

## RALPH HENSTOCK

### 1923 - 2007

Integration theorist Ralph Henstock died on January 7 2007 after a short illness. He was born in the coal-mining village of Newstead, near Nottingham, England, on June 2 1923; the only child of mineworker and former coalminer William Henstock and Mary Ellen Henstock (née Bancroft). On the Henstock side he was descended from 17th century Flemish immigrants called Hemstok.

Because of his early academic promise it was expected that Henstock would attend Nottingham University where his father and uncle had received technical education, but as it turned out he won scholarships which enabled him to study mathematics at St. John's College Cambridge from October 1941 until November 1943, when he was sent for war service to the Ministry of Supply's department of Statistical Method and Quality Control in London.

This work did not satisfy him, so he enrolled at Birkbeck College London where he joined the weekly seminar of Professor Paul Dienes which was then a focus for mathematical activity in London. Henstock wanted to study divergent series but Dienes prevailed upon him to get involved in the theory of integration, thereby setting him on course for his life's work.

He was awarded the Cambridge B.A. in 1944 and began research for the PhD in London, which he gained in December 1948 with a thesis entitled "Interval Functions and their Integrals", an extension of J.C. Burkill's theory. His PhD examiners were J.C. Burkill and H. Kestelman. In 1947 he returned briefly to Cambridge to complete the undergraduate mathematical studies which had been truncated by his Ministry of Supply work.

Most of Henstock's work was concerned with integration. From initial studies of the Burkill and Ward integrals he formulated an integration process whereby the domain of integration is suitably partitioned for Riemann sums to approximate the integral of a function. His methods led to an integral on the real line that was very similar in construction and simplicity to the Riemann integral but which included the Lebesgue integral and, in addition, allowed non-absolute convergence.

These ideas were developed from the late 1950's. Independently, Jaroslav Kurzweil developed a similar Riemann-type integral on the real line. The resulting integral is now known as the Henstock-Kurzweil integral. On the real line it is equivalent to the Denjoy-Perron integral, but has a much simpler definition and is generally much easier to work with.

In the following decades, Henstock developed extensively the distinctive features of his theory, inventing the concepts of division spaces or integration bases to demonstrate in general settings the essential properties and characteristics of mathematical integration in all its forms. His theory provides a unified approach to many problems which were considered earlier by different methods using different types of non-absolute integrals. Now many of them can be solved using different kinds of Henstock integral, just choosing an appropriate integration basis (or division space in Henstock's own terminology).

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A similar biographical note has appeared in Vol.32, No.2, 2007 issue of the Real Analysis Exchange.

The underlying simplicity of the Henstock-Kurzweil integral has revived the subject of mathematical integration and the theory now has many practitioners and exponents. It has proved useful in differential and integral equations, harmonic analysis, probability theory and Feynman integration. Numerous monographs and texts have appeared since 1980 and there have been several conferences devoted to the theory. Initially a research specialism, it is nowadays increasingly taught in standard courses in mathematical analysis.

Henstock was author of 46 journal papers in the period 1946 to 2006. He published four books on analysis (Theory of Integration, 1963; Linear Analysis, 1967; Lectures on the Theory of Integration, 1988; and The General Theory of Integration, 1991). He wrote 171 reviews for MathSciNet. In 1994 he was awarded the Andy Prize of the XVIII Summer Symposium in Real Analysis. His academic career began as Assistant Lecturer, Bedford College for Women, 1947-48; then Assistant Lecturer at Birkbeck, 1948-51; Lecturer, Queen's University Belfast, 1951-56; Lecturer, Bristol University, 1956-60; Senior Lecturer and Reader, Queen's University Belfast, 1960-64; Reader, Lancaster University, 1964-70; Chair of Pure Mathematics, New University of Ulster, 1970-88; and Leverhulme Fellow 1988-91.

A devoted Methodist, the lasting impression he made was one of gentle sincerity and amiability. Henstock married Marjorie Jardine in 1949 and is survived by their son John.

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