Proceedings of the Geological Society of Glasgow

Sessions 106 and 107 issued February, 1966

Previous Proceedings of the Society have been published as part of the Transactions of the Geological Society of Glasgow. With the joint publication by the Edinburgh and Glasgow Societies of the Scottish Journal of Geology it was resolved that the Proceedings should be published separately. The present issue covers two Sessions but it is hoped to issue future Proceedings annually, each number covering one Session.

Short notes, not exceeding 1,000 words, recording details of temporary exposures, new fossil, mineral and rock records, etc, are invited for publication in future issues of the Proceedings.

W.D.I.R.

Publications

The final part of the Society's Transactions, volume **25** (1), was issued in February, 1964. Volume **1**, parts 1 and 2 of the new Scottish Journal of Geology were issued to members in January and May 1965. A complete list of papers in the Transactions was published in 1965 and copies of this, together with lists of periodicals and text-books currently available in the Society's library, are obtainable from the Librarian.

The 'Excursion guide to the geology of Arran' by Dr Murray Macgregor was published early in 1965. Copies are still available at 12s. 6d.

Membership

The total numbers of members at the ends of Sessions 106 and 107 were 229 and 250 respectively.

Obituary Notices

SIR EDWARD BAILEY, a member of our Society since 1919, President from 1932 to 1935 and Honorary Member since 1958, died in London on 19 March 1965, aged 83.

Edward Battersby Bailey, son of a doctor, was born in 1881 in Marden, Kent. In 1899, from Kendal Grammar School, he won an open scholarship to Clare College, Cambridge, where, in 1902, he gained First Class Honours in geology and in physics, in Part II of the Natural Sciences Tripos, and won the Harkness Scholarship. He was later elected an Honorary Fellow of Clare College (1944).

Bailey joined the Geological Survey in 1902 and worked in Scotland until 1915, when he was commissioned in the Royal Garrison Artillery. He served as a subaltern in France, was twice wounded, gained the Military Cross and the French Croix de Guerre with palm, and was made a Chevalier of the Legion of Honour.

On coming back from the war in 1919 Bailey served as District Geologist in west Scotland until December 1929, when he became Professor of Geology in Glasgow. He returned to the Survey in 1937, to serve as Director until his retirement in 1945.

Between 1908 and 1930 Bailey was concerned with fourteen Geological Survey 'one-inch' maps and memoirs. His earlier work included petrological descriptions of the Carboniferous volcanic rocks of East Lothian and the Campsie Fells (1910, 1911). With C. T. Clough and H. B. Maufe he demonstrated cauldron subsidence in Glen Coe and traced great recumbent folds in neighbouring schists; the official account was given in a memoir compiled by Bailey (Geology of Ben Nevis and Glen Coe, 1916; revised ed. 1960). Bailey was also one of Clough's Survey team working on the Tertiary volcanic complex of Mull. His compilation of the classic Mull Tertiary Memoir (1924) and of the accompanying map and relief model was a major achievement. Mull provided evidence of a caldera-lake with pillow-lavas, and of ring-dykes, innumerable cone-sheets, and a great dyke-swarm.

Bailey enjoyed his Glasgow Professorship. He guided students in research in the Highlands and Lowlands, and collaborated with his staff—for instance with W. J. McCallien on schists in Scotland and Antrim and with J. Weir on Mesozoic rocks in Sutherland. With Weir and McCallien he published a geological text-book (1939).

Bailey's Survey Directorate (1937-45) was mainly in time of war. He was thus chiefly concerned in organising research on rocks and minerals of economic importance. In this task his Assistant Directors, T. Eastwood and M. Macgregor, were given very considerable scope. An account of results achieved is given in his history of the Survey: *Geological Survey of Great Britain* (1952).

Bailey's wider studies of Scottish schist tectonics were made unofficially and published in scientific journals. During periods of leave, over many years, he scoured the Highlands from Islay to Braemar—an achievement made possible only by his ardent enthusiasm and remarkable physique. In this large area he modified stratigraphical groupings and re-interpreted structure in terms of great recumbent folds and slides (fold-faults). His views met with opposition and from time to time he modified them and, with good grace, accepted corrections due to others. The broad lines of his modified syntheses have proved sound. He also re-assessed the tectonics of Moine Thrust areas in Skye and Glenelg (1939, 1955) and in Assynt (1935).

Visits to Scandinavia, Switzerland, Canada and the United States, and

assiduous reading, gave Bailey an encyclopaedic knowledge of tectonic research. In 1928 in Glasgow, as British Association Section C President, he gave a brilliant account of the Palaeozoic mountain systems of Europe and North America. His delightful book *Tectonic Essays* (1935) contains a summary of world tectonic research and details of Alpine structures and their elucidation. In later years (1948-53) Bailey published tectonic re-assessments concerning Iran, Provence, Gibraltar and Turkey—the latter in collaboration with W. J. McCallien.

The Survey memoir on Ben Nevis and Glen Coe contained Bailey's petrological account of the local Devonian igneous rocks (1916, 1960). He also wrote a wider study in which he inferred that the parental (hornblendic) Devonian magma was relatively rich in water as compared with the (pyroxenic) parent magma of Tertiary times (1958). Bailey also elucidated the structural igneous tectonics of the Tertiary volcanic complex of Rhum (1945).

Partly furth of Scotland, between 1952 and 1960, Bailey, in collaboration with W. J. McCallien, dealt with associated occurrences of serpentine, pillow-lava and radiolarian chert at Ballantrae, in Turkey and in the Apennines. The research supported hypotheses of a submarine volcanic origin for both of the igneous rocks. With McCallien at Slieve Gullion (1956) Bailey inferred that dolerite had cracked before its crystallisation had gone far and so had been locally chilled against veins of colder granophyre magma intruded along the cracks.

Bailey made important contributions to general geology. After a visit to Canada in 1927, as a guest of the Princeton Summer School, he published, with L. W. Collet and R. M. Field, a re-interpretation of the Quebec and Lévis conglomerates; these he regarded as products of submarine landslips along the line of the 'Logan Slope' (1928). It was also suggested that the Kimmeridgian Boulder Beds of East Sutherland originated in a similar manner, along a submarine fault-scarp. With J. Weir, he later re-investigated the Brora area and confirmed his hypothesis in a paper of great interest (1932). Bailey's Quebec visit led him to regard recurrent graded bedding in the Silurian of the Southern Uplands, and in the East Sutherland Boulder Beds, as due to tsunamis produced by successions of earthquakes (1930, 1932).

Other examples of Bailey's contributions to general geology are as follows: glacial retreat phenomena in East Lothian worked out (1908: with P. F. Kendall); glacial strand-lines of Loch Tulla described (1923: with J. Mathieson); desert conditions inferred around shores of the Chalk sea (1924); subterranean penetration of a Permian desert climate inferred in Arran (1926); breaks in flora and fish-fauna of the Scottish Carboniferous attributed to spread of deltas (1926); accounts of evolution of Scottish scenery (1934, 1960).

Bailey's contributions to the history of research in *Tectonic Essays* and in *Geological Survey of Great Britain* have already been mentioned. Many of his papers dealt in detail with the sequence of previous work and ideas. Late in life he published a biography of Charles Lyell (1962) and at the time of his death a life of James Hutton was in manuscript.

Bailey's international eminence is attested by his election to foreign membership of the national academies of Belgium, Norway, India, Switzerland and the United States of America and by an honorary doctorate conferred by Harvard University (1936). At home he was awarded honorary doctorates by the Universities of Birmingham (1939), Glasgow (1946), Belfast (1946), Cambridge (1952) and Edinburgh (1964).

Bailey was a Fellow of the Royal Societies of Edinburgh (from 1920) and

London (from 1930), and he had been President of the Glasgow and Edinburgh Geological Societies, and a Vice-President of the Royal Society of Edinburgh and of the Geological Society of London. He was knighted on retiring from the Survey in 1945.

Other honours included: the Neill Medal (Roy. Soc. Edin., 1929), a Royal Medal (Roy. Soc. Lond., 1943); the Bigsby, Murchison and Wollaston Medals (Geol. Soc. Lond., 1923, 1935, 1948) and the Clough Medal (Edin. Geol. Soc., 1962).

Bailey owed much to early association with B. N. Peach, C. T. Clough, H. B. Maufe and W. B. Wright and to foreign friends, such as L. W. Collet, O. Holtedahl and R. M. Field. He was a dedicated and inspiring research worker, gay, sometimes extravagant, occasionally intolerant, but one of the great geologists of his time.

Bailey married Alice Meason in 1914. The partnership, ended by her death in 1952, was an ideal one, and the hospitality of their happy home will never be forgotten by those privileged to enjoy it. In 1962 Bailey married Miss Mary Young; she, and the son and daughter of the first marriage, survive him.

A.G.M.

LIONEL E. HOLLOWAY was born at Islington on 5th August 1898, and died in 1965, on his birthday. He was educated at Dartford Grammar School. In 1933 he came to Renfrew as an engineer in the firm of Babcock & Wilcox where he was until his retiral in 1963.

Interested in the study of rocks as a youth, when he came to Renfrew he joined the Paisley Naturalists' Society, and was an active member for several years. He also attended Evening Classes on Geology at Glasgow University. There he was always ready to interest and assist budding geologists, and was instrumental in recruiting members for the Society to which he himself had been elected in 1943. He served on the Council (1944-47 and 1958-61) and was appointed Vice-President (1951-54). From 1949-52 he acted as Excursion Secretary. In 1944 he was elected a fellow of the Geological Society of London.

That Mr. Holloway took full advantage of geological excursions at home, and later abroad, is manifest from his fine collection of specimens. He was a diligent collector, taking great care in the correct labelling and recording of his specimens, and thoroughly considering and questioning his data. He was without intellectual conceit, and possessed a sturdy independence, pursuing wholeheartedly his own line of research. Several of his unpublished papers were of professional standard. Petrology made a particular appeal to him and in his collection he had specimens to illustrate, systematically, the full range of igneous petrography.

Although Mr. Holloway had a certain incalculability of temperament, at his best he had a great sense of fun. His friends will remember his apt quip or funny story, and certainly not least, the loyalty of his friendship.

Mr. Holloway is survived by his wife and two daughters. His extensive collection, through the generosity of Mrs. Holloway, has been purchased by the Hunterian Museum.

M.M.F.

ARTHUR HOLMES. With the death of Arthur Holmes on 20th September, 1965, at the age of 75, the world has lost one of the greatest geologists of this century. Indeed, he was more than a geologist; he was an earth scientist in the fullest sense, for his contributions to knowledge and ideas have ranged from meticulous studies in petrology and petrogenesis to the development of fruitful concepts on earth structure and behaviour.

From his early career he acquired a wide pattern of experience and many of the interests that were to be elaborated in later years. Holmes was born at Hebburn, near Newcastle-upon-Tyne, in 1890 and graduated at Imperial College in 1909, where he subsequently served as a member of the staff until 1920. He pioncered the dating of rocks by radiometric methods, recognising even then that this was the tool by which three-quarters of earth history was to be unravelled; indeed, his first publication on the application of the association of lead with uranium in rocks to the measurement of geological time was published by the Royal Society in 1911. The opportunity of participating in an expedition to Mozambique, initiated what was for him to be a lasting interest in problems of African geology. His 'Petrographic methods and calculations' and 'Nomenclature of Petrology', which date from this period, testify to an early determination to master the techniques and acquire a factual background that were to be the foundation of all his later work. During the next three years as chief geologist of the Yomah Oil Company in Burma his experience in structural and Pre-Cambrian geology was enlarged, and he acquired an appreciation of the practical applications of the subject. When, therefore, he was appointed in 1924 as head of the newly formed Department of Geology in the Durham Colleges, he was equipped with a breadth of vision which, aided by a great capacity for systematic and imaginative research, inspired his students and rapidly gained for his department an enviable reputation. In 1943 he was appointed Regius Professor of Geology and Mineralogy in the University of Edinburgh, a post which he held until his retirement in 1956.

Among Holmes' petrological works his studies of the alkaline volcanics associated with the western rift valley of Uganda find a prominent place. This resulted from a very fruitful collaboration with the late A. D. Combe, who carried out the field work; the association is the more remarkable in that the two never met. They were united in the meticulous conduct of their respective studies and a common devotion to their subject. Co-operation with H. F. Harwood, who was unsurpassed in his mastery of analytical techniques, was the third essential in this, now classic, investigation.

It is more especially, however, with his contributions to ideas on the physics of the earth and major earth structures that his name will always be associated. In these fields he was well equipped both as a mathematician and a physicist. His model of the earth, subject to periodic thermal cycles and a pattern of convection currents, is one that has stimulated thought over the last four decades. In a paper presented at the Geological Congress in London in 1948 from a summation of structural and radiometric data on the orogenic belts of Africa, he developed the important principle that the relative sequence of orogenic belts is determined by the pattern of transection of structural trends. From this it was clear that the Mozambique belt, then regarded as 'Basement', represented the effects of a late orogeny. His main conclusions have been amply confirmed, but it is even more significant that his approach provided an important stimulus to systematic geochronological and structural studies in Africa.

An ever recurring theme in Holmes' work has been the origin of igneous rocks; in all his many petrological studies the problems of ultimate origin always presented for him the real intellectual challenge. An early acquaintance with basalts in the north of England and the west of Scotland led him to speculate on the factors in the evolution of these and associated rocks; his later investigation of kimberlites emphasised their peculiar implications regarding the nature and physical condition of materials at great depths in the earth; and in his detailed studies of alkaline rocks he was ever seeking fundamental causes for their distinctive characters. The problem of the origin of granites was for Holmes intimately related to the significance of the continental crust itself. Here his interest was greatly stimulated by the concepts formulated by his wife, Dr. Doris Reynolds, who brought to bear on problems of petrogenesis acute observational powers in the field and under the microscope, combined with a refreshing and much-needed critical attitude towards ideas that had become hallowed by custom or mere acceptance. In this Holmes was not only a staunch ally, for he readily perceived the significance of her ideas in broader contexts.

The very numerous distinctions and awards that have been conferred on Holmes, and it is probable that no geologist has received more, testify to the high esteem in which his great and varied contributions to science have been held. His awards include the Wollaston Medal of the Geological Society of London, the Penrose Medal of the Geological Society of America and most recently, in 1964, the Vetlesen Prize. His output of published work has been remarkable, both in numbers and diversity of topics; his text-books are standard works. In particular the 'Principles of Physical Geology' is one of the most lucidly written and beautifully presented publications in the annals of scientific literature. His last great achievement, to which he devoted the final years of his life, was the enlargement and rewriting of this work. The world of geology is singularly fortunate that he saw its completion; for Holmes it is a lasting memorial.

Not only in his written work, but also by spoken word, Holmes was a magnificent and elegant exponent of his subject. His lectures to students and learned societies alike were models of clarity in description and argument; to generations of his students they were an excitement and an inspiration. Nevertheless, Holmes was at heart both modest and even reserved; a person of great sincerity and integrity himself, he rewarded these qualities in others with unfailing loyalty. To his students he was not only an inspiring teacher but also a guide and ever-willing adviser in their subsequent careers; to have been students of Holmes was their greatest privilege and his death is a personal loss.

B.C.K.

DONALD NEIL McARTHUR, who died in Edinburgh on 23rd August, 1965, had a distinguished career as research-worker, teacher and administrator, of which only a brief account can be given here. Born in Glasgow in 1892, he passed from Allan Glen's School to the University where he graduated B.Sc. in Chemistry in 1913. For a time a research-student at the University he then joined the staff of the West of Scotland Agricultural College, first as Demon-

strator and later as Lecturer in the Department of Chemistry. He was appointed Professor of Agricultural Chemistry in 1928, the year in which the University conferred on him the degree of D.Sc. This post he held with distinction for seventeen years.

In addition to his duties as professor and director of research he took an important part in the general advisory work of the College and one of the most congenial tasks he was given was to represent it on the first Council of Management of the Macaulay Institute for Soil Research in Aberdeen. When Dr. W. G. Ogg, the first Director of the Institute, was appointed to Rothamsted in 1943 it was eminently fitting that Dr. McArthur, with his wide experience of soil-science problems and his proved gifts of administration, should be chosen in 1945 to fill the vacancy.

The thirteen years of his Directorship witnessed a gradual and carefully phased expansion of the Institute's activities. New departments were set up, new laboratories planned and new techniques developed to deal with the varied and complex problems involved in the study of soils, soil-plant relationships and plant nutrition. Additional scientists had to be enrolled from time to time and it may be noted that during his tenure of office the number of these rose from fifteen to forty-five. Not the least of Dr. McArthur's qualities was his ability to convey to his scientific staff his own enthusiasm and energy. He had also to keep in view the necessity for maintaining an advisory service which was widely drawn on, mainly by other technical institutes and by government departments both at home and abroad. At the same time it was essential to make provision for the accommodation of students and research workers from overseas who sought admission to the Institute for training and research facilities. It was early apparent, however, that the resources of the Institute were being taxed to the utmost to meet these increasing demands and the need for a new building to house the various departments and to allow for expansion became urgent. It was a great pleasure to Dr. McArthur and a fitting testimonial to his long service that the plans for a new Institute were finally approved before his retirement in 1958.

Dr. McArthur was a life-member of the Glasgow Geological Society which he joined in 1916; for several years he served on the Council of the Society. He was a Fellow of the Royal Institute of Chemistry and a Fellow of the Royal Society of Edinburgh. In 1953 he was awarded the C.B.E.

M.M.

HERBERT PRIESTLEY, a Life Member of the Society, died in Dunoon in 1964, at the age of 84. Mr. Priestley lived at Paisley until his retirement from the clerical staff at Anchor Mills. He served on the Council of the Society from 1924-1927, and was an active member of the Paisley Naturalists' Society from 1912. He was Secretary of the latter society for the session 1917-1918 and gave many lectures to that society on geological topics. His interests were very wide —he was one of the first members of Paisley Players' Club and was for many years secretary of it, eventually becoming an honorary vice-president. Besides devoting himself to the welfare of these societies Mr. Priestley also held office in the Photographic Section of the Paisley Philosophical Institution.

Mr. Priestley's characteristic thought for and services to the Society continue after his death in the form of a legacy which he left to the Society.

Mrs. K. Stewart

Society Meetings

held in the Geology Department, the University, Glasgow

10th October, 1963

Miss M. B. Bruce, M.A., M.P.S., Mr. J. F. H. Kearney, B.A., Miss K. B. Nicoll, R.G.N., S.O.M., O.N.C., Mr. A. A. Percy, Miss J. T. E. Riddle, R.G.N., R.F.N., O.N.C., Mrs. J. A. Sinclair, M.B., Ch.B., Mr. K. Smith, and Miss C. H. Weir were elected ordinary members.

There followed a lecture entitled 'An Amateur in India', by W. Laing, Ph.D.

An account was given of some geological and topographical details noted during a recent stay in India. Particular attention was given to the Chota-Nagpur district of Bihar, which is world famous for its mica deposits and which is rapidly developing as a coal-mining area. Some details were given of Himalayan scenery as viewed from Srinagar in Kashmir, Katmandu in Nepal and Darjeeling in West Bengal.

Dr. D. R. Bowes read in title a 'Note on the chemical composition of conglomerates of Lower and Upper Old Red Sandstone age from Ardmore Peninsula, Dunbartonshire.' (*Transactions*, **25**: 17-18).

14th November, 1963 (Annual General Meeting).

Mr. J. M. Anketell, B.Sc., Dr. B. J. Bluck, B.Sc., Ph.D., Dr. J. D. Bradshaw, B.Sc., Ph.D., Mr. C. D. Kerr, Mr. R. H. N. Kimambo, Mr. J. Smart and Mr. D. Stewart were elected ordinary members.

The following office-bearers were elected:

Vice-President: Mr. R. J. M. Young, M.A.

Members of Council: Mr. A. J. D. Black, Mr. T. Gibson, M.A., Mr. G. S. Johnstone, B.Sc., F.G.S., Dr. W. Laing, Ph.D., Mr. W. J. Taylor.

Honorary Auditors: Mr. A. Forrest, F. S. A. Scot., and Mrs. J. Gilchrist were re-elected.

Editorial Committee: Professor T. Neville George, D.Sc., Ph.D., D.èsSc., F.R.S.E., F.G.S., and Dr. M. Macgregor, M.A., D.Sc., F.R.S.E. were re-elected.

There followed a series of short lectures on the Society's excursion to Northern Ireland at Easter 1963:

Dr. J. Phemister read a narrative poem entitled 'The New Mountains of Mourne'.

Mr. R. S. Logan spoke on the Triassic and Cretaceous sediments and Tertiary basalts of the Antrim coast.

Miss E. R. Brock spoke on the faulting and minor structures at White-park Bay.

Mr. R. J. M. Young described the Giant's Causeway, including its 'ball-and-socket' cross-joints and the interbasaltic beds containing litho-marge and laterite.

Miss E. R. Brock spoke on the diatomite, the Lough Neagh Clays and the Diamond Rocks.

Mr. A. Herriot described the structure and petrography of some of the igneous rocks seen by the party.

12th December, 1963

Mr. J. Davies, Dr. F. C. Hall, B.Sc., Ph.D., and Mr. G. Maguire were elected ordinary members.

Professor J. E. Hemingway, Ph.D., F.G.S., delivered a lecture entitled 'The Torridonian Rocks of North-West Scotland'.

Particular attention was given to depositional structures—ore beds, rhythmic units, slumps and convolutions due to flow of wet sediment—well developed in the Applecross Group, and indicative of rapid deposition. Phosphatic remains of algae were described. Pebbles of chert and other rock types suggest derivation from a source similar to that of the Middle Pre-Cambrian of the Lake Superior area, while current bedding and other depositional features show that this source lay not far to the West of the basin of deposition.

9th January, 1964 (Members' Night).

Mr. T. S. Ghaly, B.Sc., was elected an ordinary member of the Society.

Joint publication with the Edinburgh Geological Society.

The Council of the Geological Society of Glasgow, having held discussions with the Council of the Edinburgh Geological Society, recommended to members that joint publication by the two Societies would be to the benefit of the members of each Society and would enhance the prestige of Scottish geology.

A review of the discussions which had taken place between the two Councils was given by Dr. Weedon (Secretary), Mr. Young (Treasurer), Dr. G. Bowes (Librarian) and Dr. A. C. McLean (Editor).

In the ensuing discussion reference was made to the successful amalgamation of the Liverpool and Manchester Society Journals, the two Societies remaining otherwise independent. Dr. D. R. Bowes and Mr. G. S. Johnstone stressed the importance of a written agreement that editorial policy should not materially change, and that opportunity would remain for shorter contributions and papers of local or general interest. Dr. Phemister and Dr. McLean considered that this was adequately covered, although Dr. McLean pointed out the necessity of maintaining a fairly high standard in order to qualify for Royal Society and Carnegie grants.

A motion in favour of accepting the Council's recommendation was proposed by Dr. Macgregor and seconded by Dr. Laing. Dr. Whyte proposed an amendment that council be instructed to make an agreement with the Edinburgh Coucil and report back to the Society; this amendment was accepted. In final form the motion was: 'The Geological Society of Glasgow, at a meeting held 9th January 1964, accepts the principle of amalgamation of the *Transactions* of the Geological Society of Glasgow and of the Edinburgh Geological Society to form a Scottish geological journal; to include papers of local interest.

'The Society instructs Council to make an agreement with the Edinburgh Geological Society on this matter, and to report back to the Society for formal approval'.

The motion was carried unanimously.

Short talks were given by the following members:

Mr. T. Gibson—'An amateur geologist in Iona'.

Dr. E. M. Patterson—'Bringing Coals to Ayr'.

Mr. R. S. Logan spoke on some natural standing stones in Africa.

Dr. W. Laing spoke on the nature and origin of zeolites.
Mrs. S. G. Hoey discussed 'Geology on Stamps'.

13th February, 1964

Professor T. C. Phemister, D.Sc., Ph.D., Sc.M., F.R.S.E., delivered a lecture entitled 'The Pre-Cambrian Geology of Southern Ontario'.

Age-dating and detailed mapping has shown that the rocks of the Sudbury Basin are pre-Huronian, with the Huronian resting unconformably upon them. To the south the Huronian sediments show a rapid transition to a province of intense felspathisation and metamorphism. This boundary, the 'Grenville Front', has now been traced across Canada for 1,200 miles.

12th March, 1964

Mr. S. G. Khoury, B.Sc. was elected an ordinary member.

The Minute of Agreement between the Geological Societies of Glasgow and Edinburgh concerning the joint publication of the Scottish Journal of Geology was presented to the Society by Dr. D. S. Weedon.

Dr. Murray Macgregor drew attention to the fact that there was no reference to the Proceedings in the Minute of Agreement. Dr. Weedon said that in the Council Minutes it was recorded that the Proceedings would be published separately, and sent along with the joint publication to members and to those on our exchange list.

Replying to a question by Mr. A. Allison as to the effect of the new Journal on our exchanges, Dr. Weedon explained that the joint publication would be in the hands of the editorial board who would see that the present standard was maintained: it would have no adverse effect on our exchanges.

The President moved that the Minute of Agreement be adopted and the motion was carried unanimously.

The following papers were read by members:—

'Quaternary sediments with slump structures, central Glasgow', by W. G. Jardine, M.Sc., Ph.D., F.G.S. (*Scot. J. Geol.*, **1**: 221-224).

'The geological significance of a magnetic anomaly in the Kilsyth area', by R. Hutchison.

'The thickness of the concealed Lower Carboniferous lavas north of Glasgow, inferred from a magnetic anomaly', by D. W. Powell, B.Sc., Ph.D., F.G.S.

'Magnetic anomalies in the vicinity of the Lennoxtown Essexite', by J. G. Macdonald.

Dr. Bowes referred to the Glasgow earthquake of 7th March, 1964 and reiterated the appeal for information which had been made through the newspapers, B.B.C. and by questionnaire (see *Scot. J. Geol.* **1**: 288-294).

8th October, 1964

Dr. J. Phemister, M.A., D.Sc., F.R.S.E., F.G.S., delivered his Presidential Address entitled: 'Geological Maps of Shetland'.

Dr. Phemister traced the history of geological mapping in Shetland, and outlined some of the principal petrological and structural problems currently engaging the attention of geologists in the area.

12th November, 1964 (Annual General Meeting).

Mr. G. M. Cooper, Mr. G. Cummins. Miss A. Drysdale, Dr. A. M. Hopgood, M.Sc., Ph.D., Dr. D. E. Lawson, B.Sc., M.Sc., F.G.S., Mr. R. W. Marjoriebanks, Mr. T. K. Sarkar, M.Sc., Dr. Judith A. Turner, B.Sc., Ph.D., Mr. J. H. D. Walker and Mr. J. Williams were elected ordinary members; Miss E. J. Dale was elected an associate member.

The following office-bearers were elected:

President: Dr. E. M. Patterson, D.Sc., F.R.I.C., M.R.I.A., F.R.S.E., F.G.S.

Vice-President: Dr. J. Phemister, M.A., F.R.S.E., F.G.S.

Secretary: Mrs. P. Drummond.

Members of Council: Mr. A. Herriot, Mr. D. Orr, Dr. W. D. I. Rolfe.

Honorary Auditors: Mrs. J. Gilchrist and Mr. A. Forrest.

Editorial Committee: Professor T. Neville George and Dr. M. Macgregor.

The retiring President, Dr. Phemister, thanked Council Members and Office-bearers for their work throughout his term of office and welcomed Dr. Patterson as the new President of the Society.

Dr. Patterson said he was both proud and humble in accepting the Presidency and thanked all those who since his boyhood in Ireland had fostered his geological interests.

Dr. Patterson welcomed Professor T. Neville George, D.Sc., Ph.D., D.èsSc., F.R.S., F.R.S.E., F.G.S., back from North Western University, U.S.A. and there followed a lecture by the Professor on the 'Grand Canyon of the Colorado'.

Professor George said that the Colorado Plateau or Kraton had suffered very little folding although it has undergone great uplift since the Cretaceous period, causing comparatively sudden rejuvenation of the Colorado River and it would seem that the drainage system of the area has been superimposed on the older, underlying beds by the Cretaceous. The Grand Canyon, in less than 11,000 ft., exposes rocks dating from the Pre-Cambrian to the Cretaceous eras lying, in many cases unconformably and with many gaps in time, undisturbed except for some faulting. Tertiary lavas show the Grand Canyon to be post Pliocene in origin.

Professor George said that there is difficulty in explaining the flat, bare rock floors of the wide valleys in the vicinity of the Grand Canyon where erosion of the soft Tertiary clays is taking place swiftly owing to torrential summer rains and winter frosts—alluvium being absent both in these valleys and in the Grand Canyon itself.

10th December, 1964 (Members' Night).

Miss Rhoda M. Calvert, M.A., Ed.B., Dr. R. J. Price, B.Sc., Ph.D and Jean F. Stevenson, B.Sc. were elected ordinary members.

Short talks were given by the following Members:

Dr. A. C. McLean—Exploring the Clyde.

Dr. W. D. Ian Rolfe—A comment on specimens collected by Members of the Society on excursions in 1963-64 and presented to the Hunterian Museum.

a. *Girvanella*, brachiopods and conodonts from the Ordovician of Noblehouse, Peebleshire.

b. The 'fish' *Lasanius* from the Middle Silurian of the Hagshaw Hills.

Dr. A. Lamont—Kainozoic Platforms in Scotland.

Dr. M. Macgregor—Carboniferous plants collected near the old bridge at

Annbank, River Ayr.

Mr. Ian Penn—Lewisian structures on Mingulay.

Mr. T. Gibson—An occurrence of Kyanite on the Ross of Mull.

Mr. A. Herriot—Ultrabasic xenoliths from a vent intrusion at Campbel town, Hunterston.

14th January, 1965

Mr. P. Aspen, Mr. B. Dash, M.Sc., Mr. L. H. Gazely, A.A.C.C.A., Mr. I. Hamilton, Mr. D. Inamdar, M.Sc., Mr. J. B. Rankin, B.Sc., Mr. C. M. Robertson, B.Sc., A.R.I.C., A.I.R.I., Mr. R. J. Steel and Mr. T. D. Urie, M.A. were elected ordinary members; Mr. D. Mason was elected an associate member.

Dr. W. Bullerwell, B.Sc., F.R.A.S., A.Inst.P., F.G.S., delivered a lecture entitled 'Aeromagnetic Surveying in the British Isles'.

Dr. Bullerwell explained first how the survey was carried out from the air. The plane was equipped with specially adapted magnetometers, which must be kept well clear of the magnetic fields generated by the plane itself The magnetometers could be towed or, alternatively, mounted on the wing-tip or on an extended rod behind the plane—as a 'stinger'. Most of the Scottish work had been carried out by the last method. The position of the plane must be known as the survey was carried out, and location was achieved in two basic ways, by the Decca System and by photographing the ground vertically below the plane.

Cameras within the plane take readings at approximately one mile intervals, that is once every 10 seconds.

A grid covering the area with lines less than a mile apart, and with perpendicular cross-links was flown. The height of the plane could be controlled either by flying at a constant height above the ground, taking into account the topography; or at constant 'barometric heights', which in Britain would have to be 5,000 ft. Both extremes have difficulties and disadvantages affecting the amount of detail obtained or the ease of interpretation. A compromise, determined by local topography, was found best, though extreme relief (plus the great number of sources of magnetic anomalies) made interpretation of the surveys in Scotland difficult.

Dr. Bullerwell then discussed the results from various British regions and compared the isogam maps with known geology and with results from gravity surveys. Magnetic anomalies are markedly 'displaced' in relation to surface outcrops and gravity anomalies as the magnetic field is complex and dependent on factors such as the vector of the Earth's field. He briefly outlined an averaging process by which a pseudo-gravity anomaly map could be computed from isogam maps and allow a simple comparison of magnetic results with gravity results and outcrops.

In general magnetic surveys confirm the results of gravity surveys in Britain and allow discrimination between alternative interpretations of gravity maps. For example, a large gravity low trending N.W.—S.E. in the English Midlands is now known to be an uplifted block of light granitic rocks rather than a graben of light Triassic sediments—such as give rise to comparable lows further west.

Dr. Bullerwell described magnetic results from Cornwall, the Irish Sea and the Southern Uplands. The Cornish granites are not distinguished by

the isogams, but curious anomalies occur on their northern margins which may reflect mineralization at depth. The Ulster plateau basalts give a 'jungle' of acute anomalies, and the Dalbeattie and Criffel granites have anomalies that reflect the variation of composition, similar to that invoked by Dr. Bott in his gravity models.

Plans are now being made to extend the British surveys over the north of Scotland and the Shetlands and so complete the aeromagnetic coverage of Britain. Among the results may be evidence of the supposed continuation of the Great Glen Fault towards Shetland.

11th February, 1965

A lecture entitled 'Glacier Bay, Alaska', was delivered by Dr. R. J. Price, B.Sc., Ph.D., F.R.G.S.

Dr. Price talked particularly about Casement Glacier and its 25 mile retreat since 1750 when records were first kept; the change in direction from south to east-south-east of the melt water channels using any weak zone, including faults and dykes, and the formation of eskers. With the melting of the ice above them eskers appeared to be lying on top of the glacier, protecting the ice beneath and gradually giving way to slumping on their margins as lateral ice melted away. Eskers in the area were found to be up to 100 ft. in height.

The Hypsithermal gravels of former ice ages, having been over-ridden by later glaciers were found to have no deformity, probably owing to their having been frozen whilst this movement took place.

11th March, 1965

Mrs. Margaret A. Bradshaw, B.Sc., Mr. P. Davison, Dr. G. T. Day, M.B., Ch.B. (1950), D. (Obst), R.C.O.G., Mr. A. Karmoul, B.Sc., Mr. A. M. Raihan, B.Sc. (Hons), M.Sc., and Mr. M. A. Saleem, B.Sc. were elected ordinary members.

A lecture entitled 'Towards an Interpretation of the Lewisian' was delivered by Dr. D. R. Bowes, M.Sc., Ph.D., D.I.C., F.G.S.

Dr. Bowes said that structural, petrological and age-dating evidence available at present suggested that much of the Lewisian of the North West Highlands can be interpreted as representing parts of three superimposed orogenic belts. Polyphase deformation and polymetamorphism had taken place during each of the three orogenic episodes—Scourian, Inverian and Laxfordian—and ultra basic, basic and igneous masses were intruded with structural control or tectonically emplaced.

Dr. Bowes explained the geological situation and history of each of these orogenic belts and postulated the basement/cover relations. He also made comparisons with younger orogenic belts and illustrated the orogenic interpretation of the Lewisian by generalized cross-sections.

13th May, 1965

Mr. J. F. Bisset, C.A., Mr. J. B. Delair, B.Sc., Dr. C. H. Emeleus, M.Sc. D.Phil., Mr. A. J. Ferguson, Mr. D. Findlay, Mr. G. F. Jackson, Mr. P. D. Lamming, Mr. R. Phillips, B.Sc. and Mr. E. H. Sadler, A.M.I.E.E. were elected ordinary members.

A film was shown entitled 'Volcano', directed by Haroun Tazieff, France, 1959.

Dr. Patterson announced that sales of The Arran Guide had already reached 400 copies.

Excursions

18th April, 1964. Middle Silurian of the Hagshaw Hills inlier, Lanarkshire. Leader, Dr. W. D. I. Rolfe.

2nd May, 1964. Joint excursion with Edinburgh Geological Society: Calciferous Sandstone lavas of the Fintry district; Old Red Sandstone sediments and the Highland Boundary Fault at Balmaha. Leaders, Mr. W. A. Read and Dr. W. E. Tremlett.

23rd-25th May, 1964. Geology of the Lake District. Leader, Dr. G. H. Mitchell.

6th June, 1964. Old Red Sandstone sediments and igneous rocks of the Skelmorlie district. Leader, Dr. E. M. Patterson.

20th June, 1964. Caledonian diorite intrusion into Dalradian rocks at Comrie. Leader, Dr. A. R. MacGregor.

4th July, 1964. Collecting Coal Measure plants, River Ayr at Annbank. Leader, Mr. M. Yuill.

8th August, 1964. Mineral veins at Tyndrum. Leader, Dr. A. C. McLean.

10th April, 1965. Limestone Coal Group sediments and associated quartz dolerite intrusion; Upper Old Red Sandstone sediments; lower part of lava succession in the Kilsyth Hills; glacial features. Leader, Mr. A. Herriot.

17th-24th April, 1965. Joint excursions with the Belfast Geological Society. Girvan district: Dr. J. D. Lawson. Ayrshire coast: Dr. E. M. Patterson. Tinto, Falls of Clyde, Kames of Carstairs: Dr. J. Phemister. Campsies and Balmaha: Mr. A. Herriot. North Ayrshire: Mr. M. Yuill. Edinburgh: Dr. J. Phemister. Southern Highlands: Mr. J. S. Johnstone. Hunterian Museum: Dr. W. D. I. Rolfe.

8th May, 1965. Balquhidder district. Sequence of structural events which affected the Dalradian rocks; relation of metamorphism to tectonics with particular regard to the garnet isograd; glacial features and drainage pattern. Leader, Dr. D. R. Bowes.

22nd-24th May, 1965. Fife coast, Elie to St. Andrews. Ardross fault and volcanic necks; Lower Limestone Group at St. Monance; Calciferous Sandstone between St. Monance and Anstruther; fossiliferous Randerstone section; volcanic necks and Calciferous Sandstone of Kingsbarns area. Leader, Mr. I. H. Forsyth.

5th June, 1965. Joint excursion with the Edinburgh Geological Society: Dollar and the Ochils. Old Red Sandstone lavas; Ochil Fault and associated instrusions; Carboniferous sediments south of the fault. Leader, Dr. M. Armstrong.

26th June, 1965. Upper Old Red Sandstone of West Ayrshire. Sedimentary structures and cycles in sandstones and conglomerates; cross-bedding types, channelling, slumping, ripple marks, problematic sandstone lineations; southern derivation of conglomerates; section starting at Seamill, South Inch. Leader, Dr. B. J. Bluck.

11th September, 1965. Coal Measures of Garrion Gill. Leader, Mr. T. Gibson.

18th September, 1965. South Ayrshire. Kylite of Kyle; Millstone Grit of Dunaskin Glen; sill in Sillyhole Coal at Tongue Glen; Benbeoch Sill; peat-filled hollow at Knockshinnoch; Craigdullyeart Cornstone mines. Leader, Mr. M. Yuill.

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