which Sir John Murray based his theory of the formation of oceanic deposits and coral islands. Buchanan championed the hydrometer against chlorine titration as the measure of salinity, and he held to this view, although later work has convinced the oceanographers of to-day of the superior accuracy and convenience of the titration method. He made important experiments on the compressibility of substances at pressures existing in the depths of the sea, and the water and mercury piezometers which he made on board the *Challenger* yielded remarkable results in his hands, enabling him to measure depths and bottom temperatures irrespective of the length of line paid out. He pursued these investigations in later years, and read several papers to the Royal Society and the Royal Society of Edinburgh on the compressibility of solids.

The researches on sea-water initiated from the chemical or physical side were continued with the object of studying the conditions and movements of water in the sea and in lakes, thus leading their author from chemistry into physical geography. Buchanan made many scientific cruises in his steam-yacht *Mallard* on the west coast of Scotland and the lochs connected by the Caledonian Canal. Later he made a series of voyages on the cable-laying ships of the Silvertown Company along the west coast of Africa, and during the later years of his active life he was closely associated with the oceanographical researches of Prince Albert I. of Monaco. The Prince had a very great regard for him and consulted him in all details of his work on board the *Princesse Alice*, as well as in the organisation of the Monaco Oceanographical Museum and of the Oceanographical Institute in Paris.

During the 'eighties of last century the *Challenger* Office made Edinburgh a focus of activity in all branches of science, and Buchanan took his share in the intellectual revival, doing much to infuse new life into the flagging University Chemical Society, which he invited to hold its meetings in his laboratory. He helped in founding the Ben Nevis Observatory, and joined the Council of the Scottish Geographical Society soon after its formation. Above all, he furthered the work of the Scottish Marine Station which was opened at Granton in 1884. He fitted up his old chemical bench from the *Challenger* on board the floating laboratory *The Ark*, and when I was appointed chemist and physicist at the Granton station he proved a most helpful and kindly instructor. He was an exceptionally tidy worker, and planned a system of laboratory books for recording all observations, experiments and calculations, with scrupulous regard to dates and hours.

In 1889 Buchanan was appointed lecturer on geography in the University of Cambridge, and although he only occupied the position for four years, he found the social life of Cambridge so congenial that for twenty years he made Christ's College his home. This was probably the happiest period of his life, and he revealed more of his inner self in intercourse with his friends in the Combination Room than he was wont to do elsewhere. The coldness of his manner was probably due in part to shyness, in part to an extreme sensitiveness to the opinions of others, which he concealed by an assumption of indifference. He was never idle, and accumulated a mass of recorded observations, only a fraction of which was ever brought into shape for publication. He had no freedom in writing, but he took immense pains to verify every statement and to make his meaning perfectly clear. His chief pleasure was in travelling, and he was an insatiate observer of things and men in all parts of the world. He had friends in every country in Europe, and was greatly affected by the outbreak of the War, during the course of which he resided in America and the West Indies.

Had Buchanan been a poor man, or bound to some permanent scientific position, he would probably have cut a deeper niche for himself in the Hall of Memory. As it is, he left no formal book behind him, though he long cherished the idea of producing a treatise on oceanography. After returning to England, he collected his more important and some of his slighter published papers in three volumes, which were brought out by the Cambridge University Press under the respective titles "Scientific Papers, Vol. I.," 1913, "Comptes Rendus of Observation and Reasoning," 1917, and "Accounts Rendered of Work done and Things Seen," 1919. In the remarkable synoptical tables of contents prefixed to these volumes, he gives notes and criticisms which throw an interesting light on his methods of work and modes of thought.

HUGH ROBERT MILL.

MR. FRANCIS JONES.

AMONG chemists the name of Francis Jones is always associated—almost identified—with boron hydride. When Humphry Davy in 1809 heated the amorphous boron he had isolated with metallic potassium, and treated the grey mass with water, he found the hydrogen gas given off had a peculiar smell and took up more oxygen on explosion than did pure hydrogen. This observation was for seventy years the chief evidence of the existence of a hydride of boron, and after the researches of Wöhler and Deville, who doubted its existence, chemical text-books and dictionaries maintained a strict silence on the subject. The discovery of the spontaneously inflammable silicon hydride by Buff and Wöhler in 1857 left boron the one exception to the rule that all the non-metallic elements combined with hydrogen, and the methods adopted by these chemists—as well as the experience he himself had gained in determining the composition of the hydride of antimony—led Francis Jones to plan his research on boron.

Born in Edinburgh in 1845 and educated at the Edinburgh Institute and University, Jones decided at an early age to take up chemistry as a career and proceeded to Heidelberg to work in Bunsen's laboratory. It was his work here that led to his introduction to Roscoe, who brought him to Manchester in 1866 as research-assistant in his private laboratory. The years ahead were strenuous with Roscoe's great work on vanadium, whereby this element was first placed in its true order: and the young assistant could have had no better training-ground in chemical method or in manipulation. Four years later he was appointed demonstrator, and after two years' teaching at the Owens College, was chosen by the high master of the Manchester Grammar School to fill the place left vacant by Dr. Marshall Watts. His science work at the school soon won for it an almost unchallenged

position among the large schools of England: the writer remembers well the succession of brilliant candidates he sent up for the Brackenbury science scholarships at Balliol between 1879 and 1886. For forty-seven years he continued to direct the chemical laboratories and to take his full share of teaching in the school.

Francis Jones must be placed in that small class of science masters who, in spite of incessant calls on their time and energy, have advanced chemistry in England. His first important paper on the properties and composition of stibine appeared in 1876 (J. Chem. Soc.). The composition of the hydride of antimony had previously been based on the analysis of the black compound thrown down when the gas mixed with hydrogen was passed through silver nitrate solution—presumed to be pure $SbAg_3$. But metallic silver is also deposited in this reaction, and the substance is really a mixture, as Jones showed by his analyses. His next attempts were to measure the increase in volume when 2 litres of the hydrogen and stibine were sparked, but the proportion of the stibine was too small to enable its composition to be determined from the increase in volume and the weight of antimony formed. He discovered, however, that stibine was decomposed by sulphur at ordinary temperatures in bright light:

$$2SbH_3 + 6S = Sb_2S_3 + 3H_2S.$$

By passing the mixed gases through weighed sulphur-tubes and absorbing the hydrogen sulphide, he showed that one atom of antimony was combined with three of hydrogen. The orange colour imparted by stibine to sulphur gives us a very delicate test for antimony.

In 1879 appeared the preliminary note on boron hydride. In his first experiments Jones attempted to make magnesium boride by the action of sodium on a mixture of magnesium chloride and potassium borofluoride—following the method for making silicon hydride. The reaction was violent, but no hydride resulted from acidifying the product. Then he tried with success the direct heating of magnesium powder with boron trioxide:

$$B_2O_3 + 6Mg = B_2Mg_3 + 3MgO.$$

When hydrochloric acid was dropped on to the grey friable product a gas was evolved which burnt with a bright green flame and had a most disagreeable odour. He had obtained the hydride mixed with hydrogen.

Two years later a fuller paper was published (J. Chem. Soc., 1891) by Francis Jones and R. L. Taylor. Other methods of preparing the hydride were given, but the simplest was that described above—which always contained a large excess of hydrogen. The hydride was decomposed by passage through a red-hot tube leaving a brown deposit of boron; when bubbled through silver nitrate it formed a black precipitate containing silver and boron. Combustion of the mixed gases by means of copper oxide showed the hydride molecule to contain more hydrogen than the molecule H_2, and to approximate to H_3. Twenty years later, Ramsay, by cooling the mixed gas with liquid air, extracted another hydride from it, to which he assigned the formula B_3H_3.

In 1884 Francis Jones published a simple method for detecting a chloride, bromide, and iodide when the three salts are mixed together. By the addition of dilute sulphuric acid drop by drop to the salts in the presence of manganese dioxide and water the iodine can be boiled off, then the bromine, the residue with strong sulphuric giving the chlorine. His other published work dealt chiefly with the effect of different modes of heating and lighting on the air of living-rooms: he took an active interest in the crusade against air pollution.

For many years he acted on the council of the Manchester Literary and Philosophical Society, and was president for the two years 1909–11: he gave his services freely to the last, and his kindly and sage counsel was always appreciated. H. B. D.

MR. G. L. SMITH, who died at Chertsey on September 25, was head of the Instrument Research and Design Department of the Royal Aircraft Establishment. As such he was responsible for a large number of instruments used on aircraft. His remarkable genius for this type of work enabled him to accomplish much work of great importance, though his share in it is little known outside the circle of a few associates. Born at Aberdeen about 1870, Mr. Smith followed a number of scientific pursuits—among which may be mentioned the design and application of the aero fire alarm, which was extensively used in England and the United States. At the outbreak of the War, he offered his services to the Royal Aircraft Establishment, where he remained until illness compelled him to resign a few months before his death. While of a somewhat retiring and unobtrusive disposition, his kindly and sympathetic nature made him beloved and respected by every one.

G. M. B. D.

WE regret to announce the following deaths:

Dr. E. J. Babcock, professor of industrial chemistry, metallurgy and mining and dean of the College of Mining Engineering in the University of North Dakota, on September 3, aged sixty years.

Dr. H. R. Carter, assistant surgeon-general of the United States Public Health Service and a distinguished authority on yellow fever and malaria, on September 14, aged seventy-three years.

Prof. T. Case, formerly president of Corpus Christi College and Waynflete professor of moral and metaphysical philosophy in the University of Oxford, on October 31, aged eighty-one years.

Dr. Paul Héger, honorary professor of physiology in the Faculty of Medicine at the University of Brussels, aged seventy-nine years.

Dr. J. R. Henderson, C.I.E., formerly professor of zoology in Madras Christian College, and Superintendent of the Government Museum and Aquarium in Madras, on October 26, aged sixty-two years.

Prof. J. N. Langley, F.R.S., professor of physiology since 1903 in the University of Cambridge, on November 5, aged seventy-three years.

Prof. J. Massart, professor of botany in the University of Brussels, corresponding member of the Paris Academy of Sciences and foreign associate of the Royal Academy of the Lincei, aged sixty years.

Rev. E. F. Russell, of St. Alban's, Holborn, one of Huxley's early students, who contributed to our issue of May 9, p. 751, his recollections of Huxley and of the course of biology being given in 1875 at South Kensington, on November 7, aged eighty-two years.