II.—ALFRED NORTH WHITEHEAD (1861–1947).

By C. D. Broad.

When Alfred North Whitehead died on 30th December, 1947, in his eighty-seventh year, the English-speaking world lost one of its deepest and most constructive thinkers. The last twenty-three years of his life were spent in the United States at Harvard University and much of his most important work was done there. He had a deep affection and a great admiration for the country which had become his second fatherland. But he was also a typical product of Victorian England and Victorian Cambridge, and he never forgot the immense debt which he owed to his country, his public school, his university, and his college.

Whitehead was born on 15th February, 1861, at Ramsgate. His father, like W. E. Johnson's, inherited from his own father the headmastership of a private school. But he gave up the scholastic profession for clerical duty in 1867. From 1871 till his death in 1898 he was vicar of St. Peter's, a large parish with a church about three miles from Ramsgate. One of Whitehead's brothers entered the Church and became Bishop of Madras; another was for many years a schoolmaster at Sherborne. Mathematical ability would seem to be hereditary in the family; for Whitehead's nephew, son of the Bishop of Madras, is an eminent pure mathematician who at present holds the Waynflete Professorship in Oxford.

Whitehead was at school at Sherborne from 1875 to 1880. He was very happy there, and speaks of the excellence of the classical teaching in his time. In his last year he was head of the school and captain of games. He came up to Trinity College, Cambridge, in 1880, and he speaks with warm admiration and gratitude of the intellectual stimulus which he there received. Among his chief friends as an undergraduate were Henry Head, d'Arcy Thompson, James Stephen, the brothers Llewellyn Davis, Lowes Dickinson, Nathaniel Wedd, and Sorley. He was an active member of the *Apostles*, which at that time consisted of from eight to ten undergraduates or young B.A.'s, but was often graced by the presence of older members, such as Maitland, Sidgwick, Verrall, Henry Jackson, and week-end visitors who had left Cambridge for the wider world.

In 1885 Whitehead was elected to a fellowship at Trinity. In the same year he was appointed to a College lectureship in mathematics, and he held that office until 1910. He was married in 1890 to Evelyn Willoughby Wade. They had three children, two boys and a girl. Both boys served in the war of 1914-18, and one lost his life in his aeroplane in 1918.

Whitehead's life after taking his degree falls into three successive parts, spent in Cambridge, in London, and in the Cambridge across the Atlantic. It is also roughly true to say that his work falls into three divisions which correspond to these three periods in his life, though there is no breach of continuity but only a widening of his explicit interests and a gradual change of focus.

The move from Cambridge to London took place in the summer of 1910. For the first year Whitehead held no academic position; from 1911 to 1914 he held various posts at University College; and from 1914 to 1924 he was Professor of Applied Mathematics in the Imperial College of Science at South Kensington. His life in London was a very busy one, and it gave him many opportunities of seeing for himself how men act and react in co-operation and in conflict with their fellows. He was at one time or another Dean of the Faculty of Science, Chairman of the Academic Council, and an active member of many educational committees. There is no doubt that he found his life in London intensely stimulating and that it brought out much in him which had hitherto been latent. He began working on explicitly philosophical problems towards the end of the first world-war, and took an active part in the discussions of the Aristotelian Society.

In 1924 Whitehead was paid the high compliment of being invited to join the philosophical department at Harvard. It has been given to few men to start a new career in a new country at the age of 63 and thereafter to spend at least twenty more years in extremely original intellectual activity of the highest quality along quite fresh lines. Whitehead's output during this last period would be astonishing even in a man still in the prime of life. He and Mrs. Whitehead found themselves completely at home in their new surroundings, and made themselves greatly beloved by American colleagues and students and by visitors from England, to whom they showed all the old kindness and hospitality which had been characteristic of them in Cambridge and in London.

In 1937 Whitehead became Professor Emeritus at Harvard, and in 1945 England bestowed on him the highest honour at

her disposal, the Order of Merit. He had become a Fellow of the Royal Society in 1903, and in 1931 he had the almost unique distinction of combining this with a Fellowship of the British Academy. (I believe that Sir J. G. Frazer received this double honour, and I do not think that anyone else has done so.)

It is now time to say something about Whitehead's contributions to learning. It may fairly be said that he began as a mathematician with strong philosophical interests; made very important contributions to the philosophy of physics in his middle period; and ended as a constructive metaphysician, with a mathematical and physical background, who endeavoured to synthesise every important aspect of reality in one all-embracing system. A very important fact about Whitehead was that at no period of his activity was he 'philosophising on an empty stomach', if I may use that expression. Apart from his technical mastery of mathematics and symbolic logic, he had a wide and deep knowledge of history in general and the history of natural science in particular; he had had much practical experience of men and institutions, though it was inevitably confined within a somewhat narrow range; he was steeped in the best European literature and he had a sympathetic understanding of certain forms of religion; and he had an exceptionally sane and balanced personality, free from crotchets and grievances. His work, therefore, never gives that impression of thinness and clever-silliness which sometimes characterises the productions of highly intelligent writers who have lacked these advantages.

The chief work of his earliest period is his *Universal Algebra*. This begins with a general theory of the subject, and then proceeds to an elaborate and original development of the Algebra of Logic and of the Extensional Calculus of that great but neglected genius Grassmann. A second volume was projected, and Whitehead worked at it for several years. But he became absorbed in his collaboration with Russell in *Principia Mathematica*, and he may have thought that the latter work would eventually embody in an improved and generalised form all that he had intended to put into this second volume. It should be remembered that *Principia Mathematica* was to have been completed by a volume on geometry by Whitehead, which never appeared.

Mention must here be made of the difficult, but brilliantly original and fundamental paper, entitled *Mathematical Concepts of a Material World*, which Whitehead contributed to the *Philosophical Transactions* of the Royal Society in 1905. To quote his own words: "The memoir is concerned with the

possible relations to space of the ultimate entities which (in ordinary language) constitute the 'stuff' in space". Whitehead formulates and works out in detail five alternative 'Concepts'. One of them is a formal statement of the presuppositions of classical physics and geometry; some of the others involve very radical departures from that scheme of thought.

To this period belong also tracts on *The Axioms of Projective Geometry* and *The Axioms of Descriptive Geometry*, and the admirable popular book on *Mathematics* which he contributed to the Home University Library.

In the second period Whitehead devoted himself to the philosophy of mathematical physics, at the time when the theory of relativity had stirred the waters to their depths and slightly before the impact of the quantum theory had been generally felt. In the *Principles of Natural Knowledge* and the *Concept of Nature* Whitehead was mainly concerned with the following three problems. (1) To overcome the familiar dualism between a world of scientific objects, supposed to be knowable only as remote causes of sensations, and a world of sense-data, supposed to be private and mind-dependent. (2) To show in detail, by means of the Principle of Extensive Abstraction, the connexion between the crude data of sense-perception and the refined mathematical concepts of point, instant, particle, instantaneous velocity, etc. (3) To deduce the transformation-equations of the special theory of relativity from extremely general considerations about our spatio-temporal experience, without reference to such concrete and contingent matters as synchronisation of clocks by means of light-signals.

In the *Principle of Relativity* Whitehead dealt in his own way with the general theory of relativity. The book (which, so far as I know, 'fell still-born from the press') divides into three parts. The first is mainly philosophical or epistemological; the second consists of a suggested new law of gravitation, different both from Newton's and Einstein's, and the deduction from it of certain results in astronomy, electricity, magnetism, and heat, by which it might some day be experimentally tested; and the third is a purely mathematical treatment of the general theory of tensors, which approaches the subject in a purely abstract way and does not put geometrical interpretations on the various special tensors which are introduced.

It may be of interest to enumerate the points of agreement and the points of difference between Whitehead and orthodox relativists like Einstein. The points of agreement are the following. (i) The fundamental relations in nature are not

spatial or temporal but are spatio-temporal. (ii) The fundamental stuff of nature is not things, but 'events' which have duration and spatial extension. (iii) There is not just one unique way of slicing up space-time, leading to one unique space and one unique time. There is an infinite plurality of different 'directions' in space-time, each of which is equally permissible as a time-axis for dating all physical events. Corresponding to each of these there is a certain timeless space; and all these timeless spaces are equally permissible for locating all physical events, provided that the corresponding 'direction' in space-time is used as the time-axis for dating them. (iv) Not all 'directions' in space-time are permissible as time-axes. All those which are so are confined within a certain four-dimensional cone. (v) The fact that the fundamental relations in nature are spatio-temporal necessitates a modification in the form of the traditional law of gravitation. That law takes account only of instantaneous *distances* between *bodies*, whereas a genuine law of nature must be in terms of *spatio-temporal* separation between *events*. (vi) The laws of nature must be expressible in tensor form. (vii) Einstein's law of gravitation, when properly interpreted, is at least a *possible* form of the law.

The following are the main points of difference. (i) As already noted, Whitehead reaches the transformation-equations of the special theory of relativity from very general considerations and without any reference to experimental facts about the velocity of light and the synchronisation of clocks by light-signals. Among other advantages of his method he claims that it enables him to define parallelism and normality, to give a clear meaning to the notion of a Newtonian frame of reference, and to solve the old philosophical difficulties about absolute rotation. (ii) In opposition to the orthodox relativists, who hold that the structure of space-time is not uniform always and everywhere but varies with its 'contents', Whitehead asserts and claims to prove that space-time is and must be homaloidal in structure. (iii) Nevertheless the traditional law of gravitation can and must be modified, for the reasons stated above.

Whitehead claimed to prove that space-time must be homaloidal by two arguments, one epistemological, and the other based on certain empirical facts about time-measurements. I find both arguments most obscure and unconvincing, as stated.

It is rather depressing to consider how little attention has been paid by professional theoretical physicists and pure mathematicians to the many highly original ideas which Whitehead put forward and often worked out in considerable technical

detail. They alone are competent to pass a final judgment on the validity and importance of these ideas, and they cannot excuse themselves (as in many cases they quite justifiably might do) by saying that it is the work of a cranky amateur of doubtful competence. I have spoken to many of my mathematical and physical colleagues, who are intensely interested in these subjects, and I do not think that I have ever found a single one of them who had troubled to read what Whitehead had to say. I must admit, however, that the fault was largely that of Whitehead himself. He was an abominably obscure and careless writer, and this fault certainly grew on him as he became older. It is the more deplorable, since he certainly possessed at one time the power to write clearly, as his little book on *Mathematics* shows, and since he certainly retained that power when he chose to exercise it, as is shown by many passages in such later works as *Science and the Modern World* and *Adventures of Ideas*.

I shall touch very briefly on the work of Whitehead's third period, in which he developed what has been called 'the Philosophy of Organism'; partly because I understand it so imperfectly, and partly because it is to be treated by another contributor who has made a special study of it. The central work of this period is the Gifford Lectures, *Process and Reality*, but this should be taken together with its predecessor, *Science and the Modern World*, and its successor, *Adventures of Ideas*. *Process and Reality* is one of the most difficult philosophical books that exist; it can vie in this respect with the works of Plotinus and of Hegel. I cannot pretend to understand much of it, and I cannot help thinking that many of its enthusiastic admirers must simply be counted among those who "wonder with a foolish face of praise". It is often desperately difficult to understand what it is that Whitehead is asserting. When one is fairly sure of this, it is often equally hard to discover what he considers to be the reason for asserting it; for he seems often to be "not *arguing* but just *telling* you". And, finally, when one thinks that one knows what he is asserting and what he is alleging as the ground for it, one often fails to see how the latter proves or makes probable the former. *E.g.*, I am fairly certain that Whitehead thought that he had given an answer in his later books to the difficulties which Hume raised about the validity of induction. I am also fairly certain that he thought that his own account of sense-perception and of the way in which we come to believe that this causes that (which are enormously better than anything that can be found in Hume) furnish a satisfactory basis for an answer to these difficulties.

But I cannot for the life of me understand how precisely they are supposed by Whitehead to do so.

Still, from my knowledge of Whitehead and of those of his writings which I think I can understand, and from the occasional gleams and glimpses which have been vouchsafed to me in struggling with *Process and Reality*, I feel fairly certain that there is something important concealed beneath the portentous verbiage of the Gifford Lectures. Whitehead often makes profound and thought-provoking observations, expressed in happy and striking phraseology, and exhibiting real wisdom as distinct from mere cleverness. These are particularly prominent in *Science and the Modern World* and *Adventure of Ideas*, which contain much that is perfectly intelligible and intensely stimulating to any intelligent reader.

It is, perhaps, fortunate for most prophets that, unlike Whitehead, they have been without honour in their own countries and times. A lesser man than he might easily have been spoiled by the adulation which his later work received and by being treated as a kind of Messiah by many of his more foolish admirers. Nothing of the kind happened. He remained simple, natural, modest, humorous, and intensely human. He was equally great in intellect and in character, and one of the finest products of that very fine civilisation and culture which have perished in England's two Pyrrhic victories over Germany.