Preface

The 1996 ACS Separation Science and Technology Award was presented to Professors Reed M. Izatt and Jerald S. Bradshaw during the 211th National Meeting of the American Chemical Society in March, 1996 in New Orleans, Louisiana. Reed and Jerald were also honored in a Separation Science and Technology Award Symposium which was organized by the Separation Science and Technology Subdivision of the ACS Division of Industrial and Engineering Chemistry. In addition to talks by Reed and Jerald, papers were presented by a number of their colleagues and current and past coworkers.

This Special Issue of the *Journal of Inclusion Phenomena and Molecular Recognition in Chemistry* which commemorates the 1996 ACS Separation Science and Technology Award to Professors Izatt and Bradshaw contains historical overviews by Reed and Jerald as well as ten contributions by researchers who have been closely associated with them during their careers.

In 1956, Reed joined the faculty of the Chemistry Department at Brigham Young University. As a physical-inorganic chemist, his early research was centered around thermodynamic studies of proton-dissociation processes in solution and metal ion association with inorganic anions and neutral organic ligands. Reed was among the first to grasp the implications of C. J. Pedersen's classic first paper in 1967 on the synthesis and cation complexing abilities of a new class of synthetic organic ligands - the cyclic polyethers, designated "crown ethers" by Pedersen. In early 1968, he was the first scientist from outside of DuPont to visit Pedersen. Reed returned to BYU with samples of several of these new macrocycles and immediately initiated systematic, quantitative investigations of metal ion complexation by crown ethers. In early 1969, he published a paper in *Science* on the formation constants and enthalpy and entropy changes for the interaction of alkali metal ions with dicyclohexano-18-crown-6 together with the first discussion of the relevance of such complexation phenomena as models for active transport processes in biological membranes.

In 1966, Jerald S. Bradshaw also became a faculty member at BYU. Following discussions with Reed, Jerald devoted a portion of his organic chemistry research program to the synthesis of new macrocyclic multidentate ligands. Assessment of the metal ion binding abilities of Jerald's new macrocyclic compounds by Reed and his coworkers revealed the marked effect of structural variation within the ligand upon the strength of complexation with different metal ion species. The first joint publication by Reed and Jerald appeared in 1973 and the collaboration continues to this day.

In the late 1980's, Reed and Jerald initiated an extremely important advance in separations science which is already realizing its industrial potential. Jerald and his coworkers developed a viable synthetic method for the covalent attachment of macrocyclic ligands to silica gel which was reported in 1988 in *Chemical Communications*. Macrocyclic ligands with side arms possessing terminal silyl functionality were attached to silica gel by formation of Si-O-Si

bonds. The large surface area of silica gel allowed practical amounts of the macrocyclic ligands to be bound to a material with excellent flow characteristics. When the physiochemical techniques that had been developed over the past four decades by Reed and his coworkers were extended to the silica gel-bound macrocyclic ligands, it was discovered that the immobilized macrocylic ligands display metal ion association constants which are nearly identical to those of analogous unbound analogues. Therefore, the large body of published data for the association of various metal ion species with macrocyclic ligands in homogeneous solution may be utilized in the design of chelating silica gels with selectivities targeted for specific applications. This work was reported in a series of papers in *Analytical Chemistry* from 1988 through 1991.

This research was conducted in the Center for Chemical Separations at BYU, which was founded by Reed and Jerald. The Center was supported in 1987-1992 by a grant from the State of Utah Centers of Excellence Program. With technology transfer from the Center, Reed and Jerald organized IBC Advanced Technologies (IBC) in 1988 and commercial development of silica gel-bound macrocyclic ligands for metal ion separation/recovery commenced. Today IBC employs more than 30 chemists and chemical engineers in American Falls, Utah, and has multi-million, world-wide sales of SuperLig® gels and AnaLig® analytical columns which contain SuperLig® gels. Typical applications for the SuperLig® gels are the removal of lead from tin plating baths and antimony and bismuth during copper refining and for the recovery of rhodium from spent catalysts

Thus Reed and Jerald have discovered and developed an entirely new technology for performing the industrial-scale separation/recovery of ionic species. This advancement in separations technology was recognized by the 1996 ACS Award in Separations Science and Technology.

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