of specialists in any branch of science and technology are apt to have an unfortunate effect in schools and universities; for they may be out of date before a normal period of advanced training is finished.

It is of interest to examine a little further the Committee's belief that the supply of biologists at universities is lacking in quality as well as in quantity, which they attribute to the neglect of biology as a subject of study in schools. While sympathising with their views, which are shared by many people, I think it cannot be denied that whereas a biologist must have an adequate knowledge of physics and chemistry, it is not necessary for a physicist or chemist to have a knowledge of biology; and if one considers the position from a cultural rather than from a practical point of view, it would be fair to say that the boys who need least to study biology as a cultural subject at schools are those who are going to study it at a university. The only point that remains, then, is that if biology were taught more widely in schools, it is possible that here and there a boy "may experience from biology a pull which he had hitherto failed to secure from his special subject"

For my part, I feel confident that directly there is an assurance of reasonable careers in biology, suitable candidates will be forthcoming, and education at schools and in the universities will develop on sound lines. Lack of teaching of biology at schools has not led to a shortage of doctors. How, then, can it be mainly responsible for a shortage of other biologists? It needs no inspired prophet to foresee a great development some day of the biological sciences: the work of pioneers to-day makes that sufficiently obvious. The next generation may live to see a development comparable with that of the physical sciences, and their applications, in the last thirty years; but the time is not yet ripe. Until it is, our duty at universities is to keep our biological departments moderate in size, but high in quality.

These practical considerations are not exhaustive and do not lead to any definite conclusion on the problem of the size of university departments of science and technology. In the end, the optimum size is a matter of judgment; my judgment, for what it is worth, is that on the whole there is no strong case for increasing the numbers of students of science and technology at universities. In thirty years' time, this statement may look ridiculous, but one cannot foresee events so far ahead. Rather than any marked expansion in numbers should take place during the next five years, I should prefer to concentrate on giving the better man a better chance than he has now; to improve the quality rather than to increase the quantity.

Obituary

Prof. W. M. Hicks, F.R.S.

BY the death of William Mitchinson Hicks on August 17, the world of science has lost an outstanding figure, whose achievements were perhaps more appreciated by the last than by the present generation. Born at Launceston on September 23, 1850, he went up to Cambridge in 1870 as a scholar of St. John's College, and reached the position of seventh wrangler in the Mathematical Tripos of 1873. This was the year in which the Cavendish Laboratory was founded with Clerk Maxwell as first professor, and Hicks formed one of the small band of distinguished students of experimental physics who gathered round him, and came directly under his inspiration. In 1876 he was elected a fellow of St. John's, and lived there until 1883, engaged in the earlier stages of his mathematical researches on the theory of vortex rings. In that year he was appointed principal and professor of physics and mathematics in the Firth College at Sheffield, and from this time onward his energy was devoted to the furtherance of university education in that town.

This tiny College—the staff numbered only half a dozen all told—had developed, as in other towns, out of the zeal for higher education marking the earlier days of the century, which was shown in this instance by a bequest of Mr. Mark Firth. It carried on a struggling and precarious existence, but its subsequent history forms a monument to the vision and untiring work of Dr. Hicks.

The first stage of Dr. Hicks's ideal was the union of the Firth College, the Technical School, and the Sheffield School of Medicine into one university college, which he succeeded in accomplishing in 1897. The opportunity for further development, apart from the foundation of new departments, came in 1903, when the Victoria University formed by the Liverpool, Manchester, and Leeds Colleges was dissolved. It was clear that the system of constituting a university by the federation of several distant university colleges was too cumbersome to work, and each town set about providing its own. The opportunity was seized in Sheffield also—it was now or never, and a large sum would have to be raised. Dr. Hicks's quiet but persistent pressing forward of his ideals, his scientific eminence and his obvious single-mindedness and sincerity, convinced the important persons of the city, and ultimately gave rise to a wave of popular enthusiasm which brought the necessary endowment in its train. He was a man content with doing his good work for the founding of the University, and courted no popular recognition,

but those who knew the circumstances know well that his was the vision, and to him the accomplishment of it was largely due. On its constitution in 1905, the University appointed him as its first Vice-Chancellor, but he only held the office for a few months. His bent had always been for research, and he was anxious to get back to it, so that as soon as possible he withdrew from the vice-chancellorship to become simply the professor of physics, with comparative leisure for his research work. However, in 1913 he acted as Vice-Chancellor again for a year, stepping into the breach in an emergency.

Hicks's scientific work falls naturally into two parts separated in time by the year 1909. Up to this date, much of it can be summed up by the words 'vortex rings'. After the discovery by Sir William Thomson of the permanence of a vortex ring in a frictionless fluid, this subject made a double appeal to the younger school of mathematical physicists in Cambridge. In the first place, the mathematical difficulties of further treatment presented a continual challenge to their ability, and in addition there was the definite hope, in those classical days, of developing from it a theory of the real atom. Hicks made the subject peculiarly his own, inventing the necessary 'toroidal' functions for the treatment, and in a series of four brilliant memoirs in the *Philosophical Transactions* worked out the properties of vortex rings exhaustively. Among his discoveries was that of the existence of vortex aggregates, which showed a remarkable analogy with the periodic constitution of the elements. His eminence in these researches was marked by the award in 1885 of the Hopkins Prize in Cambridge, and by his election to the Royal Society in the same year. Later he was awarded the Royal Medal of the Society, and he served on the Council for many years.

From 1909, not only to his retirement in 1917 from his chair of physics, but also to the very end of his life, Dr. Hicks devoted himself to the task of elucidating the structure of spectra. Greatly attracted by Rydberg's memoir on the relationships between series lines, and imbued with a profound admiration for Rydberg's work, he set about extending it. The basic idea was to try to find out as much as possible about the relations between the frequencies of lines apart from all questions of theory. In its spectrum, each element wrote its signature, but in cypher form, and the methods he proposed to adopt were purely those appropriate to finding the key of the cypher. The difficult mathematics of his earlier works was replaced almost wholly by numerical calculations, simple individually, but laborious in the immense number of them. The results are presented in numerous papers in the *Philosophical Transactions* and the *Philosophical Magazine*. His essay on the "Analysis of Spectra" was awarded the Adams Prize in 1921, and a full account of his work up to then, based on the essay, was published in 1922. The results of his later work are to be published this autumn in a book on the "Structure of Spectral Series", on the proofs of which he was working when he collapsed with the illness which in a few weeks ended his life.

It is difficult at the present time to estimate justly the value of Hicks's results in this field. They tend to be neglected by modern spectroscopists, because admittedly in a certain proportion chance agreements occur in the applications of the rules he has discovered, and it is difficult without great labour to determine to what extent the validity of the rules may be affected thereby. But another reason is that no one can find any way of fitting them into the present day theories of the emission of light. Hicks recognised both these difficulties, but believed that his results must be held available, perhaps for a later generation of spectroscopists to succeed in fitting them into a framework of theory.

Dr. Hicks had two sons, one of whom was killed in 1915 in the War; his memory is perpetuated by the Basil Hicks lectureship, which provides for a series of public lectures at the University of Sheffield by eminent men on subjects connected with the War and international peace. Not very long after his retirement from the chair of physics at Sheffield, Dr. Hicks's wife died, and in 1919 he went to reside in the little country village of Crowhurst in Sussex, and remained there until his death. He was a man of vigorous constitution, extremely fond of walking, and a great lover of Nature. He explored the countryside for miles round his home, and many villagers must now miss his genial presence. Hampered somewhat by increasing deafness in his later years, he lived an extremely regularly ordered life, working with amazing industry at his calculations every morning, and walking in the afternoon. Nothing gave him greater pleasure than to be visited by his friends and old students, for whom he had a warm affection. The simplicity and courtesy of his mind and manners, his thoughtfulness for others, and the selflessness of his devotion to truth, mark him as a noble, not merely an eminent, man. The memory of him as such will be cherished by his friends as long as they live, while his scientific work on one hand, and the University of Sheffield on the other, form enduring monuments to his fame. S. R. M.

THE death is announced of Dr. Maurice Fishberg, the anthropologist, which took place suddenly at the age of sixty-two years in New York on August 31. Dr. Fishberg was born in Russia, but educated in New York, where he studied medicine. He also devoted special attention to the study of anthropology and questions of race, and came to be recognised as the foremost authority on the physical anthropology of the Jews. He was the author of "Physical Anthropology of the Jews", "Comparative Pathology of the Jews" and a volume "The Jews" which appeared in the Contemporary Science Series. His views on the origin of the differences in physical character displayed by the Jewish people in varying environments have been more widely accepted among non-Jewish anthropologists than they have among those of his own people, who have stressed the unity and continuity in history of the Jewish people as a race of distinctive character and culture.