obituary

J. E. Littlewood

PROFESSOR John Edensor Littlewood, FRS, Emeritus Rouse Ball Professor of Mathematics in the University of Cambridge, died on 6 September, 1977, at the age of 92.

He was the son of Edward Thornton Littlewood, a schoolmaster who had been 9th Wrangler in 1882. Littlewood was taught mathematics at St. Paul's School by F. S. Macaulay, later FRS, an outstandingly successful teacher. Littlewood has described his mathematical education, including his early experiences in research, in *A Mathematician's Miscellany,* and it seems to have been a far from ideal preparation for the kind of research which became his life. For Cambridge mathematicians had not yet fully appreciated the major advances on the Continent.

His director of studies, E. W. Barnes, suggested the problem of integral functions of zero order, in particular asymptotic formulae for functions with given zeros. Perhaps as a result of independent reading, Littlewood switched to 'elementary' methods for general functions and produced an important result in his first paper on the maximum and minimum moduli of any integral function of zero order, a type of result which Barnes had described in 1898 as 'a disguised truism'. However, Barnes now recognised the value of the work; one referee opposed publication violently, but G. H. Hardy reported favourably and the paper was published in 1907.

In 1911, Littlewood opened a new chapter in the theory of series with his Abel–Tauber theorem which led to his immensely important collaboration with Hardy lasting 35 years. It covered, besides the theory of series, and in particular Fourier series, the Riemann zeta function, Diophantine approximation, the additive theory of numbers and the theory of functions.

After three years in Manchester, Littlewood returned in 1910 to a Fellowship and Lectureship at Trinity College; he became Rouse Ball Professor in 1928. During the First World War he worked as a Second Lieutenant on anti-aircraft ballistics. He retained his rooms in Trinity as Life Fellow until his death. He spent little of any vacation in Trinity, finding a different setting better for concentration on research. He believed that periods of complete relaxation were essential and often found them in music, and in rock-climbing and ski-ing.

In his younger days he served on the Councils of his College, the Royal Society and the London Mathematical Society, but from about 1935 the fits of depression which had plagued him for many years seem to have become worse. He took no part in meetings of committees or councils or in gatherings of mathematicians. However, his fits of depression were cured sometime in the 1950s, and he paid several highly successful visits to the U.S.A. after retiring.

A very high proportion of Littlewood's work after 1912 was done in collaboration with Hardy, some with Paley, Offord, myself and others. When Harald Bohr, brother of Niels Bohr, paid his first long visit to Cambridge, he and Littlewood wrote a monograph on the zeta function, but, when it was finished, they were so exhausted that they could not take it to the printers. The manuscript was used later by Titchmarsh and Ingham in writing their Tracts on the subject. Of the papers appearing under Littlewood's name alone, the one in 1925 made a very important contribution to the problem of the coefficients of functions *schlicht* in the unit circle, a problem still not completely solved.

Although in the early days there must have been many discussions with Hardy, most of their joint work was done by correspondence. It seems that there was an unwritten agreement that Hardy could write up and publish anything based on joint work, but Littlewood only allowed me to write up parts of our joint work on condition that it appeared under my name alone as 'based on joint work.' My own collaboration with Littlewood arose out of a D.S.I.R. memorandum on the nonlinear differential equations arising in radio work, and the most important result arose out of a letter to *Nature* **120** (1927), 363, by van der Mark and van der Pol on frequency demultiplication, or rather van der Pol's interpretation of it in *Proc. Inst. Radio Engnrs* **22** (1934), 1051–1086.

I used to go to Littlewood's lectures on the theory of functions; some of them are included in his book of that title, and at one time he used the galley proofs. Although he had given the same lecture two or three times before, he showed such a passionate interest, always seeing things from a slightly different angle, that his audience could not help sharing his enthusiasm.

Littlewood's display of unequalled insight, technique and power as an analyst, was recognised by honorary doctorates, medals and membership of leading foreign academies.

Mary L. Cartwright

W. H. Sheldon

DR WILLIAM H. SHELDON, Director of the Biological Humanics Center in Cambridge, Massachusetts, died there on 16 September 1977. Sheldon is the man who invented somatotyping—a classification of variations in human body structure, to which he related variations in temperament, in physical and mental illness, and in patterns of growth and aging.

Born in 1898 in Warwick, Rhode Island, Sheldon grew up amid woods and marshes. His work shows the imprint of his country background; of his mother who raised five children and was midwife to a village; of his father, a naturalist, breeder and judge of animals; and of his godfather William James, the psychologist and philosopher. At age 10 he was working for the state ornithologist, reporting on animals of the woods and fields—observing, describing, classifying. At 15 he took pride in his ability to match judges' scorings of livestock on 100-point scales. As an adult he turned his naturalist's eye on human structure and behaviour.

After public school, Sheldon attended Brown University and the University of Colorado. From the University of Chicago he received his Ph.D. in psychology in 1926, his M.D. in 1933. He taught at Northwestern University and the Universities of Chicago and Wisconsin. A two-year fellowship in Europe allowed him to study with Jung and to visit Freud and Kretschmer.

In 1938 he moved to Harvard, where he did much of his basic research, with such colleagues as S. S. Stevens, the experimental psychologist, and E. A. Hooton, the physical anthropologist. During World War II he served as lieutenant colonel in the Army Medical Corps. From 1947 until 1959 he was Director of the Constitution Laboratory at the College of Physicians and Surgeons, Columbia University, succeeding Dr G. Draper, a pioneer in constitutional medicine. He has also held research appointments at the University of California, Berkeley, and, since 1951, at the University of Oregon Medical School.

Sheldon's earliest book (*Psychology and the Promethean Will*, 1936) and his latest one (*Prometheus Revisited*, 1975) are broad, provocative and provoking schemes for merging religious humanism with biologically grounded social psychiatry. Between these publications, he worked singlemindedly to propose and refine methods for describing individual human physical structure: to develop a "biological identification tag". Best known are his primary components of endomorphy (roughly speaking, the softness and roundness of a physique), mesomorphy (heaviness of bone and muscle development), and ectomorphy (attenuation, "stretched-outness"). By measuring the strength of each component in each individual and assigning a three-part index, the somatotype, Sheldon produced a tool which comes much closer to describing and encoding the great range of variations on the basic human body plan than was possible with older, pigeonholing typologies.

Over the years his methods moved through several revisions, toward objectivity and always seeking measures that maximise invariance, that evaluate physique not just as a current manifestation but as a lifelong trajectory. Along the way he has reported associations of somatotype with temperament, delinquency, and mental illness. His reports on physique, health, and longevity, followed in the surviving veterans of the Spanish–American war (1898), and on the later careers of 200 delinquent boys first studied 25 years ago, will be completed by his colleagues.

Sheldon's studies of some biological underpinnings of behaviour offered a much-needed counterbalance to a psychology one-sidedly emphasising learning and environment. Psychology regarded this offer doubtfully, though the term *somatotyping* found currency in labelling many sorts of physique appraisal methods, much as the term *psychoanalysis* was misapplied to all sorts of appraisal and treatment methods, and even "schools" of somatotyping developed, like the schools of psychoanalysis (Sheldon found this comparison odious).

A keen observer, Sheldon was thoroughly convinced of the value and accuracy of his observations—an asset in a pioneer researcher, a problem to academic psychologists mistrustful of personal judgments. His irreverence for some of psychology's sacred cows, and his schoolboy's sense of mischief combined with a talent for finding just the right parallel in nature to point up a description of a human structure or action, have needled many a colleague. But Sheldon enjoyed his life. A seven-days-a-week worker, a diner at cafeterias because he could not stand the delays and pretentiousness of restaurants, an inveigher against the poisons in modern life, he was also wholehearted in his appreciation of an idea, a friend, a sparrow on his windowsill, an old coin. (Numismatists know him as the author of the standard work classifying early American cents.) His work cleared and broadened one roadway into the study of human biology and behaviour that had been an overgrown trail.

Richard N. Walker

Arthur C. Hardy

ARTHUR C. HARDY, Professor of Physics at the Massachusetts Institute of Technology and inventor of the first recording spectrophotometer, died on 31 October at the age of 81.

His specialist interests were in optics and photography, and after graduating at the University of California in 1917, he immediately became involved in photography in the first world war when he served in the American Expeditionary Force as a Commanding Officer in the Photographic Section of the U.S. Army. After the war he spent two years at the Kodak Research Laboratories before taking up an appointment in 1922 as Assistant Professor in Optics and Photography at MIT, where he spent the remainder of his professional life, becoming successively Associate Professor, full Professor and, in 1961, Emeritus Professor.

He played some part in the development of sound recording on film, while in 1930, in collaboration with Professor S. F. Brown, he developed an electric organ which was intended to reproduce the sound of any musical instrument. It is, though, with his famous recording spectrophotometer that his name will always be associated, since it is fair to say that this instrument revolutionised industrial colour measurement.

Until then, spectral transmission and reflection measurements were made with visual instruments and the observations were extremely laborious and were often impossible because of shortage of light. The recording of a spectral reflection curve through the visible spectrum in the course of only a few minutes meant that it now became a commercial proposition for the colour industries to determine the key property of their products, namely the spectral absorption of a dye or pigment.

The instrument has really had a very remarkable history. It was developed in the 1920s at MIT and a fascinating account of how the design evolved was given by Professor Hardy in 1938. (History of the Design of the Recording Spectrophotometer, *J. opt. Soc. Am.* **28**, 360–364; 1938.)

A number of the MIT staff participated in the project and a major element in its success was the use of an optical attenuator, a train of polarising prisms, to balance the light reflected from the sample against the light reflected from a reference white. The photoelectric cell, which was in those days a rather uncertain device, could therefore be relegated to the role of a null detector. In more recent recording spectrophotometers, on the other hand, the measurement is usually obtained by comparing the photocurrents themselves using a ratio-recording potentiometer or similar device. Yet the Hardy instrument is still holding its own against all competitors and is still regarded by many users as the standard instrument for colour measurement.

It was produced commercially by the American General Electric Company as the G.E. Spectrophotometer, but it might have had an early rival from Westinghouse, since in 1930 I was involved, as a research engineer with Westinghouse in Pittsburgh, in discussions about the production of a competitor. These were not, however, followed up. It is now manufactured by the Diano Corporation as the Diano-Hardy Spectrophotometer and, naturally enough, includes a number of modifications and accessories although the basic design is still the same after nearly 50 years.

A further contribution which Professor Hardy made to colour measurement was the publication in 1936 of the *Handbook of Colorimetry*, prepared under his direction by a team drawn from the staff of MIT. This was the first book on colorimetry to appear following the establishment, by the Commission Internationale de L'Eclairage, of the 1931 system of colour specification based on tables defining the colour-matching characteristics of a standard observer. The many charts and tables in the Handbook provided an excellent introduction to the CIE system and undoubtedly speeded up the use of the system for colour standardisation and as a tool in the colour industries.

Professor Hardy received a number of honours, including the Frederick Ives Medal of the Optical Society of America. He also served as President of the Society from 1935 to 1937 and as Secretary from 1940 to 1957.

W. D. Wright