have a certain British flavour, however much we try to be scrupulous or even pedantic.

It will be agreed, I trust, that the science of map-making is healthily active and growing. Let us turn now to the art, which is twofold: the art of the convention by which the outline and the relief are reduced to the compilation, and the personal art of drawing the detail, the lettering, the divided margins, the ornaments, so that the finished map shall be clear, harmonious, and beautiful.

During the last thirty years we have seen the convention profoundly modified by the rapid improvement of colour lithography. Colour has, it is true, been used on engraved maps from the very first, and in my opinion the most agreeably coloured atlas ever published was the Rome edition of Ptolemy of 1486. But this was hand colouring, and no two copies are alike. In the years that followed the colour became more elaborate, but it was largely in the ornament, and the essential outline of the map was in black, from the single engraved plate. The great extension of possibilities came with the quite modern use of colour to distinguish the outlines of different classes: blue for rivers, brown for contours, red for roads, and so on. The enormous resulting improvement was conspicuously in the representation of relief. Layer colouring in particular, first employed on a large scale by the celebrated firm of Bartholomew, has given our maps all the advantages of a relief model without the inconveniences. It is a method in which the British have always excelled; and the supreme example of skill in layer colour-printing is the "Gamme" or colour scale attached to the report of the Paris Conference of the 1/Million Map in 1913: a scale which we may be proud to think was printed in England, at the War Office. There are infinite possibilities in the combination of layer colouring with contours, hachure, vertical and oblique hill shading; many of them have already been realised by the Ordnance Survey, particularly in their special maps of holiday districts, and in a map of South Devon which I regretfully remember in proof only, because it was found too expensive for issue. For we must note that a modern map passes through the press eight or ten or twelve times, and the cost of the machine work, apart from all the plates, is multiplied in the same ratio. The wonder is not that maps are expensive, but that in the circumstances they are so cheap. We should wish to believe, however, that the progress of invention may some day give us back that richness of tone that distinguishes the old engraved maps.

Obituary.

MR. J. Y. BUCHANAN, F.R.S.

THE last member of the original scientific staff of H.M.S. *Challenger* on her famous voyage of discovery in the great oceans has passed away by the death, on October 16, at eighty-one years of age, of Mr. John Young Buchanan. He holds an assured place as one of the founders of modern oceanography, and if his personal share in the fundamental researches is not more conspicuous in the text-books, it is largely because of his loyalty to the spirit of the expedition which gave the glory to the *Challenger* group rather than to individuals. He was in the most literal sense an original worker, always preferring to settle a point by observation or experiment rather than by books, and when reference to recorded work was necessary, always going direct to the fountain-head, never to a compilation. He paid no regard to authority or scientific orthodoxy, and did not get on comfortably with those who did. Censorship of research, even the reference to experts of papers submitted to a learned society, was obnoxious to him, and he spoke very plainly on this subject in communications to NATURE and elsewhere. So far as he allowed his singularly restrained and reserved nature to express itself in warm terms, he showed a passion for the freedom of research. He said: "To standardise research is to limit its freedom and to impede discovery. Originality and independence are the characteristics of genuine research, and it is stultified by the acceptance of standards and by the recognition of authority" (Preface to his "Comptes Rendus," 1917).

Buchanan was born in Glasgow in 1844, the second son of Mr. John Buchanan of Dowanhill, and was educated at the High School and University of his native city, where he graduated as M.A. Having decided to follow chemistry as a profession, he proceeded to study on the Continent, where he spent some time at the Universities of Marburg, Bonn, and Leipzig, and under Wurtz in Paris. On returning to Scotland he acted for a short time as assistant to Prof. Crum Brown in the University of Edinburgh. His leaning was always towards practical work rather than theoretical study, and he had little liking for teaching or lecturing. He excelled in manipulation, and especially in glass-blowing, a fact which weighed in his appointment as chemist and physicist on the *Challenger* expedition, where it was desirable that a scientific man should be able to make his own apparatus in case of need. The voyage of the *Challenger* lasted from December 1872 to May 1876, and most of Buchanan's time was occupied by routine work in measuring density of sea-water, collecting gas contents, and making qualitative analysis of all manner of natural deposits. He found time for several pieces of research which he afterwards developed in the private laboratory which his ample means allowed him to maintain, first in Edinburgh and latterly in London. The most important of these involved the thermal relations of sea-water and of salt-solutions generally, especially with regard to the formation of ice and steam.

A picturesque incident in the *Challenger* was his determination of the true nature of *Bathybius Hæckeli*, which Huxley believed from microscopic examination of preserved deposits to be a primitive organism covering the bottom of the sea. Buchanan proved it to be a gelatinous precipitate of calcium sulphate thrown down by alcohol, a fact which was very reluctantly accepted by the biologists on board, who were unwilling to think that Huxley, the highest authority, could possibly have made a mistake. Huxley himself at once accepted the correction in the frankest manner. A less dramatic but more constructive piece of work was the analysis of deep-sea deposits, especially of the red clay and the nodules of manganese peroxide embedded in it, on

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