reagents during the preparation of tissues for the microscope. Once assured that this might well be the case, he set himself with characteristic energy to investigate the matter. He was thus led to study aspects of the colloidal state in relations but then little known, and to deal with problems remote from his previous experience. He worked with the simplest of equipments, yet he rapidly brought significant facts to light. I was fortunate enough to occupy a room adjacent to his, and witnessed the progress of his research and the joy it gave him.

In 1899 Hardy published two classical papers "On the Structure of Cell Protoplasm" and "On the Coagulation of Proteid by Electricity". These titles do not convey the full significance of the work they describe. The clarity with which the existence of two types of colloidal dispersion was demonstrated, and the precision the work gave to the relation between electrolytes and colloids with its dependence upon ionic and micellar charges, together with other points of much importance described in these publications, made them extraordinarily influential. They stimulated work by scores of others and greatly accelerated the progress of colloidal chemistry.

Hardy retained to the end of his life an interest in this and kindred aspects of knowledge. He was specially curious as to the nature of the protein equilibrium in blood, and in the precise nature and meaning of the globulin fraction. Had he lived to deliver his address as president of the British Association, I believe that part of it, at least, was to be devoted to the results of his later thought on such questions.

The period of Hardy's researches to which I have been referring was of much significance to him. It led to his general interest in physical chemistry, and determined a direction for much of his later thought and work, his highly original dealings with the influence of chemical constitution on surface tension, for example, and the later developments which followed upon them.

In his earlier days as a physiologist, Hardy did not especially concern himself with metabolic phenomena, or with nutritional questions. The formation and management of the Royal Society Food (War) Committee, which fell to him as the biological secretary of the Society, awakened his interest in such matters and prepared him for the important work he was to do in later years as chairman of the Food Investigation Board.

Hardy's mind was but little trammelled by tradition, or even by the orthodox views of the day. His thought always worked on original lines. He was indeed no industrious reader of current scientific literature, seeking rather for the known facts whenever he wanted them for a specific purpose. This circumstance, and the great variety of his interests, together with his constant choice of the simplest possible technique in research, displayed qualities more often possessed by brilliant amateurs than by professional workers in scientific fields. One of the reasons for the success of his highly personal work was the freshness of mind that he brought to every problem, and the ingenuity with which he contrived his own simple, but adequate, experimental methods.

Hardy's genius had free play in the laboratory, and pure science has doubtless suffered from the fact that his latest years gave but little opportunity of displaying it there. One would be rash indeed, however, to suggest that he should have been spared from the administrative duties which he fulfilled so admirably and so greatly to the advantage of his country.

F. GOWLAND HOPKINS.

BY the death, on January 23, of Sir William Bate Hardy, at his home in Cambridge, in his seventieth year, science has lost a great captain and Great Britain a great public servant.

Hardy was educated at Framlingham and at Gonville and Caius College, Cambridge, where he was elected to a fellowship in 1892. He was Shuttleworth scholar in 1889, and Thurstonian prizeman in 1900. He was first and foremost a biologist, taking zoology in the Tripos, and then turning to physiology, and particularly to histology, a subject which he taught and in which he did research in Michael Foster's laboratory. To the end of his life he never lost his love of the microscope, and it is not many years since that he spent uncomfortable hours at a temperature of $-12°$ C. in one of the cold chambers at the Low Temperature Research Station, following through the microscope the process of freezing in gels.

From histology Hardy passed to the study of the colloidal state, a field then new and one in which he did pioneer work. No event in later life gave him more pleasure than to take part in the meeting at Cambridge in 1930 called by the Faraday Society to discuss the biological aspects of colloidal science. His scientific interests constantly broadened, and turning to the problems involved in action at surfaces, he entered the field of lubrication, and became a recognised authority on boundary conditions, contributing an article on the subject to the "Dictionary of Applied Physics". He was also Chairman of the Lubrication Research Committee of the Department of Scientific and Industrial Research.

The work for which Hardy was best known was, however, that which he did from 1917 onwards in the service of the Department of Scientific and Industrial Research as first chairman of the Food Investigation Board and as Director of Food Investigation. Here he found a new field that gave full scope for the exercise of his truly remarkable powers as leader and inspirer of a team of research workers, as advocate of the need for more science in industry and as apostle of co-operation in research between the members of the British Commonwealth of Nations. It was appropriate that the direction of the work should

be in the hands of a biologist, for Hardy was never tired of stressing the logical priority of biology over engineering where the transport and storage of food is concerned.

Research, to Hardy, meant essentially the untrammelled research of the university laboratory, carried out to satisfy that intellectual curiosity that he himself displayed so pre-eminently, and he never wavered in his conviction that no solution of a practical problem was worth while unless it was based on an adequate knowledge of the fundamental science that lay behind it, and therefore that it is the man with a sound training in academic research who is best fitted to unravel the practical problem and reach that solution. The work described in the annual reports of the Food Investigation Board, and in the numerous other publications that came from his three research stations, the Low Temperature Research Station, the Torry Research Station and the Ditton Laboratory, bears witness to this insistence on fundamental research; and the success he had in solving practical problems and in gaining the confidence of the whole food industry were his complete justification. Such achievements as the gas-storage of fruit, the long-range transport of chilled beef and the brine-freezing of fish were not fortuitous, but rather the inevitable outcome of much patient work of a fundamental character.

Hardy, however, was not one-sided. While he unerringly picked men capable of academic research, and saw that they had the opportunity and the means of doing it, he equally insisted that they learn the practical details of the industry they served, for he knew that only so could they gain the confidence of industry and, when the time came, apply their academic knowledge to the greatest advantage.

To-day, when the storage and transport of foodstuffs is so rapidly being put on a sound scientific basis, and when new developments are taking place in all directions, it is fascinating to go back and read the original memorandum which he, Sir John Farmer and Sir William Bayliss prepared in 1917 for the Advisory Council for Scientific and Industrial Research. One marvels that one man in so few years could achieve so much, and one realises Hardy's tremendous power. The original membership of the Food Investigation Board was strong; it comprised Sir Kenneth Anderson, Sir Joseph Broodbank (Hardy's successor in the chair), Sir Walter Fletcher, Sir Thomas Mackenzie, Sir Richard Threlfall and Prof. T. B. Wood. What they thought of him may be illustrated by a remark of Threlfall's—"Hardy, you must treat us like your umbrella—to be kept rolled up out of the way, and brought out only when a storm comes".

Hardy's other great interest in later years was marine research. On his advice, the Development Commissioners appointed an advisory committee for fisheries research under his chairmanship. This committee drew up a programme which was adopted by the Commissioners, whilst at the same time the committee was made permanent and for nine years Hardy remained its chairman. The breadth of his view and his practical knowledge, as well as his personal familiarity with the special difficulties of work at sea, were of inestimable value. His penetrating understanding of their work and his constant help and sympathy were a source of inspiration to the biologists and hydrologists engaged in the investigations. Especially he realised that no practical results could be looked for until a large amount of fundamental research had been done, not only on the life-histories of the marketable fishes themselves, but also on the physical and biological conditions under which they lived. Not only the changes in the chemical constitution of the sea-water from season to season and from year to year, the variations in tides and currents, the influence of light, must be known, but also the inter-relations of the whole flora and fauna which form the fundamental food of the fishes require detailed study. This work throughout had his earnest support and sympathy.

Many honours came Hardy's way, and he wore them with the simplicity that characterised his whole life. In the academic sphere, he was elected a fellow of the Royal Society in 1902, served as secretary from 1915 until 1925, and was Royal medallist and Croonian and Bakerian lecturer of the Society. Oxford conferred on him the honorary degree of D.Sc., and Aberdeen, Birmingham and Edinburgh that of LL.D. In 1931 he was invited to the United States of America and delivered the Abraham Flexner lectures at Vanderbilt University. At the time of his death he was president of the British Association for the Advancement of Science. In the wider sphere he was a member of the Economic Advisory Council, and of the Advisory Council for Scientific and Industrial Research, president of the British Association of Refrigeration, a Trustee of the National Portrait Gallery, and a member of the Governing Body of Charterhouse and of the Leverhulme Trust Committee. He was knighted in 1925.

Hardy's lay interests were as varied as his scientific interests. Salt-water sailing was a passion with him, and he owned a succession of small yachts which he sailed regularly. He was a good naturalist, with a wide and intimate knowledge of plants and birds. Music and archæology also claimed his time. Bridges' "Testament of Beauty" became his constant companion on its publication, and he was an enthusiastic 'Janeite'.

Hardy was a big man in every way. Big in body, with a fine head and big, capable, sensitive hands—craftsman's hands; instinctively one knew him incapable of anything small or mean. With this bigness went utter simplicity and honesty of purpose, an inexhaustible fund of enthusiasm and great warmth of heart; such a combination was irresistible.

He married in 1898 Alice Mary, daughter of Mr. G. B. Finch, who survives him, with his son and his two daughters.