the last three years of his life, and ended it, to the enforced system of rationing during the latter part of the war.

While thoroughly familiar with all branches of pure mathematics, Mathews' main interests were in the theory of numbers and projective geometry. The theory of numbers which, in its widest sense, is the theory of discrete as opposed to continuous magnitude, has passed through four well-defined stages of development. First there came the Diophantine analysis proper, of which the greatest exponents, after Diophantos among the ancient Greeks, were Fermat and Euler. In this the general problem is to determine all the solutions in rational numbers of a system of m ($\angle n$) algebraic equations.

$$R_i(x_1, x_2, \ldots x_n)=0, \quad i=1, 2, \ldots m.$$

Next came the discovery of the law of quadratic reciprocity which rendered possible a discussion of quadratic arithmetical forms, so ably expounded by Gauss in the "Disquisitiones Arithmeticæ." Such writers as Lejeune-Dirichlet, Eisenstein, and Stephen Smith added much to what Gauss had done, and a scholarly introduction to the whole theory was given by Mathews in his "Theory of Numbers" of 1892. A problem which arises in the theory of quadratic forms (the determination of the class-number) was the forerunner of the analytical theory which is intimately bound up with certain transcendental functions of a complex variable. It had little attraction for Mathews (though his book contains an introduction to it), but has recently received much attention from Prof. E. Landau, Prof. G. H. Hardy, and the late S. Ramanujan. The fourth stage was marked by Dedekind's discovery of his theory of ideal numbers, which restore completely to a system of algebraic numbers certain factorisation properties of ordinary integers that appear at first to be lost. Taking numbers of the type $a+b\sqrt{-5}$, where a, b are ordinary integers, a threefold factorisation of 21 is possible, viz.:

$$21=3\times 7=(4+\sqrt{-5})(4-\sqrt{-5})$$
$$=(1+2\sqrt{-5})(1-2\sqrt{-5}),$$

whereas none of the factors 3, $4+\sqrt{-5}$, etc., is decomposable into two factors $(a+b\sqrt{-5})(c+d\sqrt{-5})$.

Mathews' was probably the first mind in England to realise the far-reaching effect of Dedekind's discovery, two papers by him on the subject appearing in the London Mathematical Society's Proceedings of 1892. The tract "Algebraic Equations" on a kindred topic, written fifteen years later, contains a masterly exposition of Galois' theory, completed by Jordan and others, showing how the different types of irrationality which can be defined by an algebraic equation are associated with different types of group.

Written in collaboration with Prof. Andrew Gray, the "Treatise on Bessel Functions," concerned mainly with physical applications, is still a standard work. The "Projective Geometry" (1914), inspired by Henrici's lectures in London many years before, contains two unusual features: first, an exposition of the logical groundwork of the subject, and secondly, an account of Staudt's theory of complex elements (whereby a real involution defines a complex point or line). He also brought out a new edition of R. F. Scott's "Determinants" (1904), and contributed articles on *Number* and *Universal Algebra* to the 1910 edition of the "Encyclopædia Britannica."

Most of Mathews' mathematical papers appeared in the London Mathematical Society's Proceedings or in the "Messenger of Mathematics." A few of them are geometrical, and nearly all the rest have an arithmetical bearing. Pride of place, perhaps, should be given to a four-page note of 1897, in which he explained a method of reducing multiple partitions to a single partition. Several papers were written on the complex multiplication of elliptic functions, a subject which had a singular fascination for Mathews. The publication of a manuscript on the lemniscate functions has been delayed by the war and his subsequent illness.

Ever since the mid-eighties NATURE has published frequent reviews and articles from Mathews' pen. These articles, most of which appeared over the initials "G. B. M.," were always written in a careful and scholarly style; they contained his considered opinion on the book or point concerned. In conversation with the present writer he once expressed the opinion that some of his best work had appeared in NATURE reviews.

A man of simple tastes and naturally retiring by disposition, Mathews expressed sound judgment on both men and affairs. Some of his views, perhaps, were those of an idealist, and hardly feasible in the domain of practical politics. His capacity for maturely grasping everything with which his mind came into contact made him unique in the experience of his friends. Only one or two sides of so versatile a man's brilliant intellect really appealed to most people. When he was appointed professor of mathematics at Bangor, at the age of twenty-three, it was manifest that he could equally well fill four or more chairs in the college. During recent years he spent much time in reading and translating Arabic: he was also a competent musician. W. E. H. B.

DR. J. T. MERZ.

DR. JOHN THEODORE MERZ, whose death on March 21, in his eighty-second year, was announced last week, was a son of Dr. Philip Merz, headmaster of the Chorlton High School, one of the pioneer institutions of higher education in Manchester. He was an acknowledged authority upon industrial chemistry and took a leading part in the industrial development of electricity supply, being one of the founders of the Newcastle-upon-Tyne Electric Supply Company. By the use of his great scientific and practical knowledge, he rendered invaluable service to the industrial community of Tyneside and the counties of Northumberland and Durham.

Dr. Merz will, however, be most widely remembered on account of literary activities, which go so far back as 1864, when he wrote a paper, which was published in Germany, on Francis Bacon, and another on Kant. For a long time the work by which he was best known was a small but much appreciated volume on Leibniz, contributed in 1884 to Blackwood's "Philosophical Classics for English Readers." A German translation of this appeared in 1886. These publications, however, were mere preliminaries to that which he had planned as the great work of his life, "The History of European Thought in the Nineteenth Century." The first volume of this was published in 1896, the fourth and last at the end of 1914. From the first

the wide-ranging history, learned but never dry, was a literary success, receiving praise from all sides and from thinkers of all schools. The impartiality with which the author treated the contributions made to thought by England, France, and Germany respectively was universally recognised. This work he was able to complete so far as scientific and philosophical thought are concerned. A third part to be devoted to the less systematic thought that has found its expression in *belles lettres* was projected, and was to consist, like the two parts on scientific and philosophical thought, of two volumes; but this Dr. Merz finally decided, though he had collected much material, must be left for some successor.

Dr. Merz's labours, however, did not by any means cease. At the end of 1915 he published a very interesting essay on Religion and Science, in which he showed that the certainty of science within its limits depends on its method of abstraction. A view of things "all together," in which the mind, without which the external world cannot be known, is restored as part of the total system of reality, leads to recognition of the religious attitude as a mode of comprehending the universe, including man. Philosophy mediates between science and religion, explaining the validity in its own manner of each mode of viewing things.

In a like essay, "Fragment on the Human Mind" (1919), Dr. Merz showed his freedom from some prejudices of that reaction in nineteenth-century English thought which had gone to Germany for a more spiritual doctrine than the native philosophy seemed to result in. Knowing and appreciating the rule of Kant and Hegel and their successors, in the end he found in the psychological method of Locke, Berkeley, and Hume the most valid, as well as the most accessible way to show the fallacies of the "mechanical Philosophy" when regarded, not simply as the most powerful instrument of scientific thought, but as revealing the ultimate nature of the universe. To give us a suggestion that reality is spiritual, Locke's "plain historical way," namely, the method of introspection, remains sufficient.

COLONEL SIR HENRY THUILLIER, K.C.I.E.

THE late Sir Henry Thuillier, who died on March 4, was Surveyor-General of India from 1886 to 1895, and was distinguished as an able and tactful administrator. His name is so generally associated with administrative work, that his success as a geodetic observer in the earlier part of his career is apt to be overlooked.

Thuillier was commissioned in the Bengal Engineers in 1857, the year of the Mutiny, and he was appointed to the Great Trigonometrical Survey of India in 1859. In 1859–1861 he was one of the observers employed in carrying a chain of principal triangulation round the Punjab frontier along the line of the river Indus; this chain has been the fundamental base of all the later surveys, which have been extended during campaigns into Afghanistan, Waziristan, and Tirah.

In 1862 Thuillier was appointed to the eastern frontier of India, and for the next six years he had the difficult task of extending the principal triangulation eastwards from Calcutta to Burma. During the first half of the nineteenth century the geodetic triangulation had been carried across mountains and plains, deserts, fields and forests, and the observers had had to adapt their methods of observation to the varying types of country; but in Eastern Bengal Thuillier encountered a type of country that had not been met with before, and which was probably the most unsuitable of all types for triangulation. He had to carry chains of triangles over the deltaic swamps of the Ganges and Brahmaputra; the country was absolutely flat and overgrown with heavy jungle.

Thuillier had to cut glades through the jungle so as to render the several stations of his triangulation mutually visible from one another. The party suffered continually from malaria; the clearing of the glades was so laborious that their width had to be limited to a few feet. The exact line in which any particular glade had to be cut from one station to another was not known with sufficient accuracy to enable the men to clear the jungle in the correct direction, and numerous trial glades had to be cut in order to determine the true alignment. In one year on the Brahmaputra series of triangulation, Thuillier had to clear 700 miles of glade through dense jungle, and in the six years the total length of the clearance lines was nearly 4000 miles.

Sir Henry Thuillier had also considerable experience of surveying at high altitudes. He was trained in the famous Kashmir survey of Montgomerie and Godwin-Austen (1861), and from 1870 to 1873 he was in charge of the survey of the Kumaun Himalayas, including the glacial areas of Nanda Devi and Trisul. Many of his survey marks were above 20,000 feet.

PROF. J. A. GREEN.

WE are grieved to hear of the sudden death, following upon an operation, of Prof. John Alfred Green, professor of education in Sheffield University. Many of us knew Prof. Green best in connection with the Educational Science Section of the British Association, of which he was for several years Recorder. He had the virtue we admire in a Tangye silent gas engine—converting all his energy into work and none into fuss—of a restrained enthusiasm, able to work in harness, but no less enthusiastic because he did not boil over into the vapid. Hence he was invaluable in the early days of the Educational Science Section, when many doubted whether there were, or could be, such a thing as educational science. But Prof. Green had visions and lived to realise them. He was secretary of the Committee on Mental and Physical Factors involved in Education, and the opening pages of the Report presented at Sheffield in 1910 make his attitude clear: "application of experimental methods to the investigation of mental phenomena" . . . "study of the persons to be educated and their attitude towards methods of instruction." If Section L still devotes a day annually to education and psychology, that is largely Prof. Green's doing. The work was carried further by him in *The Journal of Experimental Pedagogy*, which he edited. In that journal Prof. Green has left us a monument and a guidepost which may encourage us to go forward in the way which he was one of the first to tread. H. R.