

Foreword

1. James Edmund Gibbs 1928-2007

Edmund Gibbs was born and brought up in Outer London, the only child of devoted parents. His secondary education was at the local boys' grammar school where he excelled in every academic subject. He organised a school scientific society, and he designed and made a mounting for an astronomical telescope. His school reports were not all praise, however: he was continually in trouble for playing silly pranks thereby disrupting the work of the other pupils. Considered, by his mechanics master, to have exceptional ability, Edmund took up scholarships to Imperial College, London, to read Physics. At the same time, as a by-product, he also gained a first class degree in Mathematics.

Edmund stayed at Imperial College to do a PhD in stellar photometry and, after a brief period working in Canada, did more work in that field at Edinburgh Royal Observatory, as a Cormack Research Fellow of the Royal Society of Edinburgh. From there he was recruited by the Light Division of the National Physical Laboratory (NPL) to collaborate in work on realisation of the primary standard of luminance. Thus, in 1956, he commenced a 32-year career at NPL.

His next project was work on colour-temperature standards. Meanwhile, he gained a reputation for being impeccably dressed and well-groomed, and for driving his small sports car with some dash.

In 1961, he was poached from the Light Division by one Dr Alastair Gebbie to participate as theoretician to a group in the Basic Physics Division working on infra-red Fourier-transform spectroscopy. Dr Gebbie had the reputation of being a very hard taskmaster. Edmund wrote some forty brief working papers in this field, partly resulting from brainstorming sessions with Dr Gebbie and other members of the group.

Initially Edmund wrote Fourier transform programs for the old ACE computer which he then replaced with various Elliott mini computers to provide a regular local service of numerical Fourier transformation for converting interferograms, recorded on paper tape by the group, into spectra. He was one of the first in NPL to bring measurements and the computer closer together.

In 1962, he collaborated in developing the initial idea of dispersive Fourier-transform spectroscopy. A year later, at Dr Gebbie's request for better spectra, he developed, by conflating the techniques of Taylor and Fourier, an asymptotic sequence of sophisticated apodising functions for precise numerical Fourier transformation. His interest in the mathematical techniques deepened as he produced more sophisticated algorithms.

Again at Dr Gebbie's suggestion, in 1966 he investigated the possibility of applying Walsh functions in place of sine and cosine functions (to which they are analogous, taking only the values 1 and -1) in transform spectroscopy. The idea was flawed by the fact that the Michelson interferometer is modelled by a linear time-invariant system, not a linear dyadic-invariant system, to which Walsh functions would be appropriate.

On January 13, 1967, Edmund recognised that Walsh functions could be regarded, with an extended concept of derivative, as eigenfunctions of a differentiator. The new concept of differentiation was generalised and elucidated in collaboration with two colleagues from the University of Bath. Over the next twelve years a sequence of Sandwich Course Students came from that University. This work eventually gave rise to the new mathematical discipline called dyadic analysis, and to a very general concept of differentiation on groups.

Around the time, in 1968, that Dr Gebbie left NPL, Edmund made a second discovery in pure mathematics, that of Fourier analysis in the space of functions from the integers to the Galois field $GF(2)$, these functions being regarded as elements of the dyadic field. This new discipline, extending abstract harmonic analysis in a significant way, was expounded in lectures in 1976 and 1982, but not published.

In 1970, Edmund became involved in the international Walsh-function community, and began to assist in the preparation and examination of PhD students in the field. He began to attract students of Walsh functions and generalised differentiation to work at NPL.

In 1974, he showed that Newton-Leibniz differentiation can be regarded as a special case of Gibbs differentiation. He extended the concepts of frequency and local frequency to functions defined on certain groups in much the same way as the concept of differentiation had previously been extended. In 1976 he collaborated in extending Gibbs differentiation to functions from groups to Galois fields.

In 1977 he published a hardware implementation of an instant Fourier transform in the dyadic field, requiring almost no computation in comparison with the conventional Fast Fourier Transform.

About this time, Edmund was transferred to the Time and Frequency Section. He completed a hypothetico-deductive theory of time presupposing only ordinary logic and set theory. The axiom basis comprises six non-metrical axioms that assign an appropriate set-theoretical structure to time, and two



Figure 0.1. James Edmund Gibbs at about 1970 (Courtesy of Ms. Merion Gibbs).

metrical axioms that assert the existence and uniqueness of the class of periodic time-scales (the uniform time scales desired in practice). Within this framework it was possible to give a definition of time.

He extended the well-known Boolean differential calculus to functions from the dyadic field to $GF(2)$, for which Taylor series have an uncountable number of terms.

In 1982, he discovered a summability convention, consistent with Fourier analysis in the dyadic field, for divergent series of terms in $GF(2)$ (zeros and ones modulo 2).

In his final years at NPL, Edmund concentrated on the study and implementation of algorithms for generating a uniform time-scale from data consisting of intercomparisons, at intervals between the indications of a set of good, but imperfect, clocks.

Edmund's NPL career was somewhat blighted by exasperated (though sympathetic) Divisional Superintendents complaining that he would persist in following his own ideas instead of the official lines! These complaints increased over the years as the activities of NPL inexorably changed from research to the commercialised selling of services.

It is clear that Edmund was considered by all to be a pleasant and friendly colleague, with a quiet sense of humour, very ready to offer advice, to help solve problems, and to praise and encourage the work of others. His Divisional Reports were regarded as erudite and stylistically accomplished (though making difficult reading for the average experimental physicist).

In his retirement, Edmund tried to find as much time as possible for mathematics, begrudging the hours spent in hospital waiting rooms. He happily corresponded with Bryan Ireland, one of the old colleagues from Bath University, who kindly read and commented on many pages of mathematics - including the short paper that has reached the Proceedings of this Workshop.

Since his death early this year, his post mortem has yielded some interesting research material in the field of medicine.

These notes were compiled by Marion Gibbs