

counting equipment, so that an expert knowledge of radiochemistry is no longer a prerequisite for using tracers in (say) biochemistry. Other arguments must centre on improvements in other techniques, and on the development of new approaches, so that for example it is now possible to self-diffusion by NMR methods, which can also be applied in the study of exchange reactions and fluxional processes in solution. The use of tracers as an analytical method in separation chemistry or equilibrium measurements to study low solute concentrations is no longer necessary in view of the improvements in atomic absorption spectrophotometry, and this latter technique has also largely superseded neutron activation analysis, given that cost and convenience are decisive factors in the analytical context. In terms of geological applications, age determinations now conveniently and accurately depend on the use of various types of isotopic analysis by mass spectrometry, so that determinations of the radioactive content of minerals is no longer necessary.

Similar comments could of course be applied to other specialised areas of chemistry, especially in terms of the impact which instrument manufacturers have had in popularising and widening the application of (say) NMR. *Tempora mutantur*, as I noted previously, and the real challenge to the researcher is to identify meaningful problems and to choose the most appropriate experimental method for solving those problem, not to mourn the passing of a once favourite technique. Radiochemistry played a vital role in the development of the Chemistry Department in Durham, raised the profile of scientific research in the University, and served to enthuse and educate many young people. Perhaps one should see the matters I have discussed in this context, and above all remember, as we look back in the illuminating light of 1995, the humbling words of Isaac Newton, himself a gigantic intellect.

If I have seen further than others, it is by standing on the shoulders of giants.

## Sources

In addition to my own recollections from my student years, I have relied upon the following documentation, and/or personal statements.

- 1 The University Library Archives on Palace Green contained a collection of the personal papers of F A Paneth insofar as these refer to his years in Durham, and immediately beforehand. These photocopies are a sub-set of the Paneth papers in the Bibliothek und Archiv der Geschichte der Max-Planck-Gesellschaft zur Förderung der Wissenschaften, Berlin; the selection was probably made by Miss Eva Paneth, the daughter of F A Paneth. Their significance varies immensely; on the one hand, there is a thoughtful and significant memorandum to W A Akers (see above) on the potential benefits of a radiochemistry laboratory in Durham, and on the other a submission for travel expenses of £2-10-8, related to Paneth's visit to Durham from London as a candidate for the Chair of Chemistry. I found these documents fascinating, in part because of the memories which they evoked. I am most grateful to Miss E M Rainey for her help in tracing these and other documents.
- 2 G R Martin, who was successively ICI Fellow, Lecturer, and Reader in Radiochemistry over the period 1946-1964, and subsequently Professor of Chemistry at the University of Kent at Canterbury, has written a long (24 page) personal memoir recounting his interactions with Paneth and Durham between his (Martin's) undergraduate years at Imperial College (~1938) and 1958. This was apparently written in 1983, and is full of both factual and anecdotal information about science at Durham, and the life of F A Paneth. These recollections should be consulted by anyone interested in the development of science in Durham, and in view of their detailed nature, I have not dealt with much material which I might otherwise have included. Martin's reminiscences are very charitable, and reflect his admiration and respect for Paneth on the personal, scientific and administrative level. A brief obituary of Martin himself is to be found in Chem. Brit., **26**, 449 (1990) (R F Hudson and K Wade).

- 3 In October 1988, I spent a delightful morning with W K R Musgrave, who had been appointed as an Assistant Lecturer in 1945, following a PhD at Birmingham and a period in the Montreal Laboratory. He spent the whole of his academic career in Durham, retiring as Professor of Chemistry in 1981, was Pro Vice-Chancellor in 1970-78, and Acting Vice-Chancellor in 1979. His comments were therefore those of an observer of, rather than a participant in, Radiochemistry, and of an experienced university administrator.
- 4 Also in 1988, and again more recently, I had the benefit of conversations with G R Kohnstam, who came from UCL as a Lecturer in Physical Chemistry in 1950, and retired as Reader in 1985. Again his views of Paneth and Radiochemistry are those of a highly informed close observer; his views on physical chemistry as practiced in Durham in 1950 are even more lively, but unfortunately irrelevant to this account.

In addition, I have also talked to a number of my contemporaries over the years about chemistry in Durham. Their views have inevitably coloured my own, but it would be unfair to name these people, or to identify their opinions.

- 5 R A Baker describes the attempts to establish science in the newly formed University of Durham in the period 1832 - 55, and the later successful efforts between 1920 and 1932 (History of Universities, XIV, 201 [1995-96]). The two main characters in this history are J F W Johnstone and J I O Masson.
- 6 Some useful and relevant obituaries are to be found in the Biographical Memoirs of the Royal Society. Amongst others, I have consulted
- (a) J I O Masson, by R D Haworth and A H Lamberton (9, 205 [1963])
  - (b) A Holmes, by K C Dunham (12, 291 [1966])
  - (c) L R Wager, by W A Deer (13, 359 [1967])
  - (d) G von Hevesy, by J D Cockcroft (13, 125 [1967])
  - (e) F Soddy, by A Fleck (3, 203 [1957])

Much less detailed, but still informative, summaries are to be found in Who was Who, and I consulted this on W A Akers, G M B Dobson, F G Donnan, A Fleck, E Glueckauf, A K Macbeth and W A Waters. None of these people are less important than the first group, except in the very local context of this article.

- 7 (a) See Masson of Melbourne, by Len Weickhardt, published by the Royal Australian Chemical Institute, 1989. I am grateful to Prof. Norman Greenwood for drawing my attention to this biography, and to the paper by R A Baker (ref. 5).
- (b) An obituary of Masson by C W Gibby in the Durham University Gazette, New Series, X, p.7, gives an interesting commentary on Masson's impact on Durham
- 8 A biography of G R Christie (Chem.Brit., 2, 24 [1960]) by G E Coates gives a sympathetic review of the life of one who was not easy to know as a student.
- 9 An admirable appreciation of C C Addison by N N Greenwood is in Chem. Brit., 30, 594 (1994).
- 10 Gibby's open memoirs in the University Library Archives (S R Cabinet, CI, 1976) scarcely mention his scientific activities.
- 11 For the periods during which these people served in the Department, I have relied on the University Calendars.
- 12 Durham University Library Archives, Ref. PH/3/A/28-30 and 7/75-61.
- 13 The Biographical Memoirs of the Royal Society contain a definitive account of the personal and scientific life of F A Paneth, (H J Emeleus, Biog. Memoirs. Roy.Soc., 6, 227 (1960).
- 14 See J. Chem. Educ., 59, 3 (1982).
- 15 A collection of Paneth's writings on a wide variety of non-research topics has been published as "Chemistry and Beyond" (ed. H Dingle, G R Martin and E Paneth), Interscience, London, 1964. This also contains a brief and sympathetic account of Paneth's life and character, with illuminating comments about Paneth's pre-war and post-war years in Germany, and emphasises his wide interests (and abilities) in many areas of scholarship.
- 16 There are many accounts of the development of radiochemistry and nuclear science; that written by M Haissinsky (Nuclear Chemistry and its Applications, Addison-Wesley, Reading, Mass, 1964, pp.1-9) recounts early matters from an intimate French perspective.
- 17 The contributions of M P Applebey to the development of the Durham Colleges are sympathetically recorded by J F Duff in the Durham University Gazette, vol. IV, no. 3, p.4 (1957), and The Times, January 16, 1957.
- 18 This photograph presently (1995) hangs in the Department of Chemistry.

- 20 Paneth's guest book from his home is in the Durham University Archives, ref. Add. MS745.
- 21 J. Chem. Soc., 1949, pp S325-S420, reports the proceedings of two meetings, one at Oxford (March 28-30) on The Chemistry of the Heavy Elements, and a second in London (April 1 1949) on The Use of Radioactive Tracers in Chemistry.

## Personal Background

I was born in Stockton-on-Tees in 1929, and educated at the Grammar School there between 1940 and 1946. The teaching of science in general, and chemistry in particular at the school could be charitably described as uninspiring, and my own life-time affection for chemistry seems, in retrospect, to have come from a love of "messing around with chemicals" (c.f. *Wind in the Willows*). A visit to Durham in my mid-teens gave me a taste of the city and its colleges, and I was accepted by University College for admission into Chemistry in early 1946. By the summer of that year, it was clear that demobilised ex-servicemen would rightly claim the available spaces, but in fact, a casual conversation directed me to St. Cuthbert's Society, and even more fortunate help from the then Vicar of Stockton gained me an unexpectedly vacant place in St. John's, where I lived contentedly throughout my undergraduate career. Since I am staying in St. Mary's during my time in Durham in 1995, I can claim an unusually wide personal knowledge of the Durham colleges, having known them longer and more widely than most.

On graduating in June 1949, I was strongly attracted by Paneth and the excitement of research in radiochemistry, and so I joined the Londonderry Laboratory, under the direct supervision of K F Chackett, but to my disappointment, was assigned a problem involving helium determination. This technique had been developed by previous workers (Peters, Glueckauf, Arrol, Jacobi, et al), and involved many ingenious experimental niceties, but it never captured my imagination, largely because it did not involve "messing around with chemicals", and was unrelated to the main areas of chemistry as I thought I knew them then, and have known them since. I mention this because it may well be that my judgement of the achievements of the Londonderry Laboratory is coloured unfavourably by my own personal views as to what chemistry is, or ought to be.

From Durham, I went to the Laboratoire Curie, where under M Haissinsky I worked on exchange reactions, and from there to UKAEA (Windscale). Subsequent periods of post-

doctoral work at MIT, Manchester and Cornell lead to a lectureship at Nottingham where my initial responsibility was teaching and research in radiochemistry. I also gave a course of 30 lectures on Main Group chemistry, and this, together with the then focus of interest of the Department (C C Addison, N N Greenwood, E A Addison) opened my eyes to the delights of a type of chemistry which has fascinated me ever since. The particular sea-change from radiochemistry to inorganic chemistry came from investigations of the relatively poor solvent extraction properties of indium(III) halides, and the realisation that this called for a study of the coordination chemistry of that element. This study, which is still proceeding, has also lead me into electrochemical synthesis, organometallic chemistry, and the investigation of the electron transfer reactions of Main Group elements.

Events subsequently took me from Nottingham to the newly established Simon Fraser University, B. C., Canada in January 1966. The excitement of being part of the building of that Department, and of SFU itself, were soured by the events of 1968-1971, and I was delighted to be offered the Department Headship at Windsor in 1972. I occupied this position until the summer of 1983 (and again in 1993-1994), and saw that Department grow in stature. I was appointed a University Professor in 1987, and on retirement in 1994 became Professor Emeritus. My presence in Durham for the Michealmas Term 1995 as an invited Visiting Professor completes the circle in a fashion which brings me immeasurable pleasure and satisfaction.