professor John Joly (1857-1933) was Professor of Geology and Mineralogy in Trinity College Dublin from 1897 until his death in 1933. Information about Professsor Joly's ancestry, his life and work, and his many achievements, can be found at https://royalsocietypublishing.org/doi/pdf/10.1098/rsbm.1934.001.

Meeting held on February 14, 1924

The President, Dr. G. W. TYRRELL, delivered a lecture on "The Geology of the North Atlantic." Dr. Tyrrell defined the extent of the North Atlantic, described its configuration and wedge-shaped contours, and discussed the geological frame in which it is set, emphasising the element of symmetry in the structure of its east and west sides, and the trans-polar strike of the Caledonian folding. The lecturer briefly surveyed the main occurrences and petrographic characters of the Kainozoic igneous episode, as illustrated by the North Atlantic islands, and by dredgings of the Rockall and Porcupine banks. Slides were exhibited, showing characteristic occurrences and structures.

Dr. TYRRELL summarised the theories of Suess, Wegener, Joly, and Kober, and discussed their application to the origin of the North Atlantic. He (Dr. Tyrrell) suggested that the rifting apart of the continents took place by the subsidence of wedge-shaped masses in a wave of movement from south to north, each subsidence being heralded by eruptions of basalt and dolerite, the earliest occurring in South America and South Africa, in Jurassic times.

Rev. RAMSAY SIBBALD made reference to the death of Mrs. Gray, and moved that an expression of sympathy be sent to the family. This was agreed to.

Mrs. Gray was Elizabeth Gray, neé Anderson (1831-1924), a celebrated fossil collector; she was elected an Honorary Member of the Geological Society of Glasgow on May 31, 1900. There is a previous extract concerning Elizabeth Gray in the entry for the meeting held on January 20, 1873 (Session 15), which can be found in the extracts from the Proceedings for previous anniversary years at https://royalsocietypublishing.org/doi/pdf/10.1098/rsbm.1934.001

Meeting held on April 10, 1924

Dr. TYRRELL read part I. of his presidential address—"Igneous Action and Earth Movement—The Caledonian Revolution." Dr. Tyrrell commented on the parallelism of igneous and tectonic history, and suggested that it might be appropriate to speak of petrographic periods rather than of petrographic provinces, such periods being simply sequences of rock types. Dr. Tyrrell described the phenomena and phases of diastrophism, and analysed the diastrophic cycle of the Lower Palaeozoic of Scotland, describing the rock types associated with each phase. The continental phase of the Torridonian showed no igneous activity. This formation probably corresponds to the Sparagmite Sandstone of Scandinavia, which is generally regarded by Scandinavian geologists as belonging to earliest Cambrian times. The Sparagmite formation includes amygdaloidal basalts and quartz-dolerite. In America the continental phase is associated with great floods of basaltic lavas. The submergence (or geosynclinal) and the alternating (or transgression) phases are represented in Scottish Palaeozoic igneous activity by outpourings of soda-rich, spilitic lavas, with albite, and by intrusions of serpentine and green-rocks, transformed by earth movements into hornblende-chlorite and talc-schists. In the alternating stage igneous activity is at a minimum. In the final upheaval of the Caledonian Revolution there appears to have been two paroxysms of igneous activity, separated by earth movements; this accounts for the foliation of some of the igneous rocks of this phase, and its absence from others. Granodiorites and andesites are the rock types of the Caledonian Revolution. Andesite lavas occur in the Ochil, Sidlaw, and Cheviot Hills, and are never foliated.

Session 83 (1940-1941)

The archive material for the war years is understandably rather sparse. The talk by Dr M. Macgregor on February 11, 1941 has obvious relevance to the war and the need for resources.

Extracts from the Proceedings for 1940-1941 (Session 83)

Meeting held on February 11, 1941

The President intimated that the Murchison Medal of the London Geological Society had been awarded to Dr. M. Macgregor and the Murchison Fund to Dr. J. Weir.

Dr. M. Macgregor gave an address on " The Ironstone Resources of Scotland." He pointed out that these had been fully investigated by the Geological Survey during the last war and were dealt with in volume XI of the series of *Special Reports on the Mineral Resources of Great Britain.* This volume, " The Iron Ores of Scotland," was published in 1920. Since then further research on potential resources had been carried out and was being prosecuted at the present time. The lecturer outlined the results so far obtained and gave an account of the mode of occurrence of the different types of iron ore found in Scotland, under the headings of sulphides, oxides, silicates and carbonates.

Session 84 (1941-1942)

Extracts from the Proceedings for 1941-1942 (Session 84)

Meeting held on October 11, 1941

This meeting was held in the Geological Department of the University and at its close members present were the guests of Professor and Mrs. Trueman at tea. (*Professor Arthur E. Trueman was the retiring president of the society.*)

The meeting was devoted to a series of exhibits and demonstrations arranged by various members: *(a)* wooden implements from old coal-workings near Law village, by Dr. M. Macgregor; *(b)* a map illustrating transcurrent faulting in oil-shale workings near Uphall, by Dr. W. Q. Kennedy; *(c)* coal with oil films, by Mr. H. H. Roderick; *(d)* natrolite and pectolite from Orrock Quarry, by Miss E. Melville; *(e)* a Lower Devonian trilobite with the rostral plate in position, by Mr. J. L. Begg; *(f)* ammonites from Morvern, by Miss R. M. MacLennan; *(g)* slides showing shell structure, by Professor A. E. Trueman; *(h)* cellulose peel sections of ammonites, by Dr. E. D. Currie; *(I)* minerals from the U.S.S.R., by Dr. G. W. Tyrrell; and *(j)* a series of photographs, by Dr. D. Leith.

Meeting held on November 8, 1941

A paper by Dr. M. Macgregor entitled "A Notice of John Smith," was read by title and Mr. Colin Leitch, B.Sc. then delivered an address on 'Roumanian Oil-fields,' in which he outlined the history of the Roumanian oil industry from 1918 up to the present time. (*The paper on John Smith can be found at https://geologyglasgow.org.uk/docs/017_070__johnsmith_1509017687.pdf*.)

John Smith devoted much of his life to the study of the geology, natural history and archaeology of Ayrshire, where most of his life was spent. He was an active member of the Geological Society of Glasgow from 1865 until shortly before his death in 1930.

Session 85 (1942-1943)

Extracts from the Proceedings for 1942–1943 (Session 85)

Meeting held on October 10, 1942

The President conveyed the congratulations of the Society to Professor A. E. Trueman on his election to the Fellowship of the Royal Society. He also congratulated Dr. W. J. McCallien on the award by the Royal Society of Edinburgh of the Neill Prize for the period 1939-41, and Mr. J. L. Begg on the award by the Edinburgh Geological Society of the Clough Memorial Prize for the period 1941-42.

A communication by Dr. J. Phemister, entitled " Note on Fused Spent Shale from a Retort at Pumpherston," was read by title.

Mr. V. A. Eyles then delivered a lecture on The Inter-basaltic Beds of North-East Ireland. Mr. Eyles described the occurrence of these beds between the great suites of plateau basalts known as the Upper and Lower Basalts. The process of laterisation, by which bauxite is produced from basalt, was described, as well as the products at different stages of the process. Two different types of bauxite are found in North-East Ireland, derived from two distinct parent rocks. The bauxite derived from basalt is red and ferruginous in character, with a small percentage of silica. On the other hand, interbasaltic sediments, containing rhyolitic debris have also been reduced to bauxite which is light grey in colour and contains more silica and less iron. A publication describing these beds in detail is in course of preparation.

Meeting held on December 5, 1942

This meeting was devoted to a discussion on the subject of "The Boundary between the Old Red Sandstone and Carboniferous Formations in the Midland Valley." The discussion was

opened by Dr. M. Macgregor who pointed out that the problem of fixing a boundary line was one of long standing and traced the history of the changes in the nomenclature of the Lower Carboniferous and Upper Old Red Sandstone rocks, since the time of MacLaren. For a long time the "red sandstone— cornstone group" was regarded as the basal division of the Carboniferous succession, but was later placed in the Upper Old Red Sandstone, mainly from its lithological resemblance to the Upper Old Red Sandstone of East Fife, dated by means of the fossil fish-remains of Dura Den, etc. Since these rocks pass up conformably into the Lower Carboniferous, the criteria used in drawing a boundary line are sometimes lithological, sometimes palaeontological. The palaeontological evidence is often very scanty, however, and the lithological evidence, so far as this has been studied, is not always conclusive. In some areas, for example, there is a transition series from Upper Old Red Sandstone types of sediment to Lower Carboniferous (Cementstone) types. Dr. Macgregor suggested that further research on the characteristic rock types and sedimentary cycles of the two formations might help towards a solution of the difficulty.

Those taking part in the discussion included Mr. B. H. Barrett, Professor J. Walton and Professor A. E. Trueman.

Meeting held on February 6, 1943

The President congratulated Dr. E. D. Currie on the award of the Wollaston Fund by the Geological Society of London.

Dr. Ethel D. Currie was the first woman to become president of the Society; she was president from 1952 until 1955. An account of her life and work can be found at https://geologyglasgow.org.uk/docs/017_070__currie_1517842114.pdf.

Mr. B. H. Barrett, M.A., B.Sc delivered a lecture on the Canonbie Coalfield and detailed the results of the examination of this area carried out in conjunction with Dr. J. E. Richey of the Geological Survey (see "Economic Geology of the Canonbie Coalfield," Geological Survey Wartime Pamphlets, No. 42, January, 1945.)

Meeting held on March 6, 1943

The President referred to the loss sustained by the Society through the death of Mr. P. A. Leitch and read an obituary notice by Mr. P. Robinson.

This notice is not recorded in the Proceedings, but was published in the Transactions of the Geological Society of Glasgow (Vol. 20 (1945), page 349), as follows:

P. A. LEITCH.—Patrick Arthur Leitch was born on October 25th, 1880, and died at Bothwell, on February 15th, 1943. A member of a well-known Greenock family, he was educated at the High School of Glasgow and studied civil engineering at the Royal Technical College and at the University. In 1899 he joined the staff of the District Engineer to the Middle Ward of Lanarkshire and by successive steps rose to be head of the Department under the designation of County Drainage, etc., Engineer. During his professional career he was responsible for the design and construction of many important drainage schemes and sewage purification works within the County, and he became an acknowledged authority in that particular field of engineering practice.

Mr. Leitch was a man of varied intellectual pursuits. He took a deep interest in geological problems, especially those associated with the study of petrology. He joined the Society in 1908, served as a member of Council for several periods and in 1941 was elected a Vice-President. Keenly interested in the work of the Society, he seldom missed being present at its meetings. In 1917 he contributed, in conjunction with Dr. A. Scott, a paper entitled " Notes on the Intrusive Rocks of West Renfrewshire " which is published in Volume XVI of the Society's *Transactions* (vol. xvi, part ii, 1917, pp. 275-289). In his later years antiquarian research held a

strong fascination for him, and he made a special study of the Antonine Wall between the Clyde and the Forth, reconstructing it in a series of wooden models which are now on exhibit in the Hunterian Museum, University of Glasgow.

Mr. Leitch was a Member of the Institute of Civil Engineers, a Fellow of the Geological Society of London and a Fellow of the Antiquarian Society of Scotland.

P.J.R.

Session 86 (1943-1944)

Extracts from the Proceedings for 1943–1944 (Session 86)

Meeting held on October 9, 1943

This meeting was held in the Geology Department, The University, where tea was served in the Palaeontological Laboratory.

At the first meeting of Session 82, held in the Hunterian Museum on October 21, 1939, a decision had been taken that, under war conditions, "the Society should endeavour to carry on its meetings as regularly as possible, but that the day and time should be changed to Saturday at 3 p.m.*" Five years later, at the first meeting of Session 87, held in the Geology Department on October 14, 1944, it was decided* "to revert to evening meetings to be held on the second Thursday of the month at 7 p.m.*" It appears that, during the Second World War, the October meetings of Sessions 83 to 87 (1940 to 1944) were held in the Geology Department of the University. Although the minutes do not record where the remaining meetings of each session were held, it may be assumed that they took place in what previous minutes refer to as "Society's Rooms, 207, Bath Street, Glasgow"; this building was owned by the Royal Philosophical Society of Glasgow, and, between 1880 and 1961, it was also the principal venue for meetings of the Geological Society of Glasgow.*

Meeting held on November 13, 1943

The President *[Dr. John Weir]* announced that Dr. E. B. Bailey had been awarded a Royal Medal of the Royal Society.

Dr. J. B. Simpson delivered an address on "The Study of Fossil Pollen Grains." He pointed out that the serious study of fossil spores has been confined to the last twenty-five years, and went on to describe the work done by others on fossil pollen grains in peat mosses and in Tertiary coals and lignites, as well as on spores in coals of Carboniferous age. Dr. Simpson's own work was the study of pollen in Tertiary coals and in coal seams occurring in Upper Cretaceous, Lower Cretaceous, and Jurassic strata. Most of the plants are still flourishing and so the fossil pollen can be compared with that of living forms. The method of study was described in some detail. The lecturer then showed lantern slides of fossil pollen grains of alder, maple, conifers, and water-lily, together with corresponding living forms. In the case of the alder and maple, it was pointed out that the British Tertiary pollen grains are allied to present-day Asiatic forms.

Meeting held on December 11, 1943

Dr. G. W. Tyrrell exhibited a series of lantern slides illustrating some mineral deposits of Soviet Russia. The slides were made from photographs taken by Dr. D. Williams who was Dr. Tyrrell's companion on the expedition to the Kola Peninsula during the Geological Congress in Russia in 1937.

Meeting held on January 8, 1944

Dr. T. Robertson delivered a lecture on "The Limestone Resources of Scotland", in which he summarised the results of the investigations on Scottish limestones carried out recently by the Geological Survey with the collaboration, on the chemical side, of the Macaulay Institute for Soil Research. The results of this work are now available in a series of eight wartime pamphlets issued by the Geological Survey.

Meeting held on March 11, 1944

Dr. J.C.G. Anderson gave an address on "Scottish Slates" and summarised the results of the work recently carried out by Dr. J.E. Richey and himself on the slate deposits of Scotland (see Geological Survey Wartime Pamphlets, No. 40, May, 1944). An exhibit of slates arranged by Mr. T. Graham and others interested in the industry were on view and both visitors and members took part in the discussion which followed the lecture.

Session 87 (1944-1945)

For an account of the venues and times of meetings of the Society during the war years, see the note concerning the meeting held on October 9, 1943; this can be found in the extracts from the Proceedings for Session 86 at https://geologyglasgow.org.uk/wp-content/uploads/2019/04/gsg-proceedings-extracts.pdf.

Extracts from the Proceedings of 1944-1945 (Session 87)

Meeting held on November 9, 1944

Dr. A. Muir of the Macaulay Institute for Soil Research delivered a lecture on "Some Aspects of Soil Geology."

Dr. Muir said that up to the latter part of the nineteenth century agricultural chemists dealt with the soil but not with the sub-soil. Soil surveys carried out in Russia laid the foundation of Pedology, a subject which is not just a branch of geology or of agricultural chemistry. The link between soil science and geology is the soil parent material which under differing conditions of climate and topography gives rise to different soil types. For local conditions a classification of soils on the basis of lithology of the parent material is necessary since so many soil properties are directly due to its physical and chemical properties. It is being found, for example, that many crop and animal diseases are due to deficiency or excess of certain elements and a knowledge of their distribution in rocks and soils is becoming increasingly important.

Meeting held on February 8, 1945

Dr. W. Q. Kennedy gave a lantern demonstration entitled "The Production and Processing of Scottish Mica." He said that the production of mica in Scotland is a purely war-time industry. The deposit described is in Knoydart, at a height of 2,000 ft. on the north side of Loch Nevis, where the mica occurs in "books" in pegmatite. Lantern slides were shown to illustrate the quarrying of the pegmatite, the collecting of the mica, and the splitting, cutting, grading and packing of the mica plates. Specimens of cut mica were exhibited.

Further information on this topic can be found at http://earthwise.bgs.ac.uk/index.php/Mica_quarrying_and_processing_in_Scotland_during_the_Second_World_War.

Session 88 (1945-1946)

Extracts from the Proceedings of 1945-1946

Meeting held on October 11, 1945

The President *(Benjamin H. Barrett)* referred to the Society's loss by death of Mr. H. R. J. Conacher.

An obituary of Mr Conacher (which was later published in the Transactions (Vol. 21, pp. 154-155), and part of which is quoted below) was then read to the meeting by Dr Murray Macgregor, who had composed the tribute.

Mr. H. R. J. Conacher, who died suddenly on April 12th, 1945, at the age of 60, had a long and close association with the Geological Society of Glasgow. He joined it as an Associate Member in 1911, became a Member in 1912, and was enrolled as a Life Member in 1916. For a number of years, 1913-1916, he acted as Joint-Honorary Secretary, combining this post with that of Joint-Editor of the *Transactions*. He was elected a Vice-President in 1920.

Mr. Conacher entered the service of the Pumpherston Oil Company in 1899 and was early attracted to the study of the geological aspects of the Lothians' oil-shales. He studied geology under the late Professor J. W. Gregory and in 1913 began the series of researches which he carried out over a number of years on the microscopic structure of shales, torbanites and cannels. He accompanied Sir William Fraser (now Chairman of the Anglo-Iranian Oil Company) during the 1914-1918 war as confidential secretary for the meetings of the Inter-Allied Petroleum Specification Commission. Later, he visited America to investigate and report on the oil-shale deposits of Colorado and Utah, and in 1935 was sent to Australia to prepare a report for the Commonwealth Government on Australian oil-shales. He took the opportunity of this latter journey to visit the chief centres of the Anglo-Iranian Company's operations in Iran. In addition to possessing an intimate knowledge of the oil-shale fields of Scotland, he had a wide experience of shale-fields abroad and of the oil industry generally. He was also a recognised authority on the history of shale mining in this country, and his contribution on the "History of the Scottish Oil-Shale Industry" to the third edition of the Geological Survey memoir on "The Oil-Shales of the Lothians" (1927, pp. 240-265) was a masterly summary of the subject.

Meeting held on December 13, 1945

This was a Members' Night, which included the following presentation:

Mr. R. H. S. Robertson spoke on "Fuller's Earth in Scotland." He pointed out that there is no Fuller's Earth Industry in Scotland at the present time although it was worked in the past. In England it has been worked continuously for 1600 years. He referred to 14 occurrences of Fuller's Earth in Scotland that he had traced in the literature and he considered that those at Elgin, Dunning and Maxton (Roxburghshire) would be worth investigating. Further investigations of their quality might lead to modern applications of Fuller's Earth in Scotland.

Meeting held on March 14, 1946

Mr. Barrett *(the President of the Society)* introduced the speaker of the evening, Professor Arthur Holmes, D.Sc, F.R.S., and asked him to deliver his address on "The Construction of a Geological Time-Scale."
The introduction of Professor Holmes' address is reproduced below; the full text can be found in the Transactions, Vol. 21, pp. 117-152.

To measure geological time with reasonable accuracy the first essential is the recognition of a natural process which, operating at a known rate from a defined starting point, brings about

measurable results either periodically or progressively. The establishment of an exact chronology by counting correlated sequences of the varves deposited during the last 15,000 years is a perfect example of the application of a periodic process, the period in this case being the year. The dating of a uranium-bearing mineral by determining the lead-isotopes generated within it during its life-history illustrates the use of a progressive process, the process in this case being spontaneous atomic disintegration. For the successful application of a method based on a progressive process, it is necessary to know:

a. the rate of the process at the present time;

b. the law expressing the variation of rate during the interval to be measured; and

c. the total change effected by the process during that interval.

The accumulation in minerals of the end-products of radioactive decay constitutes the only progressive process so far recognised in which these conditions are satisfactorily fulfilled over the whole range of geological time. The traditional geological methods, on the other hand, involve a complex of processes—denudation, deposition and diastrophism —so highly variable in space and time that they can be used as an hour-glass only in specially favourable circumstances covering relatively short periods. Samuel Haughton (1878, p. 268) introduced the celebrated principle that "the proper relative measure of geological periods is the maximum thickness of the strata formed during these periods." As stated in this way, the principle implies that the average rate of accumulation, measured in terms of maximum thickness, has remained uniform during all the periods considered. Rigid uniformitarianism of this kind cannot be demonstrated, and, as we shall see later, there is conclusive evidence that the effective rate of accumulation has actually increased since Cambrian times. Several considerations require to be borne in mind in interpreting the significance of maximum thicknesses. It is important to realise that rate of vertical accumulation is by no means the same as rate of deposition. Most of the strata that build up the thickest accumulations are of shallow-water facies, and, as such, they are liable to be full of innumerable 'gaps' representing intervals of erosion and transport by bottom-currents at times when the depth of water was insufficient to ensure uninterrupted sedimentation. The resulting imperfection of what may be an apparently continuous record has been ably demonstrated by Barrell (1917, p. 796) in a masterly paper which is one of the classics of our subject. A maximum thickness thus represents a balance between income and loss at that particular place. Rate of deposition refers to the total income whereas rate of accumulation refers only to the balance. The balance is eventually controlled by the space made available for thick accumulations by earth movements, the latter being generally of the kind responsible for geosynclines. Hence it follows that maximum thicknesses are in reality measures of crustal depression. Since we cannot assume that rates of crustal depression have necessarily been the same in every orogenic cycle, Haughton's principle should be limited to some such statement as the following: "The time elapsed since the end of any geological period is a function of the sum of the maximum thicknesses accumulated during all the subsequent periods" (See Table II and page 143). To determine the nature of the function it is obvious that some independent measure of time is essential. The purpose of this paper is to revise the chief age determinations from the Cambrian to the Tertiary, with a view to building up a time-scale and elucidating the relation between time and maximum thicknesses.

In the minutes of the meeting held on December 12, 1946 (Session 89) it is recorded that Professor Arthur Holmes, D.Sc., F.R.S. was elected to membership of the society; however, in the published membership list, his name appears in the list of life members rather than of ordinary members.

Session 89 (1946-1947)

Extracts from the Proceedings of 1946-1947

Meeting held on November 14, 1946

Dr. A. T. J. Dollar, A.K.C., F.R.S.E. [delivered] a lecture on "Methods of Studying Recent Scottish Earthquakes."

Neither text nor abstract of this lecture appears in the volume of the Transactions (volume 21) in which the Proceedings for Session 89 were published. However, the transcript of a lecture on a related topic, given three years later by Dr. Dollar, was published in this volume (Transactions, Vol. 21, part 2, 1951, pp. 283-361): "Catalogue of Scottish Earthquakes, 1916-1949. By A. T. J. Dollar, Ph.D., A.K.C., F.G.S., F.R.S.E., Lecturer in Geology, University of Glasgow." *The lecture deals with a range of aspects of seismic activity in Scotland, including cause and distribution, intensity and damage caused, before giving the catalogue of 122 earthquakes.*

Meeting held on March 13, 1947

To commemorate the 150th Anniversary of the death of James Hutton, which fell on 26th March, 1947, the following addresses, descriptive of his life and work, were given before the Society: (a) Hutton's Life and Times, by Dr. Murray Macgregor; (b) Hutton's Contribution to Dynamical Geology, by Dr. Murray Macgregor; and (c) Hutton's Contributions to Igneous and Metamorphic Geology, by Dr. G. W. Tyrrell.

Meeting held on April 10, 1947

The two following papers were read:

"The Dyke Rocks of County Donegal and the adjoining part of County Tyrone, Ireland," by M. Shirama Rao, B.Sc., M.Sc, F.G.S.

"Camptonitic Dyke Rocks from Inishowen, County Donegal, Ireland," by M. V. N. Murthy, B.Sc., A.I.I.Sc., F.G.S.

These papers, abstracts of which appear in the present part of the Transactions, [Vol. 21, part 2, 1951] pp. 203-206, were based on a detailed petrographic study carried out by the authors on a collection of dyke rocks made in County Donegal by Dr. W. J. McCallien, formerly of the Geological Department of Glasgow University. Mr. Rao dealt with the Caledonian and Tertiary dykes and Mr. Murthy with the camptonitic dykes to which a Permian age is assigned.

Referring to Mr. Rao's paper Dr. G. W. Tyrrell emphasised one of the most striking features of the Caledonian dykes, namely, an almost complete transition between lamprophyres and porphyrites. The transition had been noted before in the Caledonian dykes of Glen Etive, Ben Nevis and Glencoe, but nowhere was it more perfectly displayed than in the north of Ireland. With regard to the replacement phenomena mentioned by Mr. Rao, Dr. Tyrrell said that he regarded these as primary in the sense that they were produced by the last juices of the magma, rich in water and other volatiles, reacting with the already crystallised material. Finally, as regards the olivine-tholeiites there was what seemed to be a contradiction in terms. Analyses showed that these rocks were either on the border line or slightly over-saturated. This was due to the early crystallisation of the olivine not having taken out of the magma so much silica as the felspars and pyroxenes, so that some silica was stored up and appeared in the analyses as an excess.

In commenting on Mr. Murthy's paper Dr. Tyrrell pointed out that his investigations dealt with rocks the age of which had been in doubt until Professor Holmes had demonstrated by radio-active methods that they were unquestionably of Permian age. The correctness of this ascription had been confirmed by Mr. Murthy's work.

Some information about Dr. W. J. McCallien, on whose initial studies the above research was based, can be found in the Anniversaries page: see the meeting held on October 8, 1970 in the extracts from the Proceedings for Session 113 at https://geologyglasgow.org.uk/wp-content/uploads/2019/04/gsg-proceedings-extracts.pdf.

Session 90 (1947-1948)

Extracts from the Proceedings for 1947-1948 (Session 90)

Meeting held on December 11, 1947

As this was a Members' night the evening was devoted to a series of short papers and exhibits. Dr. G. W. Tyrrell described the eruption of Hekla, which occurred on the 29th March, 1947, and explained that the details had been supplied to him in a series of letters from Mr. T. Einarsson, Lecturer at Reykjavik University. Mr. G.S. Johnstone exhibited and described various specimens occurring in the Allt Dhubh Ghalair, Glen Lochay, Perthshire. There was an unusual occurrence in the mass of crystalline talc. Miss E. R. Brock showed lantern slides of (a) Lewisian Gneiss at Shieldaig Peninsula, near Loch Torridon and (b) the cliff behind the 25-Foot Raised Beach at Cardross, illustrating slicken-siding in the Lower Old Red Sandstone. Miss Brock also exhibited an interesting suite of rock specimens from the Loch Torridon district. Mr. A. C. McLean showed a geological sketch-map of Carrick and described three specimens of chalcedony (strongly suggesting a deposit from a siliceous spring) obtained from a locality two miles south of Ayr. The President, Dr. J. G. C. Anderson, exhibited copies of the following recently issued Geological Survey maps: (a) Geological Map of Scotland on the scale of 1/625,000, approximately 10 miles to the inch; (b) new editions of the Geological Map of Arran on the scale of 1 mile to the inch, showing solid and drift geology separately. Dr. Anderson also showed a fine example of fault-polishing of blaes in a specimen from the Mary Pit, Lochore, Fife. Mr. E. Stollery described some examples of Guilielmites from an old quarry at Nitshill. These structures, he said, have in the last century received many explanations, but the latest view, that of Dr. (now Professor) A. Wood seemed the most satisfactory. Dr. Wood pointed out that the sediments in which Guilielmites occur are always compact, fine-grained shales and concluded that they were due to slipping in the rock following on the collapse of some central body, generally a shell, a succession of such slips giving rise to a series of onion-like, often polished and striated surfaces. The specimens exhibited showed the bilobed type of Guilielmite and were formed by the collapse of Orthocerid shells, a type of occurrence not discussed by Dr. Wood. Mr. H. S. Walton read a short note on "The Blane Valley Alluvium." Dr. A. T. J. Dollar exhibited models of two types of solifluxion which occurred in the Ochil Hills, about four miles north of Dollar, and in addition displayed some photographs of Swiss scenery illustrating glacial structures. Mr. L. E. Holloway exhibited numerous specimens from the Glenelg district.

Meeting held on February 12, 1948

Professor T. Neville George, D.Sc., Ph.D., F.G.S. gave an address on "Hercynian Structures in Wales and in Scotland." Professor George pointed out that in the British Isles the characteristic orogenic structures of the Hercynides are seen in Southern Ireland, in South Wales, and in the Mendips, where the Upper Palaeozoic rocks are intensely folded into a series of echeloned periclines with much overfolding and large scale thrusting. The structures are most simply interpreted as evidence of direct compression along a north-facing arc, the crust being driven against a more or less rigid Caledonid front of varied foundation. To the north of this major arc the pressures were dissipated; and the Hercynian tectonics of the central plain of Ireland, of North Wales, and of the English Midlands are much gentler in expression though complex in detail. In the orogenic zone the rocks are shattered by numbers of cross-faults, many of which show evidence of horizontal displacement and of being contemporaneous in origin with the associated folds and thrusts. In Scotland there is very little evidence outside the Midland

Valley of the Hercynian orogeny; and even in the Midland Valley the age of the major structures is not always determinable. It is obvious that as a whole the structures cannot be regarded as having arisen in the crust by direct pressure from the south. In broad plan the compressive forces were too feeble to impose a novel tectonic pattern on the area, the late-Palaeozoic structures clearly being dominated by an earlier Caledonid framework. The Highland Boundary Fault has been shown by Anderson to have a strike-slip component of the order of some twenty miles, and the Southern Uplands Fault (though its detailed nature has not yet been precisely determined) is probably also in part a tear fault. The Midland Valley may then be regarded as a tract subjected to a huge torque by the Hercynian pressures. The Caledonid trend of the folds and their blunt periclinal form, and the rhomboidal reticulum of the fault pattern, are the expected products of such compressive shearing — though of course there has been much modification of the basic symmetry notably by stratigraphical variations and by local developments of thick resistant igneous rocks.

Session 91 (1948-1949)

Extracts from the Proceedings for 1948-1949 (Session 91)

Meeting held on January 13, 1949

Mr. J.S. Filshill, J.P., of the National Coal Board gave a lecture on "A Visit to the Ruhr Coalfield." Mr. Filshill was a member of a party from the National Coal Board who had visited the Ruhr Coalfield about a year previously to study mining methods.

The Ruhr Coalfield is approximately 1,500 square miles and is elongated in shape extending from S.W. to N.E. 65/75 kilometers and with a width of about 30 kilometers. The coal-bearing strata in the Ruhr are thrown into a series of anticlines and synclines of a pronounced nature and five anticlines and synclines are given names. The actual coals in the 3,000 yards of Carboniferous strata are approximately 70 yards. The coals are very much softer and very much more brittle and consequently are more adapted to mechanised mining than the British. Overlying the whole of the Ruhr there is an overburden which deepens from south to north and consists of chalk beds and sand. Consequently in the Ruhr there is a considerable amount of serious shaft sinking problems. The speaker described several of the large collieries visited and commented on the types of machinery used. The lecture was illustrated with lantern slides.

The meeting then adjourned for coffee.

Before the second paper was read, the President [Dr. J.G.C. Anderson] intimated that the Council had decided to hold a Society Dinner. Thanks to the good offices of Professor George this would be held in the University Club at 7 o'clock on Thursday 17th February.

Mr. D.M. Boyd, B.Sc., F.G.S. then read a paper entitled "A Magnetic Reconnaissance over the Essexite Intrusion and the Campsie Fault, near Lennoxtown, Stirlingshire."

Mr. Boyd said the problem was to investigate the structural relation of the Campsie Fault and the Essexite Intrusion. The Campsie Fault is nowhere seen and the Essexite is poorly exposed. This made it appear to be a problem suitable for solution by the variometer method. The speaker gave a brief account of the survey, explaining how the map of the magnetic field is interpreted. As a result of the survey the following conclusions had been reached. There is a fault running between the masses of Essexite. There is no indication of the fault bending to pass south of the Essexite on the road. The position of the south end of the Essexite is fixed, but not the nature of the junction. Although there is no indication that the Essexite crosses the fault, the evidence is insufficient to fix definitely the relative boundaries of the Essexite to show any displacement due to the fault.

Note: The President, Dr. J.G.C. Anderson (elected as President on November 13, 1947) served only two years of the usual three-year presidential term; this was due to his election in 1949 to the Chair of Geology at University College, Cardiff. The minutes of the meeting held on November 10, 1949 record that "Professor T. Neville George was elected President of the Society and took the Chair vacated by Professor Anderson."

Meeting held on February 10, 1949

This meeting was held in the Geology Department of the University by kind invitation of Professor T. N. George.

The meeting was devoted to a series of short papers and exhibits by members.

Professor J. Walton [Professor of Botany in the University of Glasgow] read a note on "A Thalloid Plant showing evidence of growth *in situ* from the Coal Measures at Dollar, Clackmannanshire." [*Transactions,* vol. 21, Part 2, 1951, pp. 278-280]

An interesting contribution by Detective-Sergeant Cannon entitled "Ten Minutes of C.I.D. Geology" gave some examples of the application of the technique of sedimentary petrology to police problems.

Dr. B.C. King described and illustrated by a fine series of lantern slides the occurrence of feldspar augen in specimens of a grey gneiss from near Ilorin, Nigeria, and outlined the evidence for regarding these as of metasomatic origin.

In a brief contribution entitled "Some Notes on Hardness", Mr. E. Stollery stressed the fact that in most of the techniques made use of in testing the hardness of minerals there was no consistency in the actual factors involved in the tests.

Dr. A.J.T. Dollar described an occurrence of curved crystals of vein quartz which he had found in a vein in a sedimentary rock in the south-west of Lundy Island.

Mr. W.G. Jardine exhibited examples of a porcellaneous breccia from Desford Colliery, Leicestershire.

Dr. N. Holgate exhibited and described a simplified conoscopic projector for interference figures in birefringent minerals, and Dr. Dollar had on view a number of mineralogical and petrological instruments.

Coffee was served in one of the Departmental laboratories where the exhibits were displayed, and the Hunterian Museum was open to members by courtesy of the Honorary Curator of Geological Collections, Professor T.N. George.

Session 108 (1965-1966)

Extract from the Proceedings for 1965-1966 (Session 108)

Meeting held on February 10, 1966

The President expressed the regret felt in the Society over the death of Dr. Murray Macgregor and the Society's gratitude to him, particularly for his work on the Transactions and, latterly, the Arran Guide.

Murray Macgregor (1884-1966) joined the Geological Survey in 1909. Throughout most of his life thereafter, he was involved in the survey of coal, ironstone, oil-shale, limestone, and of

many other resources that were essential to the Scottish economy, especially during the two world wars and their aftermath; in particular, his work made a significant contribution to the development of the coal-mining industry. He is also celebrated for his work on the Carboniferous stratigraphy of Scotland.

His association with the Geological Society of Glasgow spanned 55 years; he was President of the society from 1926-29, and he was editor of the Transactions from 1937-58.

To the wider public, his name is well known through the 1965 "Excursion guide to the geology of Arran", of which he was the author.

Murray Macgregor's obituary was published in the Proceedings of the Geological Society of Glasgow for Session 108. It can be found at https://geologyglasgow.org.uk/docs/017_070__macgregor_pgsg_1967_108_1472317424.pdf.

Session 109 (1966-1967)

Extracts from the Proceedings for 1966-1967 (Session 109)

Meeting held on March 9, 1967

The following papers were read by members:

'A temporary exposure in Quaternary sediments at Renfrew' by Mr. P. Aspen and Dr. W. G. Jardine. (*This paper can be seen at https://geologyglasgow.org.uk/docs/017_070__gsgproc_109_renfrewquaternary_1487759821.pdf.*)

'Arthropleura — a giant "centipede" from the Coal Measures' by Dr. W. D. Ian Rolfe (*Scott. J. Geol.* **3**: 118-24).

'The explosion-breccia pipes near Kentallan' by Dr. D. R. Bowes (*Trans. R. Soc. Edinb.* **67**: 109-43).

Meeting held on September 7, 1967 (Extraordinary Meeting)

Dr. Patterson (*Edward M. Patterson, the society's president, whose biography can be seen at https://geologyglasgow.org.uk/docs/017_070__patterson_1485435312.pdf*) opened the meeting to a general discussion on the financial position of the society and the necessity for raising the subscription. Two main points emerged from this discussion. The first was a request for a widening of the qualification of Associate Membership, the second was for consideration to be given to any Member whose circumstances may warrant a reduced subscription.

The proposal to increase the subscription to £3 per annum was carried.

The previous subscription, held since 1960, was 30/- (£1.50), and so the new amount represented a 100% increase. Prior to the meeting, Dr Patterson sent a letter to all members giving a detailed justification for the increase. This letter, which contains a fascinating account of the society's subscription history and its financial situation in 1967, can be seen at https://geologyglasgow.org.uk/docs/017_070__gsgproc_134_pattersonletter_1487775217.pdf.

Session 110 (1967-1968)

Extract from the Proceedings for 1967-1968 (Session 110)

The obituary of James Ernest Richey appeared in the Proceedings for Session 110. James Richey was president of the society from 1929 until 1932. The obituary can be seen at https://gsocg.org/wp-content/uploads/2019/04/017_070__richey_1485117899.pdf.

A paper entitled "Quaternary deposits near Garscadden Mains, Glasgow" by W. G. Jardine was also published in this volume of the Proceedings. This paper can be seen at https://gsocg.org/wp-content/uploads/2019/04/017_070__quaternary_deposits_1518365145.pdf.

Meeting held on February 8, 1968

Two lectures were given at this meeting. The Proceedings contain the following summary of the first of these.

"Collecting on the Great Devonian Barrier Reef of W. Australia"
by Dr. W. D. Ian Rolfe.

The speaker, who was a member of the 1967 Joint British Museum, Hunterian Museum and Western Australia Museum expedition to the Fitzroy region, discussed how sedimentation in Middle and Upper Devonian times took place in the large intracratonic Canning Basin in northern Western Australia. Stromatoporoid reefs, which grew on a more stable, fault bounded shelf forming the northern edge of this basin, are now exposed as one of the finest examples of a palaeozoic reef complex. A great variety of facies is present and several rock units, some formerly thought to be of Carboniferous and Permian age, have recenty been shown, by refined correlation using ammonoids and conodonts, to be facies equivalents of the reef proper. Collecting was confined to concretions from the inter-reef facies which were known to yield a unique assemblage of at least six phyllocarid crustaceans and a number of early fish.

Session 111 (1968-1969)

Extracts from the Proceedings for 1968-1969 (Session 111)

Meeting held on October 10, 1968

Dr. K. A. G. Shiells delivered a lecture entitled "Palaeoecological Perspectives".

Dr. Shiells gave a general account of some aims and achievements in the study of fossils in relation to the environments in which they lived.

Dr Shiells and his wife were drowned in a boating accident in November 1968. This tragedy was referred to at the meeting of December 12, 1968 (see below). Dr. Shiells' obituary, which was published in this issue of the Proceedings, can be seen at https://geologyglasgow.org.uk/wp-content/uploads/2019/08/shiells.pdf.

Meeting held on November 14, 1968

[Two lectures were delivered by] members of the Society who had attended excursions in Czechoslovakia prior to the 23rd International Geological Congress in Prague.

Dr McLean outlined the regional geology which includes mountain chains of Variscan and Alpine age. In Slovakia the Carpathians may be divided into two structural areas separated by a "klippe" zone. The Inner Carpathians have nappe structures where Trias has been thrust north over Cretaceous for distances of 20 miles. There are intermontane basins containing poorly-

sorted sediments which have undergone spectacular weathering. Most of the country has not been glaciated.

Professor George described karst country with spectacular limestone caves. He also showed coloured slides of tufa at Carlesbad where recent volcanic activity has given rise to mineralizing hot springs.

Both speakers paid tribute to the Czechs for the magnificent work they had done in organising the Congress and expressed their regret that it had been disrupted by the Russian invasion.

Meeting held on December 12, 1968

The president referred to the recent tragic loss, in a boating accident, of Dr K. A. G. Shiells and his wife.

It was agreed that a letter of sympathy be written to Dr. Shiells' parents on behalf of the Society.

Session 112 (1969-1970)

Extracts from the Proceedings for 1969-1970 (Session 112)

Meeting held on October 9, 1969

Dr. C.D. Gribble (*University of Glasgow*) delivered a lecture entitled "Diamonds: prospecting and mining in Tanzania".

The speaker described the programme of prospecting in which he had taken part. Kimberlites are emplaced mainly within areas occupied by granite shields. During three to four months a team covers an area in the region of 3,000 square miles, sampling soils by use of a grid method in flat ground, sampling river sediments in undulating country, or by the use of barrages in hilly country with abundant water supply. Samples containing ilmenite, garnet and diopside indicate the presence of kimberlite and lead to more detailed search for diamonds. The chances of finding a diamond are very remote, however; only one part in 500 million parts of sample is composed of diamond. The speaker went on to discuss the origin of kimberlite pipes and the diamonds in them.

Meeting held on January 8, 1970

Dr S.E. Calvert (*University of Edinburgh*) delivered a lecture entitled "Mineral resources of the sea floor".

Marine mineral resources have attracted considerable attention in recent years. Oil, gas and heavy minerals are at present being recovered from relatively shallow water, but the mineral storehouse of the future is in deeper water.

Phosphorite deposits, found on many continental shelves, usually on the eastern sides of the oceans, although perhaps not forming at the present day, may have done so under different conditions in the recent past. In deeper water, manganese nodules cover large areas of the ocean floor. Compositions are variable but they generally contain relatively high concentrations of nickel, copper, cobalt, lead, molybdenum and zinc as well as manganese and iron. The total tonnage of metals in the nodules of the deep seas is much larger than commercial landbased reserves.

Session 113 (1970-1971)

Extracts from the Proceedings for 1970-1971 (Session 113)

Meeting held on October 8, 1970

Professor W.J. McCallien, University of the Gold Coast (Ghana) delivered a lecture entitled 'Some illustrations of Ghanaian rock structures'.

Sedimentary structures occur in Upper Palaeozoic rocks outcropping at intervals along the coast of Ghana from Accra westwards to beyond Takoradi. These varied and abundant structures were formed during and immediately after the accumulation of sediments in the shallow waters of the ancient seaway that separated the coast of the Gulf of Guinea from the shore of South America more than 300 million years ago. They occur essentially in sandstones and shales and point to a time when the sea floor of the region seems to have been very unstable and possibly affected by earthquakes.

William John McCallien (1902-1981) came from Tarbert in Argyll; after gaining his BSc in geology from Glasgow University in 1923, he joined the staff of the Geology Department. He was elected a member of the Geological Society of Glasgow in 1924, and in several talks that he gave on lecture nights over the next two decades, society members were able to learn about the results of his extensive research in Scotland and Ireland. In 1938 he was awarded the Neill Prize from the Royal Society of Edinburgh. In 1943 he was sent by the British Government to Turkey, where he eventually became Professor of Geology at Ankara and then Istanbul Universities. He moved in 1950 to Accra, where he remained until he retired in 1965; he then returned to Scotland, and he and his wife Catherine (also a Glasgow geology graduate) settled in Helensburgh.

Professor McCallien was elected an Honorary Member of the Geological Society of Glasgow in May, 1971, seven months after giving the above lecture.

Meeting held on November 12, 1970

Dr. A.C. McLean delivered his Presidential Address on 'The western edge of Scotland'.

The geological history and structure of western Scotland can be expected to reflect the origin and development of the adjacent parts of the Atlantic Ocean. Investigations carried out in the 1960s provide evidence of ocean-floor spreading from the Mid-Atlantic Ridge since early Tertiary times. The strip of oceanic crust to the west of the Rockall Plateau is 58 million years old, and spreading has taken place at 1-2 cm. per year. The Rockall Plateau is composed of continental crust with sedimentary basins and Tertiary igneous centres. The Rockall Trough consists of oceanic crust with a thick cover of sediments, but lacks the magnetic strip anomalies of the oceanic areas to the west. It may be oceanic crust that formed during the geomagnetically stable Kiaman Interval (Permian-Triassic) or the remnants of an even older proto-Atlantic.

Tertiary igneous activity at the western edge of Scotland is coincident with the initiation of the Lower Tertiary phase of ocean-floor spreading. It also triggered off further marked subsistence in the southern Irish Sea basin, and the easterly tilt of Scotland is also probably related. Deep Mesozoic fault-bounded troughs, found on the Scottish shelf, may have been produced by stresses associated with earlier spreading that formed the Rockall Trough. Their distribution to the south of Scotland, however, suggests that they are not related in a simple direct way to the continental margin, but are part of a structure comparable to the Rhine Graben and its northerly continuation, and that it converges at a low angle with the continental edge on the western Scottish shelf. Stresses associated with the developing margin may have triggered off fault movements and igneous activity within an older structural zone.

Carboniferous events in S.W. Ayrshire and the Firth of Clyde might, like the early Tertiary events, be associated with initiation of a phase of ocean-floor spreading.

Adam McLean PhD (1926-1983) graduated in 1948 with a degree in Geology from the University of Glasgow. After a career in industry, he returned to the Geology Department in 1954, specialising in geophysics to pursue extensive research in the west of Scotland and the Midland Valley. Dr McLean served as President of the Geological Society of Glasgow from 1967 until 1970.

Further information about the life and work of Dr McLean can be found in his obituary, which was published in Proceedings of the Geological Society of Glasgow for Sessions 124-125 (1982-1983), pages 8-10. This can be seen at https://geologyglasgow.org.uk/wp-content/uploads/2019/04/017_070__mclean_1485442426.pdf.

Session 114 (1971-1972)

Extracts from the Proceedings for 1971-1972 (Session 114)

Meeting held on October 14, 1971

Dr. Gordon Biggar (University of Edinburgh) delivered a lecture entitled 'Lunar geology and experimental petrology'.

The scale of major lunar surface features was related to familiar features on the Earth e.g. some of the mare are smaller, some bigger, than Ireland. The impact origin of the lunar basins resulted in the formation of complex breccias. The lava lakes filling the basins were later events.

Experiments left on the surface by astronauts still record information on the Earth's polar wobble (and related earthquakes), continental drift on the Earth, the lunar atmosphere, solar wind, meteorite impacts on the moon, moonquakes, and on lunar heat flow.

Mare-type basalts are the most clearly identifiable rock types. Texturally, plagioclase, olivine, pyroxene and titaniferous ores have crystallised together and experimental evidence at one atmosphere demonstrates that all commence to crystallize within about 20° C. Chemically they are characterised by low Na_2O, high TiO_2 (up to 12%) and a reduced state such that all the iron is ferrous and chromium is substantially chromous. These rocks are interpreted as the last few percent of liquid left near the top of a lava lake after 80 or 90% had crystallised. The low level of sodium and other volatile elements is due to volatilization into the near-vacuum above the moon.

A second suite of rocks contains anorthosites, gabbroic anorthosites, anorthositic gabbros and norite (all with low levels of volatile elements). These rocks do not have compositions corresponding to known liquids. Addition of Na_2O and H_2O to replace the amount lost by volatilization, and the application of slight pressure, does result in compositions from which plagioclase, olivine and pyroxene crystallise at much the same temperature. The origin of these rocks is not yet clear.

OBITUARY NOTICE

Stewart M. K. Henderson (1907-1972) was a geologist turned administrator. He removed to Glasgow from Brighton in 1926, when he entered the University to graduate B.Sc.with Honours in Geology in 1930. He was then nominated to the Baxter Demonstratorship, and pursued research on which he obtained the degree of Ph.D. in 1934. His original work was initially in

palaeobotany, in the description of plants from the Old Red Sandstone of Callander; but when he applied himself to interpreting the Ordovician rocks of Girvan he entered a field that allowed him to make substantial advances in sedimentology. His mapping in difficult ground threw light on the sequence in greatly deformed rocks; and his analysis of sedimentary characters notably of the Ardwell Flags enabled him to discern and interpret what would now be called flame-structures, load casts, slump bedding, convolute bedding, and other signs of high-energy and turbiditic transport, and to recognise a contrast between 'normal' conglomerates and breccias, greywacke conglomerates, and breccias formed by the lubricated slipping and fracturing of sediments in an unstable environment; and he recognised the possibility of a seismic triggering of submarine slides as a cause of some of the structures.

He was diverted from pure research when he was appointed to Kelvingrove as Keeper of Archaeology in 1935. Thereafter he devoted his life to promoting museum affairs in Glasgow. After service in the R.A.F. during the War he became in 1946 Keeper of Natural History at Kelvingrove, and in 1947 Director of the Museum. He succeeded Dr. T. J. Honeyman in 1954 as Director of Museums and Art Galleries for the whole of Glasgow. He finally retired in 1972. The high national esteem in which his organising and administrative ability was held was marked in 1970 by his election as President of the Museums Association.

T. N. George

Session 115 (1972-1973)

Extract from the Proceedings for 1972-73 (Session 115)

Meeting held on March 1, 1973

This was a joint meeting with Edinburgh Geological Society at which the celebrity lecture was given to an audience of over 350 people by Professor Sigurdur Thorarinsson of the Science Institute, University of Iceland.

"Tephrochronology and Recent Volcanism."

He described the tephrochonological method and outlined why there are special conditions for its successful application in Iceland.

Iceland's most famous volcano, Hekla, has played a central role in the tephrochronological studies in Iceland in general and in its application in volcanological studies. Hekla has been the country's biggest producer of tephra in postglacial times and its rhyolitic tephra-layers are the most widespread and important time markers in the postglacial soils of Iceland. Besides application in the studies of the eruption history of Icelandic volcanos such as Hekla and Katla, tephrochronology in Iceland has been applied to studies of fluvial and eolian erosion, glacier oscillations, dating of icecores and periglacial phenomena, as well as pollenanalytical studies, archaeological studies and in the establishment of tephrochronological connections between Iceland and other countries. The lecture included spectacular films of various Icelandic eruptions.

Session 116 (1973-1974)

Extract from the Proceedings for 1973-74 (Session 116)

MEMBERSHIP

The new office of membership secretary was created during session 116, in order to keep up to date the Society's membership list, so that prompt action could be taken on changes of address, resignations, subscriptions and arrears. Paragraph 10 of the constitution would be more strictly adhered to, so that those with subscription arrears of two years would automatically be deleted from our membership list.

The total membership at the end of session 116 was 386.

The total membership for session 114 was 352. The apparently anomalous figure of 340 for session 115 is accounted for by the larger than usual number of deletions of members in arrears. These were made as a result of the new system of keeping records.

Meeting held on November 8, 1973

Dr. D.S. Weedon delivered his Presidential Address on **"Tertiary Igneous Rocks of Skye – a Review."**

It is possible that igneous rocks of Skye have stimulated more petrological research that any other igneous suite within a comparably small geographical area; however, when coupled with the controversies regarding their nature and origins, they must indeed rate high for this petrological honour.

Stemming from the work of Macculloch, with his famous 1919 'Description of the Western Isles of Scotland,' in which he recognised that the gabbros and granites, basalts and felsites were a contemporaneous series of rocks, there arose subsequently considerable argument regarding the ages and origins of these rocks. Geikie, disagreeing with Macculloch, and subsequently with Judd on many points of discussion regarding these rocks, was answered by Judd: "The author agreed with Dr. Geikie on one point, namely, reluctance to enter upon this controversy . . . " However, he did.

Harker in his famous memoir of 1904, apart from excellent mapping and petrological descriptions, laid down firm age relationships for the igneous rocks. Richey, in an outstanding paper to our Society on 'Tertiary Ring Structures' [*Transactions,* vol.19, 1937, pp. 42-140] contradicted Harker in suggesting two centres for the Skye central complex, and other authors subsequently have questioned Harker's theories.

Since 1945, many petrologists have involved themselves in the problems concerning the Skye igneous rocks, and their age relations and modes of origin have been constantly questioned.

Meeting held on December 13, 1973 (Annual General Meeting)

The AGM was followed by **A Geological 'CALL MY BLUFF'.**
The panel members were Professor T. Neville George, Dr. J.G. MacDonald and Mr. G. King, and their opponents, who were the winners in the game, were Mrs. Jane MacDougall, Dr. B.J. Bluck and Dr. D.F.B. Palframan. Dr. Rolfe presided over the panel.

A vote of thanks was accorded to those taking part for a most enjoyable and entertaining evening, and also to Mr. Addison and Drs. Ingham and Rolfe for having arranged the game. Dr. M.J. McIntosh, of Glasgow University Library, had kindly laid out a display of geological dictionaries and glossaries for perusal after the meeting.

OBITUARY

Mr. Archibald Forrest, F.S.A. (Scot), the eldest son of a former provost of Lanark, was born near Lanark on 8th December 1884, and died after a short illness on 18th January 1974.
He came to Glasgow in 1905 and started his long and successful career as a butcher, in premises in Victoria Road, Glasgow. After the end of the Second World War he took his son,

Robert, into partnership in the business and finally retired in 1960. He played an active part in the charitable and trade organisations associated with his trade, and was President of the United Fleshers Society in 1930 and Deacon of the Incorporation of Fleshers in 1932.

Throughout his life he was a keen motorist and acquired his first car, an Argyll, in 1913, and he only ceased driving at the age of 82. An enthusiast of the royal and ancient game, he played regularly on the links at Wester Gailes course in Ayrshire and in due course was elected club captain.

His interest in archaeology led to his election as a Fellow of the Society of Antiquarians in Scotland and he joined the Geological Society of Glasgow in 1944, becoming a keen and active member. He was a 'weel kent' face at Society meetings and excursions for almost 30 years and rendered sterling service as an auditor to the Society. He specialised in semi-precious stones and created what is possibly the finest collection of cut and polished Scottish agates in Scotland today. He was a pioneer in the revival of the almost lost art of the lapidary in Scotland and was well known in lapidary circles in the U.S.A. which he visited, with Mrs. Forrest, on several occasions.

Archie Forrest was a quiet and courteous man, a good companion and a staunch friend. He was equally welcome and at ease in cottage or mansion and the older members of the Society will long remember him for his many small private courtesies and kindnesses.
He is survived by his wife with whom he celebrated his Golden Wedding in 1962 and his Diamond Wedding in 1972, and four of his five sons.

J. Stevens.

Session 133 (1990-1991)

Extract from the Proceedings for 1990-1991 (Session 133)

The annual **Members' Night** was held on 14 February 1991. The following illustrated talks were presented:—

Mr. A. Herriot — Refractometry for Beginners;

Dr. J.G. Todd — The Costa Del Clyde, 9000 B.C.;

Miss. R. McGill — North Island, New Zealand, a Geothermal Tour;

Miss. L. Ferguson — A Geologist in China;

Mr. A. McKelvie — The Hidden Depths of Kloof Gold Mine, R.S.A.;

Dr. T. Fallick — The Scottish Universities Isotope Geology Unit: what is it, and what does it do?, and

Dr. C. Burton — Jellyfish and other Monsters from Trearne Quarry.

Both before and after the talks, members had the opportunity to view the following exhibits in the laboratory beside the lecture theatre:—

A. Herriot — Refractometry – try for yourself;

C. Burton & N. Clark — Jellyfish and other Monsters from Trearne;

J.G. Todd — Fossils and Microfossils from the Clyde Beds at Linwood;

D. Hollis — Carboniferous Fossils from the Johnstone By-Pass;

J. Jocelyn — Selected Mineral Specimens and Thunder Eggs;

A. Roberts — L.A. Necker's 'Geological Map of Scotland, 1808';

M. Kennedy — Rocks and Minerals of Aberdeenshire, Part II, and

R. McGill — East Kirkton.

In addition, there were photographs and a video display relating to the Society's field trip of the previous summer to Durham and the north of England.

Session 134 (1991-1992)

Extracts from the Proceedings for 1991-1992 (Session 134)

Meeting held on November 14, 1991

Dr. Michael C. Keen (University of Glasgow) gave his Presidential Address to the Society. He spoke on "Global Events and Sea Level Changes".

The recent geological past has seen dramatic changes in eustatic (global) sea levels caused by the expansion and contraction of the polar ice caps. Whole continental shelves which were recently above sea level have been submerged during the past 10,000 years, giving rise to some of the earth's most spectacular features such as the Great Barrier Reef of Australia. These eustatic changes are clearly related to climatic change, and study of oceanic cores has shown climatic cycles of varying duration known as Milankovitch Cycles* (20k, 40k, and 100k years). These are increasingly recognised in the geological record as small scale cycles (1-2 Ma). While they are readily explained in the context of a glacial world, such cycles are more difficult to explain in a non-glacial world such as existed during the Jurassic and Cretaceous. Larger scale cycles, which form the basis of sequence stratigraphy, have a duration of 2-3 million years and are difficult to tie in with climate. Repeated transgressive-regressive events are seen as large scale coarsening-upwards cycles believed to be eustatically controlled. The succession of biofacies can help in their recognition. Not all sea-level changes are of eustatic origin, however. The Messinian salinity crisis of the late Miocene affected the whole of the Mediterranean Basin, but was brought about by geographical changes related to plate movement; the closure of the Straits of Gibraltar brought about the desiccation of the basin, with sea level changes of several thousand metres. Major regressions have had considerable effects on the biosphere, and are considered to be one of the prime influences on faunal turnover. The mass extinctions the Permian/Triassic and Cretaceous/Tertiary boundaries were examined in this light.

**The existence of astronomically-related climatic cycles, in particular the eccentricity (100 ka) and precession (23 ka) cycles, was first proposed by James Croll in 1857, 60 years before Milutin Milankovitch published his more detailed theory. More information about James Croll can be seen at https://geologyglasgow.org.uk/archive/james-croll/.*

Excursion to East Kirkton Quarry and the Bathgate Hills, September 19 1992 (Leaders Dr. A. J. Hall and Miss R. McGill)

This excursion was planned in relation to the East Kirkton Symposium held in Edinburgh.

The Lower Carboniferous sequence exposed in the quarry and excavated by the Royal Scottish Museum is interpreted as that of a lacustrine deposit with a hot-spring influence within a volcanic terrain. Its fame stems from its unique early terrestrial biota. The Petershill Limestone, rich in marine fossils, was also visited as well as the nearby site of Hilderston silver mine.

More information about the Hilderston silver mine can be found at https://canmore.org.uk/site/47939/silvermine.

Session 135 (1992-1993)

Extracts from the Proceedings for 1992-1993 (Session 135)

Meeting held on October 8, 1992

The new session again started with a social evening. This time it was to mark the publication of a new guide, 'Geological Excursions around Glasgow and Girvan'. A small presentation was made to the two editors – Doctor J.D. Lawson and Doctor D.S. Weedon – and to the person who won the competition to supply the photograph chosen for its cover, Professor B.J. Bluck.

Meeting held on January 14, 1993

The original speaker intended for the 14 January meeting called off. Dr. Con Gillen (Centre for Continuing Education, University of Edinburgh) kindly agreed to step into the breach at very short notice and to give a talk on "The Kola Superdeep Borehole, Arctic Russia."

The Superdeep Borehole being drilled at Zapotyarny in northern Russia is the world's deepest scientific well. It is located close to the town of Nickel on the border with Norway and Finland and is situated within the Pechenga copper—nickel ore field. Drilling has been continuing for 20 years, and the present depth of l2,266 metres has been reached on several occasions, due to technical problems causing collapse and the need for parallel wells to be drilled. The upper 7km of the section consists of Proterozoic volcanics and metasediments with several ore rich horizons, Archaean gneisses form the lower part, the lowermost unit so far encountered being a strongly sheared biotite-feldspar gneiss. No granulite facies rocks have been drilled to date. It is intended that drilling will continue to the planned depth of 15km.

The lecture considered the geology, geophysics and drilling technology of the well and the geological structure of the surrounding region in the Kola Peninsula, and discussed the progress of the large-scale joint international seismic experiment conducted in the spring of 1992, in which the speaker was among a team who carried out a 45km long surface reflection profile, linked to a 6km deep vertical seismic profile within the borehole.

Library Report (Session 135)

The Society's library, together with that of the Department, was completely reorganized this session. Thanks to a donation to the Department, by B.P., of a large amount of library shelving, the library annexe is now fully equipped. This has allowed the annexe to be filled with the Journal collection, some runs coming from storage. The space created in the library itself has been further reorganized and the full reorganization is now complete. A new library location plan will be issued shortly.

The reorganization generated a considerable amount of surplus material which the Council has authorized the librarian to dispose of. This material consists of duplicates, old stock, out of date (19th century) serials, etc. and will be removed section by section, with members having first refusal (or opportunity to purchase).

A new library leaflet for members is in preparation and will be issued to all members next session.

New books purchased this session cover as wide a spectrum as ever. The guides this year include those to the English Lakeland, Epping Forest, and the Quaternary of British regions and of China and Slovakia. Basic texts include the new edition of Holmes' 'Principles of Physical Geology' (ed. Duff), and Butler and Bells' 'Interpretation of Geological Maps'. Derek Ager's last, and still controversial, book 'The Nature of the Stratigraphical Record' is on the shelves. Two rather unusual books, 'A Faculty for Science' and 'From Anatomy to Zoology' represent part of the celebrations of the centenary of the University's Faculty of Science.

Regular borrowers this session numbered 22 (28 last session), borrowing between them 85 items (107 last session). One item of stock was destroyed while on loan - by the explosion of a melon in Death Valley - a story so tall that the librarian had no recourse but to believe it! The book was replaced by the borrower.

C.J. Burton

Chris Burton retired from the society's council in December 2017, after 45 years of continuous service.

Appreciation: Elizabeth R. Brock

Miss Brock, known as "Sally" to her close friends, was the oldest member of the Society at her death in September 1992, aged 97. She was also our longest serving member.

Born in Dumbarton, she moved at age two to the house that was to remain her home until her death. Appropriately enough, this house was known as "Spittal Cottage", apparently named after the source of the flags which formed the front path. Many years later, she was to search for fossil fish in the quarry in the village of Spittal which had given the house its name.

After completing her schooling in Dumbarton, Miss Brock progressed to the University of Glasgow, where she studied mathematics. As a female student, her degree required to be that of Master of Arts, subject notwithstanding. It was whilst at University that her interest in geology was kindled.

After leaving University, Miss Brock entered teaching. She first spent a short period teaching in the Hebrides. Thereafter she returned home to teach mathematics to countless pupils in Dumbarton Academy for the rest of her working life. Shortly after this return home, she joined the Geological Society of Glasgow, in 1927. She was a member of the Society for 64 years, eventually becoming one of the rare band of honorary members.

In geology Miss Brock's interests were wide. She collected mineral specimens in the Lang Craigs near Dumbarton in the heyday of that locality. She collected fossils throughout Scotland and further afield. Though always stating that she lacked the necessary patience to collect fossils successfully, her collection showed that she was perfectly able with hammer in hand.

Miss Brock served on the Society's Council as an ordinary member and then for 14 years until 1970 was the Excursion Secretary. This was a period of rapid expansion in the membership of the Society. This was due in no small part to her efforts in attracting additional members, particularly at the exhibition staged by the Society to mark its centenary in 1958.

Outside of geology, Miss Brock had wide interests in natural history, especially in birds and wild flowers. She was for many years a member of the Andersonian Society (later to become the Glasgow Naturalists). She was the last founder member of the West Dunbartonshire Natural

History Society still to attend its meetings. A few years before her death she was active in the establishment of the Dumbarton Natural History Society.

For many years Miss Brock shared house with another spinster sister. Miss Brock worked to earn their keep; her sister kept home. Not until the death of her sister, in Miss Brock's late sixties, did she start to learn to cook. Like anything else which she threw her energies into, she became accomplished at this too. One of my abiding memories of Miss Brock will always be her efforts to learn to speak German. She was in her 75th year when she started. Her classes involved a twice weekly train trip from Dumbarton to Glasgow. The reason for all this effort? She wished to be able to speak more easily with the locals when she went on her annual walking and mountain flower hunting trip to the Alps!

Always willing to give of her time to encourage newcomers to geology, especially youngsters, Miss Brock will be fondly remembered by all those who knew her. With her passing ends a link to the past of our Society. She could remember lectures by all of the great names of Scottish geology before the last war. To many of us who knew her well the Society will never be quite the same place without her.

P.M.M.

Session 136 (1993-1994)

Extracts from the Proceedings for 1993-1994 (Session 136)

Meeting held on October 14, 1993

[The first meeting of the session] was the occasion of the presentation of the T Neville George Medal to **Professor Diane Edwards** (University of Wales, Cardiff) in recognition of her work in the field of palaeobatany. Her lecture was entitled "In the Footsteps of Kidston and Lang". It is a fitting tribute to the enduring quality and fundamental nature of the research activities of these two Glasgow based palaeobotanists that their pioneering descriptions of early land plants are as relevant as ever to studies of terrestrialization. In this lecture Professor Edwards returned to some of their Scottish and Welsh Borderland assemblages and showed how technological developments such as scanning and transmission electron microscopy have extended their anatomical observations and very occasionally modified their assessment of affinity. She also explained how an integrated approach, involving zoologists, botanists, geologists and geochemists, can provide new insights into early terrestrial ecosystems.

Meeting held on February 24, 1994

Prof. Jake Hancock addressed the Society on "**Geology of Wine**".
Of the five controls on the quality of wine before the manufacturing process (grape-variety, type of yeast ferment, amount of warmth, supply of water and nourishment), geology is the major factor for the last three in most quality vineyards. Warmth is a critical factor in northern vineyards, as in Germany, where the best vineyards are directly related to orientation and angle of slope. Water supply is more complex, but ideally a vineyard-rock has a high porosity, high mass permeability and low matrix permeability. Nourishment of vines is mostly related to availability of K^+ but it is better for the nitrogen content of the soil to be low. The lecture was illustrated by examples from a broad variety of vineyards.

Summer excursions, 1994

May 7, 1994: Corrycharmaig, Killin

Leader: Dr A J Hall, University of Glasgow

18 people attended this excursion and the number of cars was limited to five due to access. he Corrycharmaig serpenenite is one of a number of intriguing small serpentinite bodies that occur in a linear zone extending through Middle Dalradian rocks of the Scottish Highlands from near Loch Fyne in the south east to the moray Firth in the north east.

We examined the textures and minerals present in the serpentinite and considered how the rock originated and was modified by regional metamorphism. Relatively unusual minerals such as antigorite, chromite, talc and magnesite are found here in abundance. There are old workings here representing trials for chromium ore but both the chromite and talc magnesite have been considered more recently for their economic potential as refractories. Other minerals of economic significance which are often associated with serpentenites are platinum, asbestos and, indirectly, gold. The serpentinite outcrops as crags on the side of Glen Lochay with Loch Tay visible in the distance and it is a particularly suitable locality for contemplating the problem of balancing man's consumption of metals and industrial minerals with the inevitable environmental consequences.

Access is easy, involving about a 1 km walk along a farm track from Corrycharmaig Farm (NN 528359) and up a gentle incline from about 150 m to 250 m; examination of the outcrops involves walking short distances up and down some fairly steep slopes but extending from about 250 m to only 350 m altitude. (OS 1:50000 sheet 51: Loch Tay)

August 17, 1994: Glensanda Quarry

Leaders: Mr I. MacDonald, Foster Yeoman
Miss A. Smith, Tarmac Roadstones

by David Wilkinson

Everyone turned up at the arranged time of 6.45 a.m. at the Boyd Orr car park. Dr Alan Hall, who was to lead the visit and drive the minibus, was there in very good time – he thought it was a 6 a.m. start!

During the drive up Loch Lomond the weather kept changing from bright sunshine to showers and our arrival at foster Yeoman's jetty at Rubha Garbh coincided with one of the gloomier periods. Looking down Loch Crerand towards Eriska and the Appin Peninsula however, the sea appeared silvery and smooth. As we threaded through the network of channels, past the island of Lismore and punched our way across Loch Linnhe, the sun came out and gave us spectacular views in all directions. Looking across the Loch to Glensanda, the red scar of the quarry workings just above the shore line was prominent, as was the road winding up the hill out of sight. Just to the south of the quarry buildings, in rather incongruous juxtaposition, was the rectangular tower of Glensanda Castle, decorated by the Saltire. Lying just offshore was a red and green ore carrier and on the shore line was a large shed and three conical heaps of aggregate.

The quarry manager, Iain McDonald, greeted us on our arrival and was introduced by Anne Smith, who had arranged the visit. We were then shepherded into the "man transporter", which is rather akin to a Portakabin mounted on a truck with massive wheels. Inside, the seating was comfortable and, as we zigzagged our way up the hill, Iain told us something about the quarry operations. Glensanda is worked continuously day and night except in exceptionally bad weather, for example in heavy mist at night, or, less frequently, after a very heavy snowfall.

When we arrived at the top, 2,000 ft up the hill, we were able to look at the "benches" where the rock was being excavated. These slices out of the hill were several hundred metres long and about 30 metres deep along each bench. The quarry is being gradually worked further into the hill towards the boundary fence in roughly a semicircular arc. The rock was predominantly

pink granite, well shattered and cut by several dykes of black basalt. The rock is not of particularly high quality, having a Polished Stone Value (PSV) of about 55, but it has good consistency and is widely used for concrete aggregate and road foundations.

There is an ICI plant on the site who provide the explosive used for blasting. The explosive used is inactive until the two components are mixed as they are poured down the pre-drilled blasting holes. After being blasted, the rock is transported by dumper trucks to the primary crusher, which breaks it up into pieces of about 20 cm cube. The crusher is somewhat like a giant pestle and mortar made of chrome steel with the mortar being in the form of an inverted cone. The crushed rock falls through a hole in the bottom of the cone. From the crusher, the rock is taken by conveyor to the "glory hole" – a 3.3 m diameter vertical shaft 300 metres deep. The shaft is kept full and the rock gradually falls as it is removed at the bottom and fed on to another conveyor. During its fall asperities on the "clasts" are abraded away, thus reducing the amount of final crushing required. This was one of several serendipities which came about with the utilisation of gravity for the transport of the rock.

Primary crusher, Glensanda Quarry (*David Wilkinson*)

A near horizontal tunnel 1.8 km long houses the conveyer which removes the rock from the bottom of the glory hole. This conveyer is a continuous, steel-cored rubber belt about 2 m wide. This emerges to the surface where a downhill conveyer takes the rock to the final crushing plant. Secondary and tertiary crushing produces a range of final sizes from 50 mm down to 4 mm. The quarry has its own water supply, which is essential, as it is sometimes necessary to add up to 3% water by weight to the aggregate to meet the user's specifications. The final transfer of aggregate to the ship is done by remotely controlled conveyer which allows a 75,000 tonne ship to be loaded in 24 hours.

The economics of quarrying are important, just as with any other business, but Foster Yeoman seem willing to wait longer than the average company for their return on their capital investment. This may be because they are a family owned company, but they also anticipate that the quarry will have a lifetime of eighty years, and it gives them control of the product from production to the point of use. Much of the English half of the Channel Tunnel has been constructed from the Glensanda aggregate; it is exported to Germany and even to the USA. Current maximum productive capacity is 5 million tonnes per annum, although the ultimate planned capacity is 15 million tonnes per annum. The company have not stinted the investment required, although the depressed state of the economy means that some of the projected development has been held back. All our party were very impressed by the scale of the quarrying and the efficiency of the operations. All quarrying operations have effects which are social, economic and environmental and Glensanda is no exception. There are arguments against disturbing an area of great scenic beauty, but, compared with large quarries I have

seen in Germany, France, Italy and mainland Britain, Glensanda seems a model of an attempt to minimize pollution of the environment.

Our visit was well organised, visually stunning and extremely interesting. Our thanks go out to Foster Yeoman, Iain McDonald, Anne Smith, Allan Hall and Rosemary McCusker, who made this event so rewarding.

Nearly seven years after this 1994 Glensanda excursion, David Wilkinson, the writer of the above report, was one of four members of the society killed in a road accident. A statement in the Proceedings for Session 143 begins, "It is with deep regret that the Council records a serious road accident on Friday, 18th May, 2001. This occurred on the A9 north of Blair Atholl as members were travelling north by minibus to Durness for the first excursion of the Society's summer programme and were involved in a collision with a jeep travelling south." The report goes on to pay tribute to David Wilkinson and to each of the other three members of the society who died in the accident.

Session 137 (1994-1995)

Extracts from the Proceedings for 1994-1995 (Session 137)

Meeting held on October 13, 1994

Session 137 started with a very interesting and informative talk by Dr. Robert Muir-Wood (EQE International Limited, Warrington) on "Tectonics versus Glacial Rebound as the Cause of British Earthquakes". There are more earthquakes in Scotland than in the rest of the British Isles, and this gave rise in the last century to the building of the little 'earthquake house' in Comrie, Perthshire, due to the amazing frequency of the occurrence of the 'quakes in that area, albeit rather small ones. Those earthquakes occurring in England and Wales are on the whole larger; some areas, however, notably the whole of Ireland, are almost devoid of seismicity. Dr. Muir-Wood discussed the possible causes of this activity. Considerable variety and complexity of tectonic activity occurred around and through Britain during the Tertiary, when it lay in a broad sub-plate boundary shear-zone connecting the Alpine and North Atlantic plate boundaries. A major episode of compressional deformation is also found in north-west Britain accompanying the re-invigoration of the Iceland hot spot in the Miocene. However, comparative studies in other regions of post-glacial rebound, including Fennoscandia and North America, show strong parallels with Britain and also provide an explanation for the Irish seismic paradox.

Excursion to Alva Silver Glen, May 6, 1995

Leader: Dr. A.J. Hall, University of Glasgow

Report by Dr. Ben Browne

On a bright spring morning, twenty-six members assembled by the old mill at the foot of Alva Glen (NS 885975) on the line of the Ochil Fault.

A walk up Alva Glen alongside the old iron pipe which supplied the mill demonstrated good exposures of a coarse agglomerate of Devonian lavas intruded by a Permocarboniferous dolerite sill, an association possibly giving rise to hydrothermal systems and the mineralisation of Silver Glen. The story though is complicated by the occurrence of mineralisation of Tertiary age in the same general area.

Returning from Alva Glen, a traverse eastwards across a green hillside brought us to the wooded Silver Glen (at NS 892974) so named in memory of a great bonanza find of silver ore worked out in the eighteenth century.

Working upstream on the eastern bank of the burn, traces of old workings were very evident, and on recrossing the burn just above a fall, we came across none other than Dr. Stephen Moreton sifting spoil tips for silver. Dr. Moreton has made a great study of this mine and its history, and has revised previous ideas on the location of the main mine. We were most fortunate to be treated to a discourse on the historical detail eagerly awaited in Dr. Moreton's pending publication.

The mine was opened in 1714 on the land of Sir John Erskine. The ore was assayed by none less than Sir Isaac Newton as Master of the Mint and found to be good. Soon the greatest bonanza find of silver ever known to be found in the British Isles yielded £40-50,000 in fourteen weeks, without counting the ore stolen by miners. Sir John became incredibly rich and improved his estates, but he supported the Jacobite rebellion and so was exiled to France. It seems he was able to buy his reprieve with a promise to open his last mine. The venture proved disappointing and the bonanza was never repeated. The next to try his luck was Charles Erskine in 1759. He found not silver but cobalt ore "the colour of peach blossom". This ore was used to make a blue glaze in the Prestonpans pottery.

On picking over Dr. Moreton's discarded siftings, we were able to find grains of cobalt ore and pan out flakes of silver, so were were able to go home happier and wiser, if not greatly richer.

Session 138 (1995-1996)

Extracts from the Proceedings for 1994-1996 (Session 138)

Meeting held on October 12, 1995

Session 138 started with "Constraints on Rapid Rates of Metamorphism in the North-West Himalaya" by Dr. Peter Treloar, (Department of Earth Sciences, Oxford). Dr. Treloar looked at the relationship between deformation and metamorphism in the North-West Himalaya. He gave us a detailed explanation of how the dissipative heating associated with friction permitted the attainment of high temperature and rapid metamorphism in the Indian Plateau within 10my of collision.

Meeting held on December 14, 1995

After the business [of the AGM] was conducted, the Social Evening started off with a geological quiz based on musical themes. Two teams competed to identify the geological connection in a number of musical items. Jim MacDonald was not able to be present in person, so he had recorded the musical themes – all played by himself on his clarinet.

Meeting held on March 14, 1996

Dr. Adrian Lister (University College, London) gave us a very interesting and entertaining talk entitled "The Natural History of the Mammoth". This is one of the best known extinct species of mammal. A lot of detail has been preserved in the frozen mammoths found in Siberia. The woolly mammoth evolved from an African ancestor and appeared in Siberia at the start of the Ice Age. Their food was mainly grasses, mosses, ferns and small shrubs; they had only four teeth, but there were six sets of them – replaced from the back of the jaw, and each set bigger than the previous one. Their extinction came 10,000 – 12,000 years ago, possibly by a combination of climate change leading to a change in vegetation, and overhunting by the

growing human population. Mammoth bone huts have been discovered in Siberia – one with the remains of 96 mammoths in the one hut – were they collected or killed?

Session 139 (1996-1997)

Extracts from the Proceedings for 1996-1997 (Session 139)

Meeting held on October 10, 1996

The first meeting of Session 139 was the occasion of the presentation of the **T. Neville George Medal** to **Professor Bill Chaloner** (Royal Holloway University of London). His subject was **"Fossil Plants and Climatic Change."** The sedentary character of terrestrial plants gives them a direct and total dependence on the climate of their habitat. As a result, fossil plants offer a unique record of climate change through time. For as far back as plants can reliably be assigned to extant species, this "climatic signal" can be read with some precision. Fossil plants can also offer a basis for assessing changes in atmospheric composition, most notably carbon dioxide, which is linked through the "greenhouse effect" to global climate.
Professor Chaloner reviewed some of the recent results in this field.

Meeting held on January 16, 1997

1997 started with a lecture by **Mr. Norman Butcher** of Edinburgh. His topic was **"1797-1997: The Legacy of James Hutton and Charles Lyell"**. 1997 marked the anniversary of the death of James Hutton and the birth of Charles Lyell. These two major figures in Scottish Geology are recognised world-wide for their contribution to our understanding of the Earth. The lives and works of the two great geologists were compared and contrasted, their contribution to geology assessed as was the development of the Geological Sciences since their time.

Meeting held on April 24, 1997

The lecturer on 24th April was **Dr. Godfrey Fitton** (Department of Geology and Geophysics, University of Edinburgh). His talk was entitled **"Ocean Drilling and the Icelandic Plume"**. The North Atlantic margins provide a unique natural laboratory in which to investigate the role of mantle plumes in the break-up of continents and the formation of large igneous provinces. The opening of the ocean 60 million years ago was accompanied by the eruption of vast amounts of magma, most of which lie beneath the sea. The international Ocean Drilling Program has recently devoted two two-month legs of drilling to study volcanic rocks off the southeast Greenland coast. The results provide a detailed record of the initiation of the Iceland plume and the birth of the Atlantic Ocean.

EXCURSION

RIVER AYR AND HEADS OF AYR: 14th June 1997

Leader - Dr. G.E. Bowes, formerly University of Glasgow

by Monica Thorp

On 14th June 1997, Dr George Bowes led a large party to the Ballochmyle Gorge near Howard Bridge, and then to the Heads of Ayr.

The River Ayr cuts a very attractive gorge through Permian (New Red) sandstone near Ballochmyle, which is now bridged by what is possibly the largest single-span masonry arch in the world, the Ballochmyle Viaduct, that carries the railway line from Glasgow to Dumfries. This remarkable example of early Victorian engineering was built in 1846-7 from quarries

opened for the purpose of the gorge itself, so given both natural and artificial exposures we had excellent opportunities to work our way down the succession.

In the highest quarry we saw good examples of dune bedding orientated East to West, suggesting Saharan latitudes and the influence of the northeast Trade Winds. At river level we were shown a different fabric: a laminated sequence with occasional small lenses of cross-bedding (sections of ripple-marks), indicating that this was water-laid sand, probably in a transient lake in the desert. Coarser bands consist of secondary depositions typically wind-rounded 'millet-seed' sand grains. The sandstone was deposited on top of late Carboniferous-early Permian lavas, and working up the gorge and yet further down the succession we could see dark fragments of volcanic debris within the sandstone. Finally we reached the lowest level, at which perhaps 70% of the sediments consist of water-laid igneous debris.

Leaving Ballochmyle, we then travelled further through Burns country to the coast, into sunshine and back into Old Red Sandstone times, at the heads of Ayr. Here at the southern end of the bay are Devonian lavas and hydrothermal veins. Amygdales of deep blue-green chlorite, and veins of red jasper abound, and one small agate was found. Coming round the bay one moves up the succession into Old Red fluviatile conglomerates. These have been cut by tertiary dykes of the Arran dyke-swarm, which have been excavated by the sea to leave deep slots in the cliff, and baked margins. In the middle of the bay, steeply dipping cementstones, of Carboniferous age, have been downfaulted and are exposed below the Old Red cliff.

At the northern end of the bay is a large volcanic vent dating, like the lavas at Ballochmyle, from Permo-Carboniferous times. As we worked round the bay we first encountered water-laid tuff, then dykes running perpendicular to the high cliff, below which is an extensive wave-cut platform providing a horizontal section through that part of the vent. Across this, along faults, are intruded *en echelon* lenses of Tertiary (Arran) dykes. Outcrops of agglomerate show good examples of spheroidal weathering. By the time we got there the tide had covered what is thought to be a raft of sediments that fell into the vent and stayed there.

The most enjoyable day ended at a cave in the cliff where a substantial piece of what appeared to be wood is incorporated into the rock, suggesting that a tree growing on the edge of the vent had been caught up in the agglomerate during an eruption, and silicified.

Our thanks go to Dr. Bowes for an excellent excursion.

Session 140 (1997-1998)

Extract from the Proceedings for 1997-1998 (Session 140)

Excursion which took place on May 30, 1998

THE WHANGIE: 30th May 1998

Leader: Dr. J.G. MacDonald, University of Glasgow
Participants: 56 (30 from Glasgow: 26 from Edinburgh)
Report by: *Sally Rowan*

This, our annual joint excursion with the Edinburgh Geological Society, was a popular and successful excursion to this unusual and dramatic group of igneous rocks attended by around sixty people – Glasgow 30, Edinburgh 26.

Most people met at the Queen's View car park on the Drymen Road, just north of the Carbeth Inn. The large turn-out entailed some good-natured car-arranging before we set off. The weather was mild, although overcast, and remained a pleasant walking day.

A **Whang** is a slice or crack (of a whip?) and one legend has it that the Whangie was created by the Devil's tail cracking the ground open. Oddly enough, this legend seems to be relatively recent – the 18th Century Statistical Account of Scotland mentions the area but refers to no legends. There are descriptions of fissures which had to be infilled to prevent sheep falling in. This apparent lack of history could be because the area was pretty inaccessible until the Agricultural Revolution, or could indicate a relatively recent formation in the early 17th Century.

Tyrrell considered it possible the Whangie was formed following an earthquake described in Church of Scotland records in 1609. This quake was felt as far afield as Edinburgh, St. Andrews, Dundee, Aberdeen and Dumbarton. There was a lot of panic – a day of penitence and fasting was declared – and scapegoats such as Sabbath-breaking fishermen were sought. The magnitude of the earthquake seems therefore to have been much greater than anything since.

The Whangie is a slice of microporphyritic Jedburgh basalt detached from the Western edge of the Kilpatrick Hills. Its most obvious feature is huge vertical slices of grey rock towering at least 10 metres high, separated by narrow fissures. Many of the rock slabs display conchoidal fractures. There are three main sections, all narrowing towards the South. The last is the narrowest, with nearly vertical sides, while in the second the outward slope of the structure decreases. Overall, the main slabs and fissures seem to have a radial pattern – inner ones narrower and steeper, outer ones wider and shallower, all appearing to meet at a central point deeper down. There are several "mini-Whangies" nearby. Some of their fissures pinch out, and when covered over by tussocky grass make good ankle traps. They are also disconcertingly deep and tallied with old descriptions.

Modern geologists still dispute its origin but the outcrop nestles beside and slightly downhill from what seems to be a volcanic plug of porphyritic Markle basalt with large phenocrysts, although the exact nature of their association is unclear. Current researchers are trying to obtain a magnetic profile of these rocks. Usually, plugs are fresher and so have a stronger magnetic signature. It is possible that the Whangie is part of one very thick lava flow which was later intruded by the Markle basalt.

The most likely cause of the Whangie's formation is the Ice Age, when huge sheets of ice must have flowed past and around and maybe even under the Jedburgh basalt. Its pre-glacial extent is unknown, but the ice must have put tremendous stress on this corner. There is very little jointing in the Whangie's basalt, except for some on a small scale at the top, suggesting it was extruded. It seems that as it was stressed, the basalt has peeled off in big slabs and fallen away from the cliff rather than a landslip, which could account for the fissure pattern.
Dr. MacDonald was thanked for his thorough preparation, handouts and enthusiasm. After an enjoyable and thought-provoking day, almost fifty of us from both Societies descended on the Kirkhouse Inn, Strathblane for a good meal and more conversation.

Session 141 (1998-1999)

Extract from the Proceedings for 1998-1999 (Session 141)

Meeting held on October 15, 1998

Dr. Peter Kokelaar of the Earth Sciences Department, University of Liverpool

CALDERA MODEL IN BITS: GLENCOE REVISITED

Since the work of Clough, Maufe and Bailey (1909), the Glencoe volcano has been taken to exemplify caldera collapse in which coherent-block subsidence occurs piston-like along a ring-fault during a major eruption. However, recent detailed mapping of the Glencoe caldera floor

and fill, and reconstruction of five intracaldera ignimbrites, show that collapse was incremental and that it involved complex movements of numerous fault blocks. Caldera depocentres shifted throughout the early volcanic history, before formation of the ring-fault. This "piecemeal" caldera collapse was profoundly influenced by tectonism along pre-existing major faults trending NW and NE. A dominant NW-trending graben controlled the major depocentres and persistently channelled a major river through Glencoe, probably flowing towards the active Great Glen Fault. Glencoe shows that the "piecemeal" nature of calderas may only be plainly evident in deeply dissected systems and suggests that piston-like subsidence is less common than hitherto recognised. Major aspects of the new interpretation of Glencoe were presented and the implications for old caldera models explained simply.

Meeting held on March 11, 1999

Dr. Alan Gibbs, Midland Valley Exploration, Glasgow

VIRTUAL GEOLOGY – TIME TRAVEL AND FIELD WORK WITHOUT THE RAIN?

Geology involves us in the process of making observations and then trying to place these in the context of a model which allows us to understand the geological processes in space and time, which gave rise to present day geology. The development of geological tools to take advantage of recent advances in computer graphics gives rise to new capabilities in our science. In particular, we can now work in full three dimensions rather than on flat paper and then use the power of the computer to travel through geological time.

Meeting held on May 13, 1999

MEMBERS' NIGHT

The summaries that follow are a selection of the short talks given by members.

Stephen Thomson spoke on the 1998 **Expedition to the Breidamerkurjokel glacier in the SE of Iceland.** This was a joint expedition (for which the Society provided financial assistance) of geographers and one geologist from Glasgow University studying the sedimentation in and around a glacial lake and seven civil engineers from Loughborough University updating maps of the area. The glacier no longer reaches the sea but calves icebergs from its toe into a lake which in turn discharges to the sea through many more meltwater channels than were mapped on the last survey. Traversing the area is difficult with a "new" road bridge now threatened by icebergs in a meltwater channel.

Dr. Neil Clark – A Stegosaur from Scotland – All the earlier finds described on Skye have been on the Trotternish Peninsula in the north of the island. In Berreraig Bay two pieces of ulna and radial elbow bones of the fore limbs of a dinosaur were found. From their size and shape the animal walked on all fours. They were compared with the appropriate bones of a Stegosaurus with which there are many similarities. In fact no other animal remains, especially from the Jurassic, exhibit the same characteristics, although there were some from the Cretaceous. From the fossil assemblage, these Skye bones were dated in the Middle Jurassic, Bajocian Stage. Prior to this, the earliest Stegosaurus discovery came from the Lower Bathonian Stage, the one above the Bajocian, of the Jurassic. So these Skye bones came from the **oldest** Stegosaurus in the world!

Although only five dinosaur bones have been found in Scotland they represent a range of animals – Femur of a plant-eating Sauropod, a rib bone, possibly of a Sauropod, a vertebra of a Sauropod, one vertebra of a Coelophysis, and the Stegosaurus.

Roy Smart – "In the beginning" – An entertaining selection of excerpts from the History of the Geological Society of Glasgow 1858-1908 concerning some of the very early (1859) excursions

of the Society, many of which started on Saturdays after 1 p.m. because most people had to work on Saturday mornings. Although there were some railways, transport was mainly by horse-drawn omnibus, followed by a lot of walking, with reports of a strange sight of a group of people walking through the villages of Bearsden and Milngavie. Only if public transport was unavailable and the walking distances were too great did the Society hire an omnibus and charge an appropriate amount for its use.

Excursion reports – all non-geological – were a collection of personal recollections and comments, including a rebuke in one about the excessive taking of refreshments. This was tempered in another when members had to repair to the local inn in Strathblane while the horses were rested for the return journey to Glasgow.

Allan Hall – Island of Melos (100 miles S of Athens)

This island, where the Venus de Milo statue was found, has no airport and therefore has few international tourists. It contains several connected volcanic centres, all now extinct, which caused high grade metamorphism. The resultant hot springs created deposits of sulphur, gypsum, alum, and china clay, all of which have been extensively worked, leaving only the coastal fringe untouched. Because of the economic importance of these deposits, the island has a long human history, with a map from 200 B.C. The many archaeological sites are now protected by guards.

Obituary

Alexander Herriot, M.I.C.E., M.C.I.W.E.M. 1913-1999

From time to time there emerges someone who, while pursuing a successful career in one profession, is remembered by many of those who knew him for the contributions he made in another field of activity; Alex was one of these. From boyhood he spent many holidays on the island of Arran. Later in the 1930s, while studying Civil Engineering, it is perhaps unsurprising that he took up an interest in geology as a hobby. What is more remarkable is that, having equipped himself with a petrological microscope, and having mastered the use of this instrument in the study of thin sections of rocks, he acquired a mastery of igneus petrography of truly professional standard.

Alex joined the Society in 1937 and devoted a lifetime of support to it thereafter. He was a member of council for 35 years, held the office of Treasurer and was elected President from 1976 to 1979. His interest in Arran and its igneous rocks in particular never abated. It is no exaggeration to maintain that his knowledge of the island was unsurpassed, and when the professionals needed help, they could rely on Alex to keep them right on the intimate details of the outcrops there. He published a number of papers in the Scottish Journal of Geology and the Society's Proceedings, and was co-author in 1983 of the third edition of the Geological Guide to Arran. The value of his work was acknowledged by the British Geological Survey when it incorporated many of Alex's observations in the 1987 edition of the geological map of the island.

His interests in geology were not confined to Arran. He collected material from many parts of the British Isles and from further afield. One certain way to please was to present him with a piece of some exotic rock from a far country. His only stipulation was that it had to be big enough to make a thin section of it. Latterly, his collection of thin sections exceeded 5000, and it is now housed in the Hunterian Museum, where it constitutes a remarkable memorial to his skill and passion for igneous petrography. This enthusiasm was infectious. With Alex's encouragement, many of the Society's members were encouraged to take up the making of thin sections as a hobby, and there was a surge in the sale of Canada balsam.

Alex's service to the Society was recognised in 1983, when he was made an Honorary Life Member. In 1990 he was presented with the Worth Medal of the Geological Society of London

in recognition of his ‘scholarship and devotion in the advancement of geology’. But above all, he is remembered with affection by all who knew him, for his passion for geology, his patience and good humour when he taught others the skills that he had acquired, and the meticulous attention to detail that accompanied his investigations in the field or under the microscope.

J. G. MacDonald