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Geography in Scotland since 1889

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concerned will be looked on with approval by all, but there still remains a large class, whom motives cannot reach, the feeble-minded, the hopelessly degenerate, the criminally idle; but with regard to these classes I will merely say that it is very significant that from so many sides, representing different tendencies of thought, the demand is daily becoming stronger that these classes should be isolated and not allowed to multiply to the detriment of the community.

GEOGRAPHY IN SCOTLAND SINCE 1889.

A REPORT PRESENTED TO THE TENTH INTERNATIONAL GEOGRAPHICAL CONGRESS AT ROME, MARCH-APRIL 1913.

By MARION I. NEWBIGIN, D.Sc., Editor of the *Scottish Geographical Magazine*.

IN the year 1889, Mr. A. Silva White, then Secretary of the Royal Scottish Geographical Society, and Editor of its *Magazine*, presented to the Fourth International Geographical Congress at Paris a *Report* on the Achievements of Scotsmen during the Nineteenth Century in the Fields of Geographical Exploration and Research (see *S.G.M.*, vol. v., p. 480 *et seq.*). This Report, covering as it did a period of nearly ninety years, was of a very comprehensive nature, and summarised the work of Scotsmen both at home and abroad. The present Report, which refers only to a period of some twenty-three years, and brings the previous one up to date, must necessarily be shorter.

We may note in the first instance that during this period geography has followed in Scotland much the same lines as in other countries. As, in broad outline, the surface of the globe, at least in lower latitudes, was tolerably well known before the beginning of the period, there has been, naturally, everywhere a diminution in the amount of exploration done. More attention has therefore been devoted to the detailed study of the homeland, and to the investigation of special problems relating to the geography of Scotland. Thus we have had, as will be noted directly, investigations of the Scottish Lochs, of the vegetation of the country, and so forth. In devoting special attention to such detailed problems Scotland has followed the example of other countries within recent years.

In the second place, in Scotland, as elsewhere, the fact that the land surfaces of the earth are now tolerably well known has led to an increasing concentration of attention upon the ocean, with the result that many papers have been published and many investigations conducted on problems connected with Oceanography.

Finally, as high latitudes constitute the least-known part of the surface, we find that Scotland has taken her full share in Polar Exploration during the last two decades.

Again, in Scotland, as elsewhere, great interest has been taken in

recent years in methods of improving Geographical Education, and in this, as in the fields of research, considerable progress has been made.

I. INVESTIGATIONS IN SCOTLAND.—After this brief introduction we may take up the different subjects in order, beginning with research in the homeland. Of such investigations the most elaborate has been the *Survey of Scottish Lochs*, conducted under the direction of Sir John Murray and Mr. Laurence Pullar. This Survey has not only yielded a great mass of scientific material, but it has also served as a training school for a number of the younger investigators, and has thus had a direct as well as an indirect importance in connection with geography in Scotland.

The inception of the scheme may be briefly noted. In 1883 the Royal Society of Edinburgh wrote a letter to the Secretary of the Treasury, pointing out the desirability of having a bathymetrical survey made of at least some of the more interesting of the Scottish Lochs. This letter was followed by one from the Royal Society at London, and by other efforts to bring pressure upon the Government of the day. These efforts were ineffective, and in the year 1900 Sir John Murray and Mr. Fred Pullar published a first article containing observations made by them on the depth, temperature, life and so forth of the Lochs of the Trossachs and Callander District. This article was copiously illustrated with maps and figures, and was based upon the personal observations of the two gentlemen named; geological notes by Messrs. Horne and Peach, of the Geological Survey, being added, together with a geological map. Two further instalments were published during the following year, but the work was interrupted by the tragic death of Mr. Fred Pullar, who was drowned while endeavouring to save the lives of others, in the early spring of 1901. The early investigations had owed much to Mr. Pullar's mechanical skill as shown in the invention and modification of sounding-apparatus, and his father, Mr. Laurence Pullar, resolved that the Survey should be completed as a memorial to his son. The successive papers appeared in the *Geographical Journal* and in the *Scottish Geographical Magazine*, before their final issue in six volumes under the title of *Bathymetrical Survey of the Scottish Fresh-water Lochs* (1910). These volumes, in addition to containing the detailed results, soundings, temperatures, and so forth, and also papers on the fauna and flora of the lakes, and on the geology of the regions in which they lie, include also a number of general papers which render the whole monograph to a large extent a summary of our present knowledge of the subject of lake study. The beautiful maps which accompany it are the work of Dr. J. G. Bartholomew.

As already suggested, the Survey also stimulated research in a number of directions. One of the most important of the subsidiary problems raised was that of seiches and other oscillations of lake surfaces. The late Prof. Chrystal of Edinburgh University and Mr. E. M. Wedderburn undertook the investigation of this subject in the Scottish Lochs, a very detailed research being carried on upon Loch Earn. As a result some interesting new conclusions were arrived at, and the Scottish investigators have the satisfaction of knowing that their work has led to a greatly increased interest being taken in seiches throughout the civilised world.

The second important line of investigation which has been pursued in Scotland during the last twenty-two years is the *Botanical Survey of the country*, and this investigation also, sadly enough, had its inception marked by the loss of a young and promising life. Mr. Robert Smith, a student of University College, Dundee, by the advice of Prof. Geddes, went to continue his studies at Montpellier under Prof. Flahault, and was there initiated into the new methods of botanical survey. On his return he began to apply these methods to Scotland, and in 1900 published two sheets of his survey, the Edinburgh District and the North Perthshire District, with accompanying letterpress. These two sheets were to be but the first instalment of a very elaborate scheme, but, only a month or two after their publication, Mr. Smith succumbed suddenly to a severe attack of illness, leaving his work begun merely.

But it has not been allowed to remain untouched. The new methods aroused much enthusiasm in Great Britain generally, and a number of separate investigations have been carried on, a Committee having been appointed to ensure uniformity of method, and to avoid overlapping. In Scotland Mr. Robert Smith's work has been continued by his brother, Dr. W. G. Smith, who has published (1904-5) sheets for Forfar and Fife, with illustrative letterpress. Dr. Marcel Hardy, also associated with Dundee College, has published (1906) a very beautiful vegetation map of the whole of the northern part of Scotland, with an accompanying article. A number of less elaborate articles have also appeared; we may note as illustrating the way in which the work is being continued the article on the vegetation of a small region which appeared in the issue of the *Scottish Geographical Magazine* for September 1911, and the more elaborate study of a limited region which is to appear in the April issue of the present year (1913).

A third line of investigation which has been receiving a considerable amount of attention is that of *Regional Surveys*. A scheme for such surveys, based upon the 1-inch maps of the Ordnance Survey, was first suggested by Dr. H. R. Mill in 1896, and he subsequently prepared a specimen memoir based on sheets 317 and 332 of the Map of England. In connection with the application of the method to Scotland my own article on the Kingussie district (1906) may be mentioned. Surveys along similar lines are also being undertaken in connection with the work of the recently established lectureship in Geography in Edinburgh University. A number of the papers prepared by the students here have already appeared, and in the course of time the whole of Scotland will no doubt be studied in this detailed fashion. Further, the publication, at Cambridge, of a series of volumes dealing with the counties of the United Kingdom (*The Cambridge County Geographies*), should be noticed. The volumes on the Scottish counties have been contributed by Scottish geographers and others, and attest the increasing interest in Regional geography. Another indication of this is the attention which is being paid to the study of Ordnance Survey maps in schools.

In connection with the subject of Regional Survey we may note that in 1908 a Royal Commission was appointed to report upon the ancient and historical monuments and constructions of Scotland. Three sections

of this Report, dealing with Berwick and Sutherland and Caithness respectively, have now been prepared. Much archaeological work has also been done, especially in connection with Roman antiquities, by Dr. David Christison, Mr. James and others.

To this account of progress which has been made in the investigation of detailed problems in Scotland, we must add a note in regard to the High-Level Meteorological Observatory on Ben Nevis, to which allusion was made in Mr. Silva White's Report. Here we have to record not progress but retrogression. In October 1904 the High Level Observatory, and also the Observatory at Fort William carried on in connection with it, were both closed for want of funds to continue their work.

The Observatory at the top of Ben Nevis was commenced in 1883 and completed in 1884, and in the autumn of 1890 a fully-equipped observatory, almost at sea-level, was opened in Fort William. For the summit of the mountain a complete set of hourly observations of the various meteorological elements is available for a period of fully twenty years, and for the last fourteen years of that period there are simultaneous hourly observations for Fort William. From 1884 to 1890 there is a useful Fort William record of observations made at fixed hours several times each day. The entire series of observations has been published in detail, along with numerous scientific papers, in vols. 36, 42, 43, and 46 of the *Transactions* of the Royal Society of Edinburgh, and these volumes form a splendid record of the enterprise of the Scottish Meteorological Society, which, with only the scantiest help from Government, raised the extensive funds necessary for such a great undertaking. Imperishably associated with the history of these Observatories are the names of Mr. R. T. Omond and the late Dr. Buchan. Great regret was expressed at the time of the closing of the Observatories, and it is hoped that they may be re-opened at some future date. Both were of great importance in connection with Scottish geography, not only from the information which the records supplied, but also from the way in which they afforded training to many young investigators, some of whom are now occupying important posts in different parts of the world, and have already done much useful work.

Dr. John Horne, F.R.S., has supplied the following account of the progress made by the Geological Survey :—

“The chief work done by the Geological Survey in Scotland since 1889 may be grouped under the following heads: (1) the Highlands and Western Isles; (2) the Southern Uplands; and (3) the Midland Valley.

“The mapping of the belt of complicated ground in the north-west Highlands, comprising the Lewisian Gneiss, the Torridon Sandstone, Cambrian strata and Eastern Schists, which was begun in 1883, was completed about 1896. Nearly all the maps embracing this area have been published, and the results of the work are embodied in an important memoir on *The Geological Structure of the North-West Highlands of Scotland*, published in 1907. Since the publication of this memoir the north-west of Scotland has become a classic region for the study of those great movements by which the crust of the earth has been affected in mountain building.

"East of the great post-Cambrian displacements large areas of the Eastern Schists in the counties of Sutherland, Ross and Inverness have been surveyed. The conclusion has been reached by some of the members of the staff that the Moine Series represents a succession of altered sediments which rest unconformably on inliers of Lewisian Gneiss. Of special interest is the evidence obtained in Ross-shire between Loch Luichart and the river Carron, which drains into the Kyle of Sutherland, proving the manufacture of crystalline schists and gneisses out of sediments and intrusive igneous rocks by movements after the consolidation of the igneous material.

"The greater portion of the area occupied by metamorphic rocks between the Great Glen and the Highland border has been surveyed. Various maps, with accompanying memoirs, comprising parts of this wide region, have been published since 1889, of which the following may be mentioned: Sheet 93, Ben Wyvis; Sheet 85, Lower Strathspey; Sheet 65, Braemar and Ballater; Sheet 55, the district of Blair Atholl and Pitlochry; Sheet 45, Oban and Dalmally; Sheet 36, Mid-Argyll; Sheet 37, Upper Loch Fyne; Sheet 28, Knapdale and Jura; Sheet 29, Cowal. The islands of Islay and Colonsay have been surveyed, and the maps 19, 27, and 35, with the memoirs, have been published. While much valuable information has been obtained regarding the metamorphic rocks of this region, it must be admitted that the order of succession of the strata has not been satisfactorily determined. Various theories have been advanced to explain the tectonics; the latest put forward by one of the officers of the staff postulates great recumbent folds and displacement of the rocks.

"Progress has been made with the mapping of the Jurassic sediments and the plutonic and volcanic rocks of the Western Isles. The central and south-eastern parts of Skye and the islands of Raasay, Scalpay, Rum, Canna, Eigg and Muck have been surveyed, and sheets 70, 71 and 60, with descriptive memoirs, have been published. Special reference ought to be made to the valuable memoir on *The Tertiary Igneous Rocks of Skye*, published in 1904, which deals specially with the petrology of the rocks of that region.

"The revision of the Southern Uplands in accordance with the sequence of the graptolites, as determined by Professor Lapworth, was begun in 1888 and completed about 1896. The results of this work are set forth in a large memoir on *The Silurian Rocks of Scotland*, published in 1899, which deals with the stratigraphy, the palæontology, and the petrography of the region. In the course of this revision an important zone of Radiolarian Cherts of Lower Llandeilo and Arenig age was detected, underlain by Arenig volcanic rocks, which appear along anticlines throughout the Uplands.

"Regarding the Midland Valley progress has been made with the revision of the coalfields. In 1900 a memoir on *The Geology of Central and Western Fife* was published, and in 1902 a volume appeared, descriptive of the geology of Eastern Fife—both by Sir Archibald Geikie.

"The detailed revision of the coalfields was begun in 1902, and since

that date the Carboniferous areas in the Lothians and large parts of the Lanarkshire and Stirlingshire fields have been re-examined. New editions of sheet 32 (Midlothian) and sheet 33 (East Lothian), with accompanying memoirs, were published in 1910. A special map of the Glasgow district with a descriptive memoir was also published in 1911. The characteristic feature of these memoirs is the large additions to our knowledge of the economics of these fields, and of the petrology of the igneous rocks associated with the Carboniferous strata. A special economic memoir on *The Oil Shales of the Lothians* was issued in 1906, for which there was a steady demand, and a second edition was published in 1912.

"Colour-printed geological maps on the scale of four miles to one inch are now being issued, chiefly for educational purposes. Four sheets have been published.

"In 1910 colour-printed geological maps on the scale of one inch to a mile were issued for the first time in the history of the survey in Scotland. These maps show both the solid geology and superficial deposits.

"Since 1889 a photographic department has been organised in connection with the Geological Survey. Nearly 3000 photographs have been taken, illustrating the geological features of different parts of Scotland. A brief descriptive catalogue of about 2000 of these photographs has been issued for the benefit of educational institutions.

"In the course of the detailed mapping of the geological structure of the country much valuable information has been acquired regarding the evolution of mountain forms and the various systems of drainage."

II. OCEANOGRAPHY.—The second subject with which Scottish geographers have been especially busied during the last twenty-two years is that of Oceanography. An interest in this subject is easily accounted for in a country which has so large a coastline, and which in certain regions depends more upon its fisheries than upon the products of the often barren land.

It will be recollected that the publication of the *Challenger Reports* took place from Edinburgh, and the Challenger Office, under the Directorship of Sir John Murray, was an active centre of scientific work in Scotland for more than twenty years. Sir John Murray took over the Directorship in 1882, on the death of Sir C. Wyville Thomson, and the concluding volumes of the Reports were not issued till 1895. Even after their completion the Challenger Office remained, and still remains a centre of active life; from it the Reports of the Loch Survey were issued in 1910.

The two concluding volumes of the *Challenger Reports*, entitled Summary and Results, include what is virtually a treatise on Oceanography by Sir John Murray. Since the date of their publication the author's continuous interest in the subject is attested not only by many separate papers and memoirs, but also by the fact that in 1911 he supplied the funds for the *Michael Sars* expedition to the North Atlantic, an expedition which has yielded results of high value for oceanographical science, and led to the publication of a very important book, *The Depths of the Ocean* (1912), by Sir John Murray and Dr. Johann Hjort.

Further, the North Sea Fisheries Investigation Committee, acting in co-operation with the International Council for the Exploration of the Sea, has for some time been carrying on detailed investigations both of practical and theoretical problems. Prof. Darcy W. Thompson, of Dundee College, together with his assistants, has already been able to draw from these investigations various conclusions of great interest in connection with hydrographical problems.

Under the heading of Oceanography also we should include much of the work done by Dr. W. S. Bruce, although Dr. Bruce has mostly carried on oceanographical research in high latitudes, so that his work falls under the heading of Polar Exploration—but the general subject is one which he has enriched by many pieces of research. Dr. Bruce has also founded, in Edinburgh, the Scottish Oceanographical Laboratory, where a considerable number of expeditions have been organised.

III. POLAR EXPLORATION.—The mention of expeditions leads us to the third subject in which great interest has been displayed in Scotland in recent years, this being Arctic and especially Antarctic exploration. In 1892-3 Dr. Bruce, in company with some other Edinburgh gentlemen, visited the Antarctic regions on board a Dundee whaling expedition. Some of the results of this expedition were laid before the British Association in the autumn of 1893, and before the Royal Scottish Geographical Society in the early part of the following year. To the British Association also Dr. Bruce expressed his strong desire to return to the Antarctic, a desire which was not fulfilled till some years later.

In 1898 the Royal Scottish Geographical Society issued a special Antarctic number of their *Magazine* with the special object of enlisting sympathy with work in this region, and of obtaining support for a British Antarctic Expedition. This number contained a stirring appeal from Sir John Murray, and also an article by the same author setting forth the advantages to science which might be expected to result from a well-equipped Antarctic expedition. There were also included in addition articles on the History of Antarctic Discovery, on the Flora and Fauna of the Antarctic, and an Antarctic Bibliography.

These efforts no doubt played their part in determining the British Government to give a grant in aid of the proposed British Expedition, but they did not exhaust Scottish interest in Antarctic exploration. In 1900, Dr. W. S. Bruce put forward his plans, the result of long consideration, for a Scottish National Expedition to the Weddell Sea. In the following year Dr. Bruce published a further article indicating the final form of his matured plans, and at the beginning of November 1902 the *Scotia* set out from Troon for the Far South with the members of the expedition on board.

Work was carried on in the south for two years, and not till July 1904 did the *Scotia* return to Scottish waters. During their first summer, in March 1903, the members of the expedition set up a Meteorological Station in the South Orkneys. This station was subsequently taken over by the Argentine Government, and is still in operation, so that it is satisfactory to think that one result of the Scottish Expedition has been the permanent establishment of a Meteorological Station in the Far South.

Mr. R. C. Mossman, the meteorologist of the expedition, remained behind in the South Orkneys for another year, in the service of the Argentine Government, and he has since become permanently attached to the Meteorological Office of that country, and has published a number of articles on meteorological subjects.

The *Results* of the *Scotia* expedition are still in course of publication, but we may note as especially important the rich zoological collections obtained, and the extensive soundings which were made in the South Atlantic Ocean and the Weddell Sea, which permitted Dr. Bruce to construct a bathymetrical map of this part of the ocean. It is interesting to note that Lieut. Filchner's recent explorations in the Antarctic have led to the discovery of a coastline which is undoubtedly a prolongation of Coats Land, discovered by Dr. Bruce. As already suggested, the meteorological observations made were also extremely valuable, and have thrown much light upon the atmospheric conditions in the Weddell Sea.

Dr. Bruce proposes to return to the Antarctic area with another expedition, but in the meantime he has taken a number of cruises to the north, notably to Prince Charles Foreland, Spitsbergen, of which he has made a special survey. Other members of his scientific staff also have carried on various Polar investigations. For example, Mr. R. C. Mossman made two visits to the Greenland Sea, which permitted him to publish a valuable paper on the Summer Climate of that Sea and the Ice Distribution there. We may perhaps also note that the *Scotia*, the ship in which Dr. Bruce made his cruise, has recently been chartered by the Government for ice observation in the Atlantic, with a view to preventing a repetition of the *Titanic* catastrophe.

IV. GENERAL TRAVEL AND EXPLORATION.—As already noted, the day for sensational discoveries in this field, save in the case of Polar regions, is almost past, but during the last twenty years a number of Scotsmen have advanced geographical knowledge in various regions of the globe by their exploring work. Among others, we may mention, in addition to those already referred to, the names of Lieut. Boyd Alexander and his brother Lieut. Claude Alexander, whose African explorations, so sadly cut short, disclosed many facts of great interest; of the Hon. D. W. Carnegie, who during his short life undertook three expeditions into the desert interior of Western Australia; of Mr. G. F. Scott Elliot, who has done exploring work in the Ruwenzori region of Africa and in South America; of Dr. H. O. Forbes, who has carried on investigations in various parts of the world; of Prof. J. W. Gregory, now of Glasgow, who has done exploring work in Africa and Australia; of Col. J. R. L. Macdonald, who has added much to our knowledge of Uganda; of Prof. Sir W. H. Ramsay, whose researches in Asia Minor, though primarily archæological, touch geography on various sides.

V. GEOGRAPHICAL EDUCATION.—In regard to this progress has been rapid during the last twenty-two years. To the Oxford School of Geography, established in 1899, Scotland has sent two successive Readers, Mr. Mackinder, and Dr. A. J. Herbertson, both of whom have promoted geographical education greatly both by teaching and by their text-books. The Universities of Scotland were later than those of England in estab-

lishing Departments of Geography, and not until 1908 were the efforts made by the Royal Scottish Geographical Society to establish geographical lecturerships in Scottish Universities crowned with success. In January of that year Mr. Geo. G. Chisholm, M.A., B.Sc., the author of the well-known *Handbook of Commercial Geography* and other books, was appointed Lecturer on Geography in the University of Edinburgh. In the following year, Captain H. G. Lyons, Director-General of the Survey Department of Egypt, was appointed Lecturer in the same subject in the University of Glasgow, and on his resignation in 1911, Dr. J. D. Falconer, late principal officer of the Mineral Survey of Northern Nigeria, took his place.

Considerable progress has also been made in regard to the teaching of geography in schools, which is now beginning to follow distinctively modern lines.

VI. THE WORK OF THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY.—In Mr. Silva White's *Report* allusion was made to the foundation of this Society, and to the work which it had done at the time of the publication of the article. Since this date the membership has been doubled, the Society has received an annual Government Grant of £200, and all its activities have greatly increased. On the 31st October last there were 1898 Ordinary Members, and 166 Teacher Associates. In connection with the Society an Association of Scottish Teachers of Geography has been formed, with the object of promoting the teaching of geography on modern lines.

VII. GEOGRAPHICAL PUBLICATIONS.—The number of geographical text-books has increased so greatly since 1889 that it would be impossible to give a list of all those written by Scottish authors, or dealing with Scottish subjects, while it would be invidious to make a selection. But three atlases of outstanding importance must at least be mentioned. The first of these is the Royal Scottish Geographical Society's *Atlas of Scotland*, which was designed and prepared under the direction of Dr. J. G. Bartholomew, with the assistance of a number of specialists, and was published in 1895.

In 1899 there appeared as the first instalment of *The Royal Physical Atlas*, the *Atlas of Meteorology*, which was prepared by Drs. J. G. Bartholomew and A. J. Herbertson, under the general editorship of the late Dr. Buchan. In the beginning of the present year another instalment of the same atlas appeared in the shape of the *Atlas of Zoogeography*, prepared by Dr. Bartholomew and Messrs. Eagle Clarke and Grimshaw. All these are beautiful pieces of work, almost invaluable to the student.

In the above summary account attention has been limited to geographers who have had a definite association with Scotland. It would have been easy to extend the list of achievements considerably by including the names of those of Scottish birth or descent, whose work has not been carried on in close association with Scotland; but it has been thought better to leave these to be discussed among English explorers.