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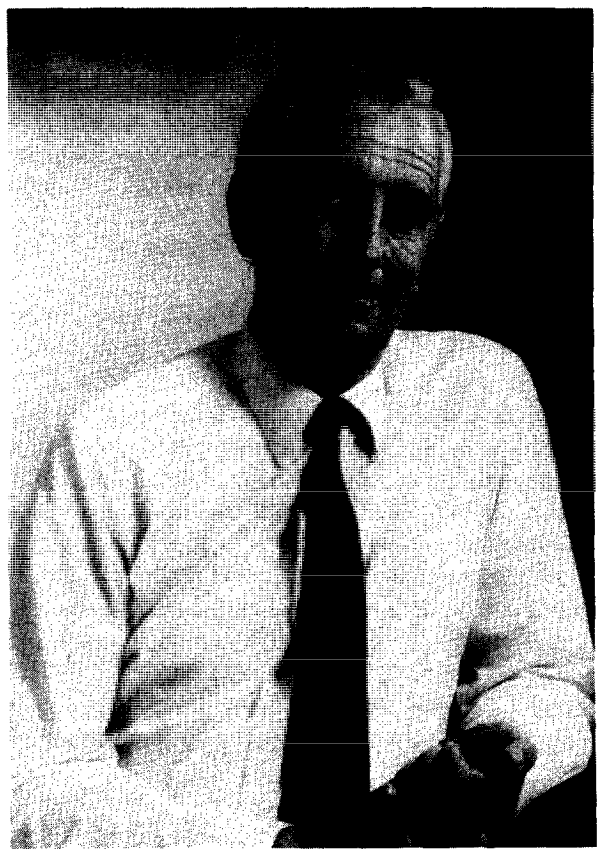

OBITUARY

George Wallace Kenner
1922–1978

George Kenner was born in Sheffield, England, on November 16, 1922. His sudden, tragic death in July 1978 will be felt keenly by his many friends and colleagues throughout the world. Organic chemistry, particularly the synthesis of compounds of biological importance, will be the poorer from the loss of such a versatile master who had become an acknowledged leader in the synthesis of polypeptides, but who had also distinguished himself in other aspects of chemical synthesis.

His parents were both chemists, and his father, James Kenner FRS, became Professor of Chemical Technology at Manchester College of Technology (later University of Manchester Institute of Science and Technology). Despite his title, James

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Kenner was very much a "pure" chemist who carried out distinguished work on alkaloids and reaction mechanisms. George attended Manchester Grammar School, where he went up the Classical Side. It is unlikely, however, that this course represented a diversion from the family involvement in science, since the school provided an exceptionally broad education and the concentration on Latin and Greek was accompanied by exacting courses in the usual school subjects, including modern languages, mathematics, and science. Manchester Grammar School was and still is noted for its high proportion of able boys; and it is interesting that, of the boys in the school within a year or two of George, five subsequently became Fellows of The Royal Society. Even so, he was regarded as an outstandingly brilliant student, able to excel in any subject that interested him.

He decided on a career in chemistry, and his ability and strong academic background enabled him to change course without difficulty. In those days it was not considered particularly desirable to move away from home to a university, other than perhaps to Oxford or Cambridge. No doubt excellent parental advice persuaded him to enter the University of Manchester, which had a long history of distinction in chemistry and had boasted such names as Lapworth, Robinson, Heilbron, and Polanyi among the then more recent incumbents of the chairs there. The big attraction, however, must have been the recent arrival of the young Professor of Organic Chemistry, A. R. Todd (later Lord Todd). George graduated with 1st Class Honours in Chemistry in 1942 and joined the group with Todd on the synthesis of purine nucleosides. The objective for the overall program was to confirm by synthesis the partial structures proposed mainly by Levene for the nucleosides and to establish the remaining unknown features. The group had already developed an unambiguous general method for the synthesis of 9-β-glycosylpurines, and George further developed this approach for the synthesis of adenosine itself.

In 1944 Todd moved to Cambridge and took with him several of his Manchester colleagues, including George. These were great days in the history of the Todd laboratory, and the spirit of scientific enthusiasm was quite remarkable. Prospects were bright for the synthesis of nucleosides and nucleotides, and it seemed likely that the synthesis of nucleotide coenzymes would be achieved, thereby clarifying a number of uncertainties about the structures already proposed. Even nucleic acid structures were on the list for study, as the then current view that they were tetranucleotides seemed unlikely. The synthesis of nucleotides presented special difficulty in view of their ready hydrolysis and general instability toward chemical reagents. Moreover, their solubility properties and the need to synthesize pyrophosphate linkages from monophosphates by condensation, usually in aqueous solution, required the development of novel methods and reagents. Nevertheless, it was clear that there were excellent chances of success. Members of the laboratory at that time recall the strength of purpose and unity of the group, as well as the friendly informal atmosphere; and it is understandable that to this day those who moved from Manchester to Cambridge, or who joined the laboratory at that time, meet annually to dine in Cambridge under the inevitable title "Toddlers." George was a keen member of this body.

In 1946 he was elected a Fellow of Trinity Hall, Cambridge, and in 1948 was awarded a Rockefeller Foundation Fellowship to work in Prelog's laboratory at the ETH, Zurich. He worked with Prelog on erythrina alkaloids, and it was there that he

met and worked with another visitor to the ETH laboratory, H. G. Khorana. As a consequence of this meeting, when George returned to Cambridge to a lectureship, Gobind Khorana also joined the Cambridge laboratory. It was at this time that George became interested in peptide synthesis, and, with Khorana, developed methods for carboxyl activation of *N*-protected amino acids and reaction to give peptides. This was a landmark, not only in connection with future developments in peptide synthesis, but also in the synthesis of nucleotide coenzymes and nucleic acids. Khorana introduced dicyclohexylcarbodiimide for peptide synthesis, but it was immediately realized that it could be of great value in the synthesis of substituted pyrophosphates. The reagent was developed independently by Khorana as well as by Kenner and Todd, following Khorana's move to Canada. In Todd's laboratory the reagent was used together with others for the synthesis of nucleotide coenzymes, whereas in Khorana's laboratory it found its greatest use in oligonucleotide synthesis.

Kenner and Todd, together with a succession of able but more transient colleagues, achieved notable success in the first chemical synthesis of flavin-adenine dinucleotide (FAD), uridine diphosphate glucose, and nicotinamide adenine dinucleotide (NAD, or, as it was then called, DPN). These syntheses were important because not only did they confirm the suggested structures, essential for a full understanding of the mechanism of their action, but they made the nucleotide coenzymes available in reasonable amounts for biochemical study.

In 1957 Kenner was appointed to follow A. Robertson as Heath Harrison Professor of Organic Chemistry at the University of Liverpool. The Chemistry Department was well known, and natural product chemistry had been carried out there for many years. The rapid development of instrumentation in chemistry had left it unprepared, however; but George, together with his staff, eventually succeeded in building up an impressive laboratory that is today among the best equipped in the country. A new building was opened in 1961; and the improved and enlarged accommodation enabled him to appoint Alan Battersby to the second established chair, thereby extending the interests of the department to alkaloid structure and biosynthesis. The importance of the Liverpool laboratory today is due in no small measure to George's efforts.

At Liverpool he continued his earlier studies on peptide synthesis, and this became his main interest for the rest of his life. He and a steadily growing research group developed many improved techniques for activating amino acid carboxyl groups and condensing them with other amino acid derivatives in high yield with retention of stereochemical configuration. The general procedure for peptide synthesis, protection of amino groups, and activation of carboxyl groups, usually through mixed anhydrides, has much in common with nucleotide synthesis, and stability and solubility problems are also similar. In was quite natural then that George should make peptide synthesis his main research activity. Nothing could have been better than to do this at Liverpool, because of the interest in peptide hormones in a nearby laboratory. In 1964 R. A. Gregory, the Head of the Department of Physiology at Liverpool, described the isolation and purification of a gastric secretion hormone, gastrin. This brilliant work was further developed in collaboration with George, and in 1968 he and Shepphard determined its structure as an oligopeptide embodying a number of novel features. The structure determination of gastrin from a number of species including man was followed by chemical synthesis, and, in collaboration with a group in Imperial Chemical

Industries, many analogs of medical interest were prepared. The value of chemical studies of structure–function relationships was demonstrated by the finding that of the seventeen residues in porcine gastrin, activity was associated with the terminal tetrapeptide sequence only. It was then shown that a natural prohomone of gastrin, of much larger size, contained as amino acid residues 18–34, the same structure as the smaller oligopeptide; and in 1976 the complete sequence of human big gastrin was synthesized.

The success of the gastrin work was a powerful stimulus to an even more ambitious project, the synthesis of an analog of lysozyme. The objective was not simply a demonstration of the power of chemical synthesis, but to obtain a structure in which a number of changes (28 in all) had been introduced into the known structure of hen's egg lysozyme, the modifications being chosen partly for simplification of synthesis. It would be of much interest to see what effect the changes had on polypeptide chain folding. George did not live to see the completion of this formidable plan, although the complete sequence of the 129 amino acid residues has now been constructed in a fully protected form.

Another of George's interests was the synthesis of porphyrins. This project was started in the Cambridge days and was continued at Liverpool. This is not the place to give a detailed description of this elegant work, but he made notable advances in our knowledge of the structure of several porphyrins and synthesized a number of tetrapyrrole derivatives by new methods. Here again the motivation was synthesis not simply for its own sake, but with a view toward a deeper understanding of structure–function relationships in these biologically important molecules. This has been the theme throughout, from nucleosides and nucleotides to porphyrins and polypeptides.

Although he had no particular love for administration, and in fact developed a healthy dislike of the increasingly cumbersome administrative complexity of universities, George did not refuse to accept such work, especially if it involved the administration of scientific research. Thus he served on a number of committees of the Royal Society and the Science Research Council—he was Chairman of the Chemistry Committee of the SRC for several years—and he serve on the Council of the Chemical Society. He was President of the Perkin Division of the Chemical Society from 1974 to 1976 and of Section B of the British Association in 1974.

His great ability and contribution to science was well recognized. He was elected a Fellow of the Royal Society in 1964 and was its Bakerian Lecturer in 1976. He was Meldola Medallist of the Royal Institute of Chemistry in 1951 and Corday–Morgan Medallist of the Chemical Society in 1957. He gave the Tilden (1955), Simonsen (1972), and Pedler (1977) Lectures of the Chemical Society.

He had a number of interests outside of chemistry. He was interested in paintings, mainly those of this century, and enjoyed hill walking and particularly motoring, being keenly interested in higher-performance cars. He also owned a motorcycle and frequently relaxed sailing. He was always approachable and friendly, and devoted much of his very hard-pressed time to helping and encouraging colleagues. It was hoped that the worries of administrative duties would be resolved when he was appointed to a Royal Society Research Professorship at Liverpool in 1977, but any such relief was short lived. His wife and two daughters, along with his very many friends and colleagues, will miss him greatly.

JAMES BADDILEY