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.