KODAIKANAL OBSERVATORY REPORT.—Mr. Evershed's report on the work of the Kodaikanal and Madras Observatories during 1916 refers to several points of interest besides observations of a routine character. Solar observations were made on 342 days, and spectroheliograms in K light were obtained on 329 days. With the grating spectroheliograph photographs of the sun in H_α light were obtained on 258 days, and it was found that the number of absorption markings due to dense prominences on the disc had increased largely. It is interesting to note that visual spectroscopic observations were continued with reference to such phenomena as metallic prominences and displacements of the hydrogen lines, which are not readily photographed, and to furnish a check on the position angles determined from photographs. The spectrum of Venus was photographed with very high dispersion, and it is expected that besides yielding a fair value of the solar parallax, these plates will give valuable information as to the wave-lengths of solar lines on the side of the sun which is turned 90° or more from the direction of the earth. Mr. Evershed remained at Srinagar, Kashmir, until November 1. He reports that while the results obtained during the summer of 1916 confirmed his original estimates of the general excellence of the climate for solar work, the conditions during the months November to April inclusive did not appear to differ materially from those found in other localities; that is, the definition was generally good in the morning and evening, and poor near midday. In the summer months good definition throughout the day was the rule, and superlative definition was of quite frequent occurrence.

SOUTH GEORGIA.

THE island of South Georgia offers especially instructive evidence as to the geological history of the South Atlantic. Though one of the most isolated of the islands there, its structure is continental, and its geographical relations led Suess to the conclusion that it is a member of an island festoon which included the Falklands, Shag Rocks, Sandwich Islands, South Orkneys, South Shetlands, and Grahamland, and projected as a prolongation of the Andes into the South Atlantic, as the West Indies project into the tropical Atlantic.

South Georgia offers the best opportunities of deciding between Suess's theory and the alternative view that South Georgia and the Falklands are parts of an ancient South Atlantic land. Much new information as to the geology and geography of South Georgia was collected by Mr. D. Ferguson during a visit there made owing to the generosity of Mr. Theodore Salvesen, of Leith. Mr. Ferguson's results have been published in the Transactions of the Royal Society of Edinburgh (vol. l., part 4, Nos. 23–25, pp. 797–836, plates 81–94), and will be also issued in the Papers of the Geological Department of Glasgow University. Mr. Ferguson's account of the stratigraphical geology is illustrated by numerous excellent photographs, a geological map, and sections. This report is followed by papers based on Mr. Ferguson's collections dealing with the petrology by Mr. G. W. Tyrrell, and with the physical geography and palæontology. South Georgia is a long and narrow mountainous ridge, which rises to a height of more than 8000 ft. Its

FIG. 1.—Moraine Flat, glacier, small loch and stream, Cumberland Bay. From the Trans. Roy. Soc. Edinburgh.

central range, the Allardyce Mountains, is capped by perpetual snowfields, which feed numerous icefields and glaciers, some of which enter the sea, while others almost reach it, as is shown by Mr. Ferguson's photograph of Cumberland Bay (Fig. 1). Numerous spurs project north-westward from the central range and the coast is indented by an elaborate series of fiords and fiards. Mr. Ferguson claims that the scenery is the grandest and most picturesque in the Antarctic Islands of the South Atlantic. He compares it with that of north-western Scotland, and his beautiful photographs illustrate some of the resemblances between them. These arms of the sea form magnificent harbours, which are used by the South Atlantic whaling fleet. One of the chief centres, Leith Harbour, is shown in Fig. 2.

FIG. 2.—Leith Harbour, Stromness Bay, Whale Oil and Guano Works, South Georgia Co., Ltd. From the Trans. Roy. Soc. Edinburgh.

The island is mainly composed of sedimentary rocks, which have been much folded and faulted. At the south-eastern end of the island is an area of igneous rocks, amongst which Mr. Tyrrell has identified granite-porphyry, alaskite, quartz-trachyte, and felsite, and a sill of diabase occurs beside Cumberland Bay. Mr. Ferguson's field of work lay chiefly among the sedimentary rocks, which include phyllites, slates, mudstones, graywackes, cherts, and trachytic tuffs. Their composition is throughout generally similar though the lowest rocks are the most altered and disturbed. Mr. Ferguson classifies the rocks into two divisions, a lower, or Cape George, series, and an upper, or Cumberland Bay, series. They are together more than 6000 ft. in thickness. The evidence as to the age of these rocks is conflicting. Their lithological character at first suggests that they are Palæozoic, but that is an unsafe guide. The palæontological evidence is difficult of interpretation, for the fossils are badly preserved.

The first fossil was obtained in an erratic block at Moraine Fiord in Cumberland Bay by the Swedish Expedition under Dr. Otto Nordenskjöld; it is a lamellibranch which has been identified as a Mesozoic Posidonomya. Dr. König, of the German Antarctic Expedition under Lieut. Filchner, found an ammonite in the middle part of the Cumberland Bay series; Prof. Pompeckj says that it may be an Acanthoceras, and, if so, is Cretaceous. Some cherts, which were collected by Mr. Ferguson at Cape Pariadin, the south point at the extreme north-west end of the island, contain radiolaria. They have been examined by Dr. Hinde, who regards their age as probably between the Triassic and the Cretaceous; but their evidence is inconclusive, and Dr. Hinde remarks that this view might be modified by further knowledge of these radiolaria.

The Middle Cumberland Bay series therefore appears to be Mesozoic; but the fossils obtained from the Lower Cumberland Bay series in the promontory between Leith Harbour and Nansen Harbour, near the middle of the north-eastern coast, appear much older. The fossils are so crushed that their identification is only put forward tentatively. One of them appears to be a tabulate coral resembling Omphyma. It is associated with some fucoids which resemble *Buthotrephis succulens* from the Trenton Limestone of New York, and with some branched fossils referred to Camarocladia, which occur with Buthotrephis in the Trenton Limestone of Illinois. The fossils have been

examined by Dr. Bassler and Mr. Ulrich, of the National Museum, Washington, who regard them as nearest to Camarocladia. A fragment that may be part of a graptolite was also found, but it is too small for confident identification. The evidence at present available suggests that the lower part of the Cumberland Bay series is Silurian or Ordovician, while the middle and upper parts of the series are Mesozoic. The difficulty in this conclusion is that Mr. Ferguson recognised no stratigraphical break at the top of the Lower Cumberland Bay series; there may be a hidden disconformity which would be easily overlooked, as the rocks above and below that horizon consist of material derived from the same source.

The material collected by Mr. Ferguson is against rather than in favour of the view that South Georgia belongs to an Andean loop, for the igneous rocks that have been determined are of the alkaline or Atlantic, and not of the Pacific, type, and the sedimentary rocks are more allied to those of the eastern United States than to those of the Andes.

It is to be hoped that the island will soon be further examined to settle the problems which have been raised by Mr. Ferguson's useful work. Mr. Wordie, the geologist with Sir Ernest Shackleton's expedition, made an extensive collection of the igneous rocks from the south-eastern end of the island, but it was unfortunately lost by the wreck of the *Endurance*. His field observations will, however, doubtless throw much further light on the general geology of South Georgia.

J. W. GREGORY.

SOURCES OF NITROGEN COMPOUNDS.

IN the *Scientific American* for April 21 Prof. T. H. Norton contributes a valuable article under the heading, "American Sources of Nitrogen." Prof. Norton has given special attention to this important question, and the Department of Commerce published in 1912 an exhaustive report by him on "The Utilisation of Atmospheric Nitrogen." In 1916 Congress appropriated the large sum of twenty million dollars for the purpose of constructing and organising Government works for the production of nitrogen compounds available for military requirements and for general economic purposes.

After outlining the wide application of nitrogen compounds for agricultural purposes, emphasising the importance of ammonia and its compounds in industry, and nitric acid for the production of explosives and dyestuffs, the sources of combined nitrogen are considered, the principal being (1) Chile saltpetre; (2) ammonia; obtained as a by-product from the carbonisation of coal and lignites, and from Mond type gas plants working on coal, peat, etc.; from cyanamide by fixation of atmospheric nitrogen by calcium carbide; synthetically from hydrogen and atmospheric nitrogen by the Haber method; (3) nitric acid; from saltpetre, by the fixation of atmospheric nitrogen by the electric-arc process, and by the oxidation of ammonia by the Ostwald catalytic process. It is shown that Chile saltpetre is subject to wide fluctuations in price, being dependent on current demands, rates of freight, etc. The export duty of 11 dollars per ton levied by the Chilean Government is a heavy addition to cost. The economics of the various alternative methods outlined above are carefully considered in detail.

Cyanamide made at Niagara Falls, on an annual rate for electric power of 12 dollars per horse-power year (h.p.y.), is estimated to cost 28·74 dollars per short ton; 4·12 tons of 20 per cent. cyanamide will yield one ton of anhydrous ammonia; the cost of manufacture will be 30·80 dollars, so that the total cost of one short ton of anhydrous ammonia by this process is estimated to be 149·21 dollars. By the Haber method (synthetically from its elements) it is estimated that the cost should be reduced to 64 dollars per ton, but the method involves technical supervision of a high grade.

Turning to the cost of nitric acid, prior to the war the cost in New York for acid obtained from Chile saltpetre is given as 144·5 dollars per short ton (100 per cent HNO_3), the cost in Hamburg being equivalent to 96·32 dollars. By the Norwegian, or Birkeland and Eyde, process, with electric power at 12 dollars per h.p.y., the pure acid would cost 56·17 dollars. It is claimed that the new American Rankin arc process gives a yield 33 per cent. greater than the Norwegian process per unit of electric power, and Prof. Norton estimates that the cost of nitric acid might be reduced to 41·47 dollars. With reference to the Ostwald catalytic process, from information based upon statements of results in a Belgian plant he concludes that pure nitric acid, from ammonia obtained by the cyanamide process, would involve a cost of production of 63·68 dollars per short ton. In general this is the cost of nitric acid (100 per cent.) when anhydrous ammonia costs 150 dollars per ton.

RESEARCH INSTITUTIONS IN THE UNITED STATES.[1]

Federal Department of Agriculture.

WHEN the department was first organised, and for a number of years thereafter, its work was confined largely to matters directly affecting agriculture. Later, the Weather Bureau and the Forest Service were transferred to the department, and more recent legislation has charged the department with the enforcement of a number of regulatory laws, including those relating to meat inspection, animal and plant quarantine, foods and drugs, game and migratory birds, seed adulteration, insecticides and fungicides, and vaccines and viruses. The income of the department increased from 16,000*l*., in 1863, to 727,000*l*., in 1889. In 1915 the expenditure was 5,330,000*l*. There are now about 15,000 employees in the department. Of that number 3000 are employed at Washington, and 12,000 elsewhere. Nearly 2000 persons are engaged in scientific investigations and research, 1400 in demonstration and extension work, and 700 in administrative and supervising work.

Agricultural Colleges and Experiment Stations.

The grants to agricultural colleges under the Acts of 1890 and 1908 are now fixed at 10,000*l*. to each of the forty-eight States, and to Porto Rico and Hawaii, and aid sixty-nine institutions. The total value of the property held by these agricultural colleges is approximately 32,000,000*l*., and their annual revenue 7,000,000*l*., of which about 700,000*l*. (10 per cent.) is derived from Federal grants under the above Acts, 3,600,000*l*. (52 per cent.) from State appropriations, and 2,700,000*l*. (38 per cent.) from tuition fees, endowments, and miscellaneous sources.

Statistics show that approximately 53 per cent. of the graduates of the agricultural colleges return to the farm, and that 95 per cent. devote themselves to agriculture in some form, including college and station work. Of those not graduating, practically all return to the land.

The Hatch Act, 1887, provided that in order to aid in acquiring and diffusing among the people of the

[1] From a Memorandum on the Organisation of Scientific Research Institutions in the United States of America by Mr. Gerald Lightfoot, issued by the Advisory Council of Science and Industry, Commonwealth of Australia.