The statement of the bibliographer Hājī Khalifa that his name was not pronounced Amyal (as has sometimes been supposed), but Umail, is confirmed by the vowel points placed on the name in the Leningrad manuscript of the work. It might, however, be mentioned in this connexion that Hājī Abdu'l-Muhyī, who possesses a very extensive acquaintance with Arabic alchemical literature, and whom the present writer consulted on the point a few years ago, was emphatically of opinion that the correct pronunciation was Amyal. The Latin transcription Hamuel would support the latter as against Umail; it is therefore difficult to arrive at a final decision.

The importance of Ibn Umail's work lies in its early date; in its possible affiliations with the celebrated "Turba philosophorum", the "Shawāhid" of Razi, and a treatise by the little-known alchemist Mahraris; and in its richly detailed picture of Muslim alchemical thought of the tenth century. Messrs. Stapleton and Husain promise us a detailed study of the text of the Mā' al-waraqī and its comparison with the work of Razi just mentioned, as soon as leisure from their official duties permits. Meanwhile, an inspection of the Arabic version side by side with the Latin translation shows that while the latter is a creditable production for its

age, the translator made a great many slips and not seldom failed completely to understand his author. Those historians who can read Ibn Umail in the original will find an abundant store of important and interesting information in Mr. Turab Ali's carefully edited text; but the general reader of alchemical literature must impatiently await an annotated English translation and hope that Mr. Stapleton may not long delay it.

The descriptive index of names of people, countries, places and books mentioned in the Mā' al-waraqī, with its Latin rendering, and in the Qasidat an-nūniyah, is largely the work of Prof. Maqbul Ahmad, of Presidency College, Calcutta. It is by no means the least valuable part of the treatise, for it throws considerable light on those personages, real or fictitious, then regarded as authorities, and shows at a glance the books most frequently quoted and therefore presumably esteemed most highly. We note, for example, that Jābir ibn Hayyān is mentioned 31 times, Mary the Jewess 27 times, and Hermes no fewer than 51 times. But we feel that we should like to know more of Abu'l-Qāsim 'Abdu'l-Mahmūd ibn Hayyān, an unsuccessful alchemist and contemporary of Ibn Umail, who worked for twenty-three years without letting his furnace go out!

E. J. HOLMYARD.

Obituary

PROF. E. W. HOBSON, F.R.S.

ERNEST WILLIAM HOBSON, who was born at Derby on October 27, 1856, and died rather suddenly, after a short illness, on April 19, 1933, had been for many years one of the first of English mathematicians. Although he lived to be seventy-six, he was active almost up to his death; his last book (and perhaps in some ways his best) was published when he was seventy-four. He was a singular exception to the general rule that good mathematicians do their best work when they are young.

Hobson was the son of William Hobson, who was editor and part proprietor of the *Derbyshire Advertiser*, and was prominent in municipal affairs. He was the eldest of a family of six, J. A. Hobson, the well-known economist, being one of his brothers. His early education was at Derby School, where his mathematical talents were very soon noticed and encouraged. When he was fifteen he obtained a Whitworth Scholarship at what is now the Royal College of Science, and studied physics in London for a short time under Dr. F. G. Guthrie. Two years later he was elected a mathematical scholar of Christ's College, Cambridge. He went into residence in October 1874, 'coached' with Routh, and was Senior Wrangler in 1878.

A Senior Wrangler of those days succeeded almost as of right to a fellowship, and Hobson became a fellow of Christ's, and a lecturer in

mathematics, in the autumn of the same year. He also did a good deal of private coaching. In 1883 he was made one of the first University lecturers in mathematics. But 'research' meant much less for a college and even for a university lecturer then than it does now, and Hobson wrote very little, and that of little importance, in his early years. His Royal Society memoir on spherical harmonics, which is now classical, and is the first of the papers on which his reputation rests, was not published until 1896.

Hobson's development as an original mathematician seems now to have been strangely slow. By 1903, however, he had moved a very long way; he had (largely as the result of intercourse with W. H. Young) acquired his interest in the modern theory of functions; and he had abandoned coaching in order to win leisure for research. From this time onward he changed rapidly into the Hobson whom we knew. In 1903 he became Stokes lecturer, a position which is now associated definitely with applied mathematics, and has been occupied, since Hobson held it, by Jeans, Fowler and Dirac; but Hobson was by then very plainly a pure mathematician. The first edition of his great "Theory of Functions of a Real Variable" appeared in 1907. In 1910, at the age of fifty-four, he succeeded Forsyth as Sadleirian professor, and he held this office until his retirement in 1931. He was still surprisingly vigorous, but, as well he might be,

tired, and he admitted that he found retirement a great relief.

Hobson received honours from many quarters. He was elected to the Royal Society in 1893, served twice on the Council, and was Royal medallist in 1907. He was president of the London Mathematical Society in 1900-2, and received its de Morgan Medal in 1920. He was president of Section A of the British Association at Sheffield in 1910. He represented Cambridge at the Abel centenary in Oslo in 1902. He was an honorary doctor of six universities, and a member of various foreign academies. But he said that no honour paid to him pleased him more than the dinner organised in his honour by the mathematical faculty of Cambridge less than a year before his death.

He had many interests outside mathematics. As befitted a man of his origin and training, and an intimate and long-standing friend of James Ward, he was a keen philosopher. Philosophy, indeed, was his strongest external interest, as one could judge from passages of his great book. He was not a 'mathematical logician', but he was attracted by fundamentals, and was the first English mathematician to see the point of the discussions of the 'antinomies' and to recognise the importance of 'Zermelo's Axiom'. It was therefore quite appropriate that he should have been one of the two or three mathematicians who have been invited to deliver Gifford lectures. In these lectures, which were published as "The Domain of Natural Science", in 1926, Hobson defends a rather extreme and rather abstract form of the 'descriptive' view of science.

Hobson wrote five books in all. His "Trigonometry" is a well-known textbook which has run through many editions. "Squaring the Circle", a reprint of six lectures delivered in 1913, is a popular book which may be compared with Klein's "Vorträge über ausgewählte Fragen der Elementargeometrie". It is more solid than Klein, but is full of interesting information and most agreeably written, and makes one regret that Hobson did so little in the way of popular exposition. The two remaining books, the huge treatise "Theory of Functions of a Real Variable", which occupied him from before 1907 until 1926, and the "Spherical and Ellipsoidal Harmonics", published only in 1931, though a great deal of it was written more than thirty years before, contain the record of most of the chief work of his life.

The "Functions of a Real Variable" was published in 1907, at first as a single volume. Young's "Theory of Sets of Points" had appeared one year before. The modern theories of measure and integration were then almost new, and Hobson and Young were the first to introduce them to English readers. The classical theory of functions of a complex variable had been introduced into Cambridge by Forsyth, but real function theory was practically unknown. To-day it is the part of pure mathematics that has been studied most intensively, and it is to Hobson and Young that

the revolution is due. The book, in its various editions, occupied Hobson for twenty years, and it was no doubt the central fact in Hobson's life, both for himself and for English mathematics. The whole theory has expanded out of recognition, and very little of the first edition survives unchanged. In particular, nearly all of Hobson's contributions to the subject were made after 1907 and appear only in the later editions. The most important of these are to the theory of orthogonal series.

It was in 1908 that Hobson published the first of his series of papers on the representation of an arbitrary function by a series of normal orthogonal functions. In these papers he aims at obtaining conditions for the validity of such a representation "comparable in generality with the known sufficient conditions for Fourier series". The series in question include Sturm-Liouville series, Legendre series, and Bessel-Fourier series (and also Hermite and Laguerre series, which Hobson does not consider). The theory of integral equations, as developed by Hilbert and Schmidt, had led to a certain unification in the theory of these series, but only for functions of a severely restricted type; Kneser alone had obtained, for Sturm-Liouville series, 'reasonably general' conditions. Here, and in other parts of the theory of orthogonal series, Hobson's work marks a big advance. All this is set out systematically in its place in Hobson's book, which is, if any book ever was, a 'standard treatise', and is probably the most important book written by a modern English mathematician.

The modern theory of functions of a real variable was in its infancy when Hobson began his work. In England it was practically unknown, and rather derided. There may perhaps have been a little excuse for the people who, like Greenhill, regarded it as a monstrosity, for there was still a faint air of mystery hanging about the elements, and much of the superstructure was inelegant and more than a little tiresome. Hobson and Young were the first English mathematicians to see the significance of the new ideas, and fought what must often have been a rather disheartening fight for their recognition. Hobson lived to see real function theory the most highly developed mathematical discipline in Cambridge, a subject recognised even as 'a good Tripos subject', the most popular and paying subject in 'Schedule B'. The most commonplace Cambridge mathematician now has forgotten the superstition that it is impossible to be 'rigorous' without being dull, and that there is some mysterious terror in exact thought: now we go to the opposite extreme and say that "rigour is of secondary importance in analysis because it can be supplied, granted the right idea, by any competent professional". All this we owe very largely to Hobson, but Hobson never quite understood how completely he had won his fight. He always retained something of the air of the protagonist of an unpopular cause; he was a little too old to understand fully that everything that he had been fighting for had been achieved.

G. H. HARDY.