

PROFESSOR ROY L. WHISTLER

This issue of *Carbohydrate Research* is dedicated to Professor Roy L. Whistler, a scientist internationally recognized, primarily for his investigations of polysaccharide structure and function and, more especially, for his efforts towards the industrial utilization of polysaccharides, although he has been active in several areas of carbohydrate chemistry and biochemistry. Because of his interest in, and knowledge of, the industrial modification and uses of polysaccharides, and because of his business sense, Professor Whistler is known and respected by both academicians and industrialists. He has been sought as a consultant to many corporations, more in fact than he could serve because of conflicts of interest and limitations of time, and has served on the Boards of Directors of several companies. This association with industry has kept industrialists supplied with ideas and has brought their questions and problems into his academic research laboratory. As a result, an impressively large number of his basic research discoveries have led to important practical uses.

Roy Lester Whistler, born on March 21, 1912, grew up in Tiffin, Ohio. While a junior in high school, he became interested in chemistry. As a high-school senior, he won his first award, The Ohio State Garvan Award, for his essay on the subject "The Relation of Chemistry to National Defense".

Roy Whistler attended Heidelberg College in Tiffin, Ohio, where he majored in chemistry, physics, and mathematics while working part-time in the chemical storeroom. In 1934, after earning the B.S. degree, he became a graduate student of Professor M. L. Wolfrom's at The Ohio State University in Columbus, Ohio, and the two became close friends and collaborators. Roy Whistler completed the requirements for the M.S. degree in 1935.

A second close, life-long association also began in Columbus, for that is where Roy met his wife Lea. Carbohydrate chemists the world over know Lea as a charming, intelligent person and hostess. We who dedicate this issue to Professor Whistler remember with pleasant memories the times shared with them, not only in their home, but also as they have been able to travel together.

Because of financial problems at The Ohio State University brought about by the economic conditions of the country in the mid-thirties, Professor Wolfrom was unable to obtain financial support for his student and recommended Roy to Professor R. N. Hixon at Iowa State College (now Iowa State University).

His laboratory work while a doctoral student of Professor Hixon's resulted in five publications, two of which were outside the thesis topic. One of his non-thesis accomplishments was the development of a commercial process for producing β -D-glucose, a substance needed in the soft-drink industry for cold-water solubility. This discovery marked the beginning of his extensive association with industry. He was awarded the Ph.D. degree in 1938.

Both Professors Wolfrom and Hixon recommended the new Dr. Whistler

for a post-doctoral position at the National Bureau of Standards, where he became associated with Dr. Milton Harris. One of his accomplishments while in this position was the development of a widely used quantitative method for determination of the uronic acid content of polysaccharides.

After two years at the National Bureau of Standards, Dr. Whistler was hired to lead the Starch Structure Group at the then newly established Northern Regional Laboratory of the U.S. Department of Agriculture at Peoria, Illinois. While there, he investigated the separation of the molecules making up the starch granule and isolated intermediate fractions, in addition to amylose and amylopectin. Preparation of esters of amylose and amylopectin, and determination of the physical properties of films and fibers made from them, followed. He was the first to show that useful films and especially fibers could be spun from amylose triacetate. Later, he determined that certain xylan acetates had acceptable film properties. While at the Northern Regional Laboratory, he taught an evening course in carbohydrate chemistry at Bradley University and served a one-year term as President of the Peoria Academy of Sciences.

In 1946, following the Second World War, Dr. Whistler accepted a position as Assistant Professor in the Department of Agricultural Chemistry (now the Department of Biochemistry) of Purdue University. There he began a research program on the polysaccharides of agricultural crops, while through his writing, he championed chemistry in general.

His early work at Purdue emphasized annual-crop hemicelluloses. He determined their structures, brought clarification to their classification, and investigated possibilities of their industrial use. First, he delignified plant residues with chlorine dioxide to produce undegraded holocellulose. Then, he separated the hemicelluloses into distinct fractions and a number of pure polysaccharides. To determine structural details of the polysaccharides, he developed the method of partial hydrolysis using acids and enzymes. To separate oligosaccharides, the widely used method of carbon-column chromatography was developed.

"Doc", as he is affectionately known to his students, quickly perceived the value of new instrumental techniques to carbohydrate research. He was among the first to apply infrared spectrophotometry to the analysis of carbohydrates. He also pioneered in the application of transmission electron-microscopy for examination of the fine structure of starch granules.

Professor Whistler was a leader in the development of high-amylose corn (maize) and guar, both now commercial crops in the United States of America. He and Professor Kramer at Purdue University, simultaneously with Robert P. Baer, discovered the amylose-extender gene. This discovery enabled breeders to raise the amylose content of corn (maize) and led to the commercial production of high-amylose, double-cross hybrids. He promoted the cultivation of guar and worked out the structure of guaran, the polysaccharide from the seed of the guar plant and now an important industrial gum. Later, he determined the fine structure of locust-bean gum.

Investigations of modifications of polysaccharides to make new products with unique properties has also been an important part of his research program. He unraveled the chemistry of oxidation of starch with chlorine. I have already mentioned the preparation of organic esters of xylan and the starch polysaccharides. In addition, he opened up the possibility of commercial production of sulfuric half-esters of cellulose and other polysaccharides through application of sulfur trioxide-tertiary amine complexes, and introduced the 3,6-anhydro ring into amylose sulfates. He first examined the possibility of grafting poly(acrylamide) to starch, and produced polymers by condensation of alditols with dibasic acids and with diisocyanates, and by polymerization of epoxide and episulfide derivatives of sugars.

His contributions have not been limited to the chemistry and physical properties of polysaccharides. One of his more important contributions has been the preparation of 5-thio-D-glucose, an analog of D-glucose. 5-Thio-D-glucose has the same conformation and most of the same chemical and physical properties as D-glucose, but different physiological and biochemical properties. Among its several interesting biological effects is its ability to block the uptake of D-glucose by cells. This effect led to its investigation as an inhibitor of sperm development. It was found that, when given orally or by injection to male mice, 5-thio-D-glucose quickly and effectively stops sperm development and maintains infertility when given periodically. When withdrawn, the mice resume sperm production and are able to give rise to normal progeny. This finding has been the subject of further extensive investigation. Other sugars and nucleosides having a sulfur atom replacing the ring-oxygen atom have since been made in his laboratory and by others.

Shortly after arriving at Purdue University, Professor Whistler began writing the book "Polysaccharide Chemistry" with the help of his student C. Louis Smart. This book, published in 1953, was the first and only complete compilation of the chemistry of all known polysaccharides. It was described by one reviewer as "not only a work of science but of literature". In this book, he established the beginning of systematic polysaccharide nomenclature.

Next, he turned to the editing of the book "Industrial Gums" with another of his students. "Industrial Gums", now in its second edition, is a practical book that describes the chemistry, properties, and applications of water-soluble or -dispersible polysaccharides and polysaccharide derivatives with commercial, or potential commercial, value. In the introductory chapter of this book, Professor Whistler presented important concepts about the relationships of structure to properties of polysaccharides.

The most widely used of his books are undoubtedly those of the "Methods in Carbohydrate Chemistry" series. This series is testimony to a recognition by him that advances in carbohydrate chemistry and biochemistry and a number of related fields depend on the development of reliable methods, followed by their dissemination and use. The *Methods* series has been described by reviewers as "a must for sugar chemists" and "a monumental work of permanent value". The treatise on "Starch: Chemistry and Technology", which he co-edited, is now being revised. Few men in any field

can look back upon such significant, clearly written, and factual contributions to the secondary literature. To date, Professor Whistler has more than 370 publications, including articles in the primary literature, books, chapters in books, book reviews, patents, and popular articles.

Dr. Whistler rapidly moved up the professorial ranks at Purdue University, becoming an Associate Professor in 1948 and a full Professor in 1950. Also in 1948, he was appointed Assistant Department Head, and chairman of an interdepartmental committee concerned with industrial uses of agricultural products. The latter activity grew, and in 1960, Purdue University established an Institute for Agricultural Utilization Research, with Professor Whistler as its first head. In 1975, he was named Hillenbrand Distinguished Professor of Biochemistry.

Professor Whistler has served on, and as Chairperson of, a wide range of university committees. He was a member of the committee established to organize a University Senate, and served as a Senator for four years. For two years, he was Chairperson of the Faculty Affairs Committee of the senate. He has been active for more than 20 years on the Patent Advisory Committee of the Purdue Research Foundation. He has served almost as long on the Purdue Athletic Committee and has been its Executive Secretary. Since 1968, he has been Purdue's Faculty Representative to the Intercollegiate Conference of Faculty Representatives (the Big Ten) where, for many years, he headed its Rules and Agenda Committee. He also chaired a university committee to suggest ways and means for creating a Division of Women's Intercollegiate Athletics.

Professor Whistler himself has always been physically active. For many years, he spent several weeks each summer hunting big game in Africa. Within the past two years, he has become a certified scuba diver. In dedicating this issue of *Carbohydrate Research* to him, it is our hope and expectation that he will continue to "think young".

While Professor Whistler has enjoyed both his scientific and extra-scientific work, he has also enjoyed and taken pride in his teaching, especially in his classes for beginning students. His former graduate students remember his uncanny demonstrations of memory and our humorous, unsuccessful attempts to rattle him.

In addition, Professor Whistler has always been willing to give of his time and service to Scientific societies. He has held several offices in the American Chemical Society. Among them are service on the Board of Directors; as Chairman of the Division of Carbohydrate Chemistry, the Division of Cellulose, Paper and Textile Chemistry, and the Purdue Local Section; as a Councilor and a member of a number of Board and Council committees; and as Chairman of the Polysaccharide Nomenclature Subcommittee of the Carbohydrate Nomenclature Committee. He has served the American Association of Cereal Chemists as Chairman of the Committee to Organize a Carbohydrate Division, first Chairman of the Carbohydrate Division, national President, and Chairman of the Board. He has served the Society of Sigma Xi as Chapter President and as a National Executive Committeeman.

One association with the American Chemical Society to which we look forward with anticipation twice each year is the ritual of having dinner with him on the

Monday evenings of the national meetings. These dinners are the source of many memories and stories.

For his research efforts, Professor Roy L. Whistler has been recognized with the Annual Research Award of the Purdue University Chapter of The Society of the Sigma Xi (1953), the Claude S. Hudson Award of the Division of Carbohydrate Chemistry of the American Chemical Society (1960), the Anselme Payen Award of the Division of Cellulose, Wood, and Fiber Chemistry of the American Chemical Society (1967), the Award of Merit of the Japanese Society of Starch Science (1967), the Alsberg-Schoch Award (1970) and the Osborne Medal (1974) of the American Association of Cereal Chemists, the Saare Medal of the Association for Cereal Research (Arbeitsgemeinschaft Getreideforschung) (1974), and the Spencer Award of the Kansas City Section of the American Chemical Society (1975). He has been an invited lecturer in every country of the world in which there is a significant interest in carbohydrate chemistry, and has been made an honorary life member of several chemical societies.

Professor Whistler served as Honorary President of an international carbohydrate symposium held in Paris in 1960. At this meeting, international leaders in carbohydrate chemistry and biochemistry recognized the value of continued international meetings, and began discussions which led to the establishment of the International Steering Committee for Carbohydrate Symposia. Professor Whistler served as Secretary of the organizing group. Later, he was chosen to be the first National Representative of the United States of America and first Secretary of the Steering Committee. During 1972-1974, he was President of the Steering Committee.

It is to Professor Roy L. Whistler that this issue of *Carbohydrate Research* is dedicated. This issue is itself unique among dedicatory issues in that all the papers in it are from his former graduate or post-doctorate students. Those of the more than 80 former graduate and post-doctorate students who were unable to submit articles for publication but who wish to be part of this special recognition have their names listed below. Each of us, and carbohydrate chemists the world over who hold Professor Whistler in such high esteem, offer our congratulations for his achievements with this additional honor. At the same time, through the dedication of this issue, we wish him many more productive years of research, writing, consulting, and professional service. We expect to continue to benefit from his tireless contributions.

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