

## PREFACE

Lloyd Robert Snyder was born on July 30, 1931 in California. He studied chemistry at the University of California at Berkeley where he graduated with highest honors in 1952. In 1954 he received a Ph.D. in physical organic chemistry from the same department and then joined Shell Oil in Houston, Texas. There he was introduced to gas chromatography (GC), and in 1955 he independently discovered the technique of column switching for the analysis of certain "key" hydrocarbons in gasoline [1]. A few years later he joined the Union Oil Company in California where he embarked on a vigorous research program that resulted in a number of major achievements over the ensuing fourteen years.

Before Snyder's seminal work commenced in the early sixties, liquid column chromatography (LC) with an adsorbent as the stationary phase was widely used—but not in the linear elution mode that was so successful in liquid-liquid partition chromatography and GC. Snyder's thorough studies published in over fifty papers during the sixties have changed this with far-reaching consequences. He provided a simple theoretical framework to account for the physico-chemical phenomena underlying separation by *linear elution adsorption chromatography*, he developed methods for reliably adjusting and standardizing adsorbent activity and he described quantitative rules for controlling mobile phase strength and selectivity. He also demonstrated the versatility, efficacy and importance of this technique by a variety of applications in the petroleum field, culminating in the first reported analysis of all of the important oxygen and nitrogen compound types in the distillate from a representative crude oil [2].

Concomitantly, Snyder began the development of a comprehensive theory of gradient elution based on his linear solvent strength (LSS) concept [3]. In retrospect, it is now eminently clear that his work at the advent of the era of high-performance liquid chromatography (HPLC) played an essential role in providing a solid foundation on which this technique has been developed. At that time there was only a handful of scientists who recognized the potential of LC as an instrumental analytical tool and advanced this technique in a major way. The accomplishments by Snyder in the first decade of his distinguished career as chromatographer, which culminated in the publication of his first book *Principles of Adsorption Chromatography* in 1968, place him in the top echelon of these pioneers.

In 1971 Lloyd Snyder accepted a position with Technicon in New York and was soon appointed Vice President of research for that organization. Despite his heavy managerial duties and responsibility for clinical chemistry R&D, he continued an active interest in many aspects of HPLC, which in those years emerged as a prime analytical tool and enjoyed meteoric growth. Lloyd continued to play a leading role in advancing the technique of HPLC while at Technicon, but in 1982 he went into business for himself in order to work exclusively with chromatography. A few years later he founded LC Resources with Dr. John Dolan, and in 1985 he returned to California as part of this organization. His company is devoted to research, education and contract services in various areas of HPLC and GC and markets the highly successful DryLab software for computer-assisted chromatographic method development.

Dr. Snyder has served on the editorial boards of many periodicals covering the fields of chromatography and analytical chemistry, as well as advisory boards for several organizations related to petroleum and clinical chemistry. Since 1987 he has been one of the editors of the *Journal of Chromatography*. He was an adjunct professor of chemistry at Pace University (1980–1986), and in 1984 he was invited to Lanzhou University in China by the ministry of education. Dr. Snyder has been bestowed with many awards for his pioneering work in chromatography. Among others he received the ACS Award in Petroleum Chemistry (1970), the Stephan Dal Nogare Memorial Award in Chromatography (1976), the ACS Award in Chromatography (1984), the Pittsburgh Society Award in Analytical Chemistry (1984), the L. S. Palmer Award in Chromatography (1985) and the A. J. P. Martin Award (1989).

The publication list of Dr. Snyder contains over 250 entries as well as several patents. This work reveals a professional career which has been closely associated with the development of modern liquid chromatography and does not show any sign of slowing down; he published nearly sixty papers in the past five years. Since 1970 he has published on almost every aspect of HPLC, and his significant contributions have made a great impact on the development of the technique at large. Many of his papers show an uncanny combination of theory and practice with the result of providing a simple framework not only for the evaluation and interpretation of chromatographic data but also for predicting and designing the separation. His treatment of gradient elution [4] based on a simple algebraic relationship has been enormously successful in making possible the prediction of separation as a function of gradient conditions. This approach has been applied to numerous practical situations and forms the basis of computer simulation (DryLab), a technique for chromatographic method development that was developed by Dr. Snyder in collaboration with John Dolan [5].

Recently, he extended his comprehensive and practicable theory of gradient elution to preparative separations with column overloading [6]. In the late 1970s Snyder refined his early results and put forward a solvent classification scheme [7] to aid mobile phase selection in HPLC. His solvent selectivity triangle has become extremely popular in many areas outside of chromatography, because it provided a simple method for data interpretation and *a fortiori* the selection of solvents in experimental design for various fields of science and technology.

The growing interest in the chromatography of biological macromolecules brought about by advances in biotechnology prompted Snyder to examine the conditions for gradient elution and preparative chromatography of such large molecules. Besides offering practical insight and guidelines for method development, his numerous papers in the middle 1980s have laid down a broad foundation for the separation of large biomolecules by gradient elution [8], which is an essential feature of biochromatography. Thus, through his lifetime involvement with adsorption chromatography and gradient elution, Snyder has also made his mark on the development of HPLC during the transition of this technique to the separation of large molecules.

Another important contribution by Dr. Snyder is his discovery of the power of “solvent strength optimization” [9] in HPLC method development. In almost all cases previously, solvent composition (%B) was varied in order to adjust retention within desirable capacity factor limits, without regard for the possible effect of solvent strength on band spacing. It is now known that such band spacing changes are quite common and important, and this phenomenon provides much of the value of DryLab

computer simulation. More recently he has demonstrated similar effects in GC [10], where changes in temperature also often provide significant variation in band spacing. In both GC and HPLC, the use of programming techniques further extends the value of this approach.

The picture would not be complete without recalling his major role as an educator who has taught the theory and practice of LC to almost two generations. His book with J. J. Kirkland, *Introduction to Modern Liquid Chromatography*, was first published in 1974 with a second edition in 1979. The book has been the "Bible" of HPLC and has sold more than 25 000 copies—a remarkable success in scientific publishing. His teaching through numerous audio and video courses dealing with various aspects of chromatography has also had a very great influence on the field. With Dr. Kirkland he has taught a very popular ACS course on HPLC since 1971; this course has been attended by over 5000 students in that period. As a prolific writer, Snyder has also contributed to the advancement of chromatography by his numerous review articles and book chapters. Some of his other books also have to be mentioned. These are: *An Introduction to Separation Science*, with Karger and Horváth (1973), *Practical HPLC Method Development*, with Glajch and Kirkland (1988) and *Troubleshooting HPLC Systems*, with John Dolan (1989).

It appears that the tumultuous years in which the edifice of modern LC as an instrumental analytical tool was erected are coming to an end. Future progress, which is expected to be quite substantial, will come about in a more orderly fashion. In honoring Lloyd Snyder at his sixtieth birthday we are paying tribute to a scientist who was one of the most influential personalities responsible for the development and wide employment of HPLC. In addition to the written work, he has exerted a great influence by his presentations at international and national meetings as well as by seminars. He has been a coveted speaker whose lectures are always very clear and substantial.

I personally feel lucky to have had many contacts with Lloyd which were particularly close in the 1970s and early 1980s when he lived near Connecticut. In fact he lured me into the world of clinical chemistry, which he quickly mastered after coming to Technicon. The twenty or so papers he published in this field manifest his versatility and inventiveness as well as his capability of treating complex problems, such as band spreading in segmented flow [11], to arrive at a simple but elegant theory of utilitarian importance. Over the years I learned to appreciate his friendship, his straightforward manner and integrity, his no-nonsense approach to problem solving, and his proficiency in writing. Lloyd has managed to make several major career changes which have provided him with fresh impetus without losing his devotion to chromatographic research, his prolificacy and creativity. This has been an enviable accomplishment and I wish him the best in his endeavors with LC Resources. After his return for the second time to California, he is likely to stay in his native state. I do not wonder. He and Barbara, his lovely wife of almost two scores of years, enjoy a beautiful home in Orinda, where it is always a pleasure to visit, and I feel fortunate to have enjoyed their hospitality.

With the contribution to this volume and in the name of his many friends, I wish Lloyd Happy Birthday and further success in coping with the challenges that chromatography apparently does not cease to offer.

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