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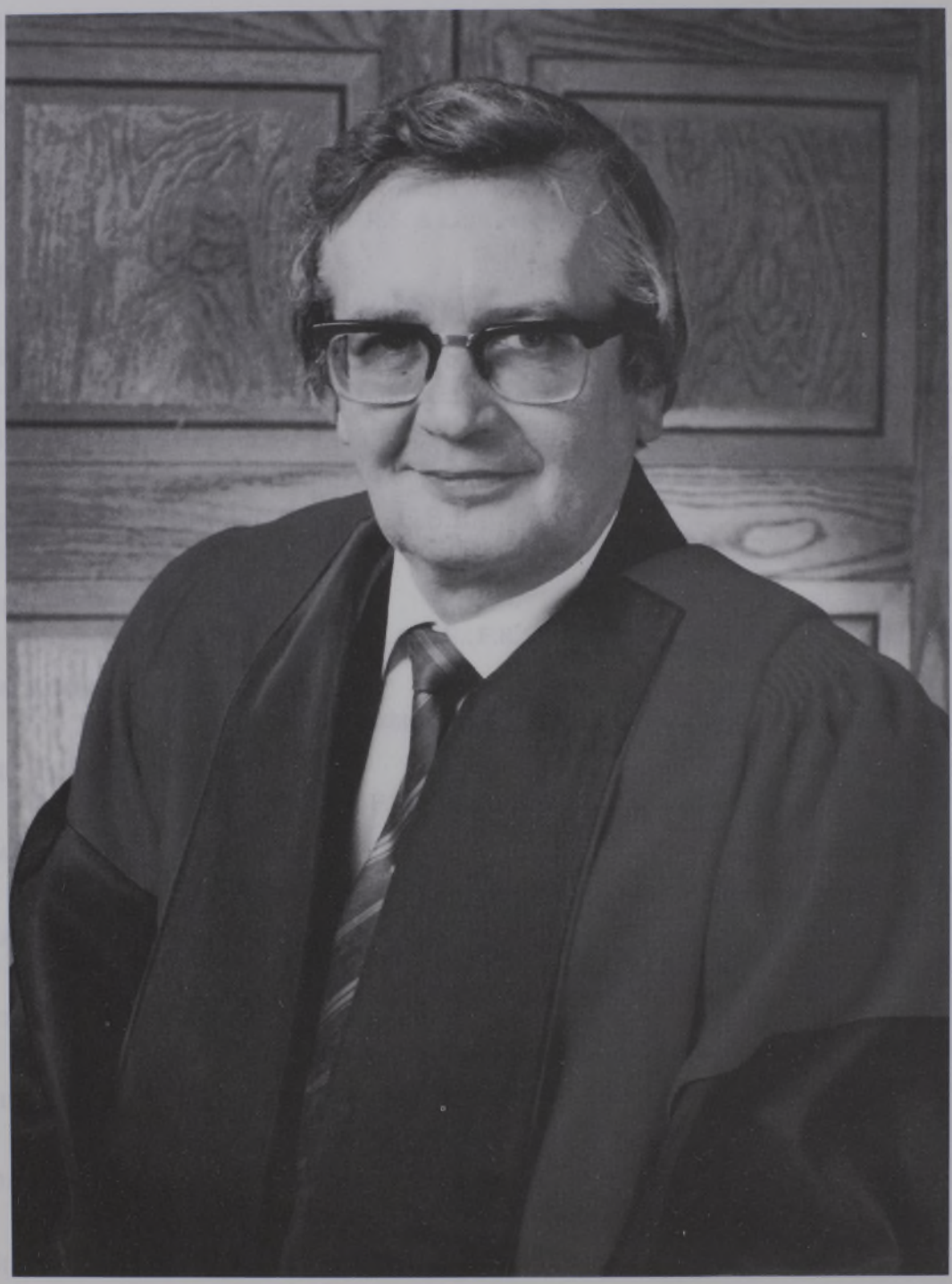
3 November 1934–8 May 1991



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INTRODUCTION

Michael Barber (Micky as he was known to his many friends) was a kind and generous person, a scientist who combined theoretical work with a determination to develop new applications based on his knowledge in chemistry, particularly applications to major and wide-ranging problems. He was also a man with an appreciation of music and the arts. In his order of priorities, it was always his family that came first and he derived his greatest pleasure from travelling on holiday with them, especially in Italy. Contrary to general belief, he did not enjoy visits to conferences, the preparation of lectures and of papers in the literature, nor the presentation of his ideas formally to large audiences. Basically, he was a shy person who much preferred to communicate his thoughts informally as one of a small group of colleagues and acquaintances.

BACKGROUND AND EARLY LIFE

Despite his apparently effortless climb to scientific prominence, Micky did not come from what would be considered in material terms to be a privileged background. He was one of two boys; his brother Peter was seven years his elder. His parents, Joseph and Alice (née Proudlove), lived in Newton, Hyde, Cheshire, and Micky was born at home, at 166 Lodge Lane, Newton.

Joseph Barber was a carpenter by trade, and because of an earlier family connection with the local church of St Michael and All Angels in the Manchester suburb of Wythenshawe, had actually been employed in the construction of the present building, carrying out most of the woodworking. He had also designed, built and presented a Bishop's Chair to the church, and

had helped in the construction and erection of a new pipe organ at the church, which Micky was later to play when he became church organist. It was through his father that Micky developed an appreciation of music. As with many other scientists, his background as part of a skilled artisan family played a very important role in his scientific and technological development and taught him the importance of accuracy and good design in his experimental work.

Joseph died when Micky was only a few years old and his mother was forced to move to live with her sister, who kept a public house in Hyde. This is where he spent much of his time, being looked after by his aunt. His mother had become the family breadwinner and worked at the local I.C.I. Rexine factory which was located close to their home.

As a boy he had a beautiful soprano singing voice which was developed, in parallel with music lessons, by his singing teacher, Alice Shawcross, with whom he kept in touch for many years. He was attending Flowery Field Primary School in Hyde, but had not made an auspicious start there and by the age of seven was still unable to read or write. This was surprising, in view of the fact that in every other way he was bright and intelligent. It was his schoolmistress who organized nature lessons who discovered the reason; he had apparently decided that there was no point in copying letters from a blackboard on to a sheet of paper and so refused to take any part in this activity. However, during a nature lesson he was persuaded that he could not benefit fully from the knowledge that he gained from his observations if he was unable to write notes for future reference. Fully convinced by this argument, he quickly became literate.

By the age of nine, his voice had developed to the stage that he was giving singing recitals and by the age of ten he had made a record. The debate as to whether he should be sent to choir school or should take the examination for entry into Manchester Grammar School was decided when his voice suddenly began to break. There was no formal music course at Manchester Grammar School; had there been one, it is likely that he would have pursued a career in music rather than in science. There was, however, sufficient interest in music among the pupils to be able to form a Music Group and Micky was instrumental in organizing this and arranging a series of lunchtime concerts within the school. At these concerts, Micky played the organ and John Ogden the piano.

At the age of 15, he began to play the organ at the church his father had helped to build. He continued with this activity for the rest of his life, eventually becoming the church organist. At the time he started playing there, the senior organist was George Elmsley, who helped and encouraged Micky to develop further his love of church organ music.

While at school, he began to play lacrosse, which he continued long after his schooldays. He was also keenly interested in other sports, but only as a spectator. In later life he was very proud of the fact that he acquired a professional footballer as a son-in-law and supported his son-in-law's team, first Manchester City and later Everton, with enthusiasm.

While at Manchester Grammar School, he was attracted to science, and in particular towards chemistry, through the teaching of the senior chemistry master, Solomon Klyne. He won an Open Exhibition Scholarship to Queen's College, Oxford, but before taking it up was required to do two years of National Service. For the first three months of this service he was stationed at Aldershot and Bodmin but was then sent to London University as a member of the Intelligence Corps. He took a Russian interpreter's course and was commissioned. After his National Service he was able to use his knowledge of Russian to translate Russian scientific papers into English for Pergamon Press.

He went up to Oxford in October 1955 completing his B.A. in 1958 and his B.Sc. in 1959. During this time he continued his active interest in music, acting as Secretary of the Eaglesfield Musical Society. He formed several close friendships as a result of his music, with James Dalton who was the organist and choirmaster at Queen's College and with Dudley Moore who was an organ scholar there. He sang as a member of the Queen's College choir. He also continued to play lacrosse and was awarded a half blue.

During this period at Oxford, he was married, in 1958, to Joan Gaskell. They had three children. The eldest, Nigel Peter, is now a doctor in general practice in Middleton, Lancashire, and has two children; Carolyn Anne (m. Leighton) has two children, one of whom was born shortly after Micky's death; and Suzanne Jane (m. Hinchcliffe) does veterinary work.

Post-graduate research at Oxford

Micky's D.Phil. was undertaken at Oxford under the supervision of the late Professor J.W. Linnett, F.R.S. The work involved the design of modifications to a mass spectrometer for investigating the kinetics of gas-phase reactions that included unstable intermediates. The reaction chosen for detailed study was between methyl radicals and oxygen. The radicals were produced by the photolysis of methyl iodide. A pin-hole leak in a thin diaphragm was used as a sampling system and was combined with a differential pumping arrangement to maintain low pressure in the ionizing region of the mass spectrometer. A pin-hole leak has the disadvantage that it gives a beam distributed over a wide angle. To reduce this, a molecular beam sampling system was used to control the angular spread and hence increase the chance that species would travel from the reaction zone to the ionizing region without suffering a wall collision. The flow system enabled spectra of all products to be scanned continuously.

A second part of his thesis was concerned with the cyclopropenyl cation, the simplest cyclic system which, according to Hückel theory, should exhibit aromaticity. The object was to carry out a complete π-electron treatment both for the cyclopropenyl cation and radical and, from the results, to obtain the ionization energy. This could be compared with the value obtained by Streitweiser by Hückel-type molecular orbital treatment.

Research at A.E.I. Ltd

From Oxford, in 1962, he joined the Scientific Apparatus Department of A.E.I. Ltd and continued research into mass spectrometry. At that time, at their Barton Dock Works, A.E.I. had a mass spectrometry group that, in terms of size as well as quality, was probably the best team of mass spectrometer design and applications engineers in the world. Their greatness stemmed partly from the enlightened attitude of the managing director, Dr J.D. Waldron, and the research director, Dr J. Halliday. They encouraged fundamental research and collaboration with other research groups particularly in the universities. They had organized the first international mass spectrometry meetings, had donated equipment to universities, including Oxford, and had kept in close touch with Barber's D.Phil. research topic.

In 1955, Metropolitan Vickers Ltd, which later became part of A.E.I., had built the world's first commercial double-focusing mass spectrometer of Nier-Johnson geometry, the MS8.

This had proved very successful and had been enlarged and improved to be sold from 1960 onwards as the MS9. Its performance in terms of resolution and mass measurement accuracy remained unrivalled for more than a decade and hundreds were sold worldwide.

The excellence of the group at Barton Dock in Manchester stemmed from the coincidences of people such as Robert Craig, Martin Elliott, Brian Green, Patrick Powers, Mike Wallington and Bob Brown, all of whom made major contributions to the development of mass spectrometry. They showed a total willingness to share ideas, to collaborate and, when necessary, to work all the hours God gave. Their camaraderie was infectious and raised the sights of all who joined the group. Micky Barber was an ideal member; he was full of ideas and enthusiasm, willing to discuss his ideas and listen to criticism and, in addition, had a tremendous confidence in his ability to accomplish any task or solve any problem to which he set his mind.

The early 1960s saw rapid development in the instrumentation for mass spectrometry and expansion of the applications. The combination of gas chromatography and mass spectrometry demanded the very rapid scanning of spectra, and accurate mass measurement of all peaks in a spectrum was required. There was a concomitant change from valves to solid-state electronics, the introduction of on-line digitization and the data processing of the output information. As the range of samples increased there was a continuous demand for better performance in terms of sensitivity, speed and greater resolution and a need for the development of new methods for obtaining spectra. With great foresight, A.E.I. established a 'demonstration' laboratory to exploit the power of the fast-developing new techniques. The laboratory was equipped with the latest versions of major instruments fitted with the most recently developed modifications and accessories. Potential customers were invited to send or bring their samples for analysis. Publication of the results was thought to be of real benefit to the customer and to A.E.I. and so was encouraged.

While some people might see this 'service' work as merely routine analysis, Barber recognized that it presented the opportunity of becoming involved in the solution of a great variety of real problems. He and the other members of the laboratory had the opportunity to develop their own research ideas provided that the customers' samples were analysed. The laboratory produced a continuous flow of requests for manufacturing changes to the factory to which a rapid response was needed, though not always provided. Micky was in the forefront of providing ideas for new accessories but not interested in being involved in the details of the engineering designs necessary.

The so-called 'metastable-ion peaks' in mass spectra, diffuse peaks appearing at non-integer positions on the mass scale and due to fragmentation of ions in flight through the mass spectrometer, were considered to be a nuisance in quantitative analysis. However, in the early 1960s, they were becoming of increasing interest as mass spectrometers were used for deducing the molecular structures of organic compounds. It was sometimes possible to deduce fragmentation pathways of ions from the presence of metastable peaks, but the characteristics of these peaks were difficult to determine because they were overlaid with the normal mass spectral peaks. Micky Barber, working with Martin Elliott, showed that it was possible to adjust the field strengths in a double-focusing mass spectrometer in such a way that the normal mass spectral peaks were suppressed, leaving the metastable peaks free from interference. Their results were reported at the American Mass Spectrometry Conference, held in Montreal in 1964. Typically, the results were never published in the literature and, having shown what

was possible, Micky took no further part in the experimental work except for encouragement.

He interested himself in all aspects of the instrumental developments that were going on in mass spectrometry at that time. These included the improvement of the resolution of the MS9 to a value of around 100 000, fast scanning of spectra whilst maintaining high resolution and the development of software for interpretation of spectra and for accurate mass measurement of every peak in a mass spectrum. A.E.I.'s generous policy of allowing him to pursue fundamental research, provided that customers' samples were analysed, resulted in his collaboration with Professor Lederer, which stimulated his interest in the production of ions from 'large' molecules. This resulted in seminal papers on the amino-acid sequencing of naturally occurring peptides. In 1966–67 he further broadened his horizons with a 12-month Visiting Professorship at Harvard and a 6-month Fellowship to work at the Mellon Institute at Pittsburgh.

It was towards the end of 1968 that Micky Barber read the remarkable report prepared for the US Airforce by Kai Siegbahn and his collaborators from Uppsala University on the technique of X-ray photoelectron spectrometry, or as it was known at the time, electron spectroscopy for chemical analysis (ESCA). What particularly impressed him was that the method gave information about the environment of atoms on solid surfaces and that, unlike the widely used technique of nuclear magnetic resonance, it was applicable to all the elements. In a single weekend, he and Brian Green succeeded in poaching sufficient odds and ends of an MS9 mass spectrometer and parts of Raymax X-ray equipment scattered around the laboratory to build a rudimentary ESCA spectrometer and begin to investigate its potential. The components that had been available were far from ideally suited for producing a high sensitivity instrument, but such was the interest shown, even to the extent of firm offers to purchase copies of the instrument, that A.E.I. decided to design and build a production model as quickly as possible. By mid-1969, a small project team headed by Micky Barber was at work with the design brief of producing equipment suitable for use by industrial applications chemists and within a year the very successful ES100 was demonstrated live at an international scientific exhibition. Following its appearance, came a fruitful period of collaboration with Professor J.M. (now Sir John) Thomas, F.R.S.'s group at Aberystwyth, during which they were successful in studying several topics in surface and solid-state chemistry, *inter alia* the state of bonding of heteroatoms on surfaces, the electronic band structure of disordered carbons and sub-monolayer amounts of oxygen on solid surfaces. At the same time, he was also collaborating with several other research groups in industry and at other universities.

Research at U.M.I.S.T.

He left A.E.I. in 1972 and was appointed Lecturer at the University of Manchester Institute of Science and Technology (U.M.I.S.T.). In 1973, together with Dr Don Sedgwick, he offered a final year option entitled 'ionization phenomena' which covered the instrumentation and applications of mass spectrometry and electron spectrometry. This course was outstanding in that at most universities contact with these subjects at undergraduate level is superficial, leaving students with little to get their teeth into. One of the students on this course was Dr Bob Bordoli, who was to play a key role in the research achievements of the U.M.I.S.T. group over the next decade.

In 1971 Micky had begun a collaboration in secondary ion mass spectrometry with Dr John Vickerman of U.M.I.S.T., their interests being mass spectrometry and sputtering phenomena on Micky's part, and catalysis and the gas/solid interface on John's. Early experience, using beams of rare-gas ions to bombard insulators (glasses, ceramics, zeolites) led to substantial surface charging problems and it was decided to neutralize the ions in the beam to reduce this effect. It took over two years to design and build a system in which a beam of, say, argon ions could be accelerated out of an ion source into a charge-exchange chamber containing argon gas. A beam of high velocity argon atoms issued from this chamber and could be used to bombard the sample.

Early experiments involving solid samples on metallic sample holders were disappointing both with respect to the total ion current and, more importantly, the relative abundances of high-mass ions. The spectral intensity decayed rapidly with time as a result of radiation damage and surface charging. It was observed, however, that samples of viscous liquids gave spectra that were more intense by about two orders of magnitude, gave higher abundance at high masses and had long lifetimes. The breakthrough came with the realization that many of the samples in which the group was interested, for example peptides, were soluble in glycerol. Dr Bordoli and Dr Lee Tetler placed glycerol on the sample probe and added to it a little of a synthetic tripeptide, Ala-Leu-Gly. The sample dissolved immediately, and when the probe was inserted into the mass spectrometer an intense, long-lived spectrum was obtained, including peaks corresponding to ions $[M+1]^+$ and $[M+Na]^+$ where M represents the mass of the sample molecule.

The new technique, which they christened 'fast-atom bombardment' (FAB), extended the range of samples that could be investigated by mass spectrometry to higher molecular weight materials and the use of FAB exploded worldwide. Its use entailed only the use of a new ion source, rather than a new mass spectrometer and so it was relatively inexpensive. It sparked a renaissance in mass spectrometry, both in the development of new instruments capable of extending the range of mass that could be measured and by convincing biologists that it was a vital technique for the characterization of biologically important molecules. The U.M.I.S.T. group began a collaboration with Vacuum Generators, a major manufacturer of high-performance mass spectrometers based in Manchester. Vacuum Generators gave them access to a high-mass instrument at their factory, but the long-term aim of acquiring such an instrument themselves was frustrated when their grant application to the Science and Engineering Research Council was rejected. There followed a relatively unproductive period during which some members of the U.M.I.S.T. group left for other employment and Micky became disillusioned and depressed, feeling that his development of FAB and his ability to develop and exploit it were not appreciated in Britain. This feeling was dispelled in 1985 when he was elected to Fellowship of the Royal Society.

To work for Micky or to collaborate in research with him was a stimulating and unusual experience. The apparent lack of organization in his office was legendary. He hated to waste time on what he saw as unnecessary administration and his desk and other office furniture were covered by huge piles of unopened letters, lecture notes, research plans, photocopies of papers that he had found interesting and the like. One of the qualities necessary in his students was the ability to sift through this pile from time to time, to recognize which incoming letters might be important, to separate these out and urge Micky to deal with them. If they did not remind him, deadlines would pass unnoticed and it was inevitable that many were missed. He

tried to avoid preparing formal lectures for scientific meetings preferring to discuss research topics in smaller groups of people. He read widely, but seemingly non-systematically, scanning through a variety of journals, many of which were not directly related to his research interests.

He enjoyed the cut and thrust of scientific discussions as a means of testing new research ideas, particularly if these were completely informal. Many ideas were thoroughly analysed over coffee or during a lunchtime visit to the local pub. There was never any doubt during these discussions that Micky was, in every sense, the leader of his group, but his quiet and gentle manner did not inhibit even the most junior of his students from contributing to the discussion. Many ideas for future research equipment were crystallized as sketches on whatever scraps of paper happened to be immediately available.

Two recurrent themes in his conversation were the inordinate amount of time that was wasted at universities by attendance at unnecessary meetings and the inability of funding bodies to recognize truly innovative science and the benefits to be gained by supporting it. He became discouraged by his own relative lack of success in attracting funds, though this must surely have been influenced by his tardiness in publishing the results of his work which in turn delayed widespread recognition of its importance. Indeed, when his seminal work on fast-atom bombardment had been completed, he was in no hurry to report it and his students had to be alerted to the fact that another group was about to publish the first research results using the technique, results that had been obtained on Micky's own equipment.

Micky Barber had a sure instinct for the way forward in his research and this, coupled with his infectious enthusiasm and tolerance of other people's views, inspired many young scientists and earned their loyalty and affection.

Honours and distinctions

He received the Royal Society of Chemistry Award for Analytical Chemistry in 1979. His development of fast-atom bombardment was recognized by the receipt of the Strock Medal and Award of the American Society for Applied Spectroscopy in 1983. He was elected a Fellow of the Royal Society in 1985. He was also to have received the American Society for Mass Spectroscopy Award for distinguished contributions to mass spectrometry in 1991 and was on the point of travelling to receive it when he died.

Acknowledgements

The frontispiece photograph, taken in 1985, is reproduced with the kind permission of U.M.I.S.T.

Bibliography

A bibliography appears on the accompanying microfiche. A photocopy is available from the Royal Society Library at cost.