

PROFESSOR ROGER W. JEANLOZ

Roger William Jeanloz, to whom the current issue of *Carbohydrate Research* is dedicated, is one of a small group of scientists who founded this journal in 1965. Since that time, he has been a regional editor. His outstanding contributions to the study of carbohydrates have made him a leader in this field.

Roger Jeanloz was born on November 3, 1917 in Berne, Switzerland, to a French mother and a Swiss-German father. He was brought up in French-speaking Geneva where he pursued classical studies emphasizing Greek and Latin at the College Calvin. In 1936, he was awarded the B.S. degree from this College and in 1941 a Diploma in Chemical Engineering from the University of Geneva, where he studied organic chemistry and biochemistry.

The keen interest of Jeanloz in science and research began in 1941 when he was accepted as a doctoral student by Professor Kurt H. Meyer, well known for his pioneering studies on cellulose and starch. In the laboratory of Meyer, he investigated glycogen and at the same time served as head instructor for Organic Chemistry. In 1943, after being awarded the D.Sc. degree, he was appointed as Research Associate, first with Meyer and then with Professor Tadeusz Reichstein, with whom he worked on the chemistry of deoxy sugars. In 1946-47 he spent one year in Canada as Research Associate at the University of Montreal and then moved to the United States. Here he started his career as Senior Research Fellow at the laboratory of the noted carbohydrate chemist, Claude S. Hudson, at the National Institutes of Health. The following three years were spent at the Worcester Foundation for Experimental Biology, then under the direction of Gregory Pincus.

In 1951, Jeanloz was invited by Dr. Walter Bauer, Chief of the Medical Services at Massachusetts General Hospital and Chief of the Arthritis Unit, to become a member of the Robert W. Lovett Memorial Group for the Study of Crippling Diseases and to organize a laboratory for the study of the chemical structure of the polysaccharides of connective tissue and of related biochemical problems. Ten years later, he was appointed Head of the newly formed Laboratory for Carbohydrate Research of the Lovett Group. He still holds this position and he is also Professor of Biological Chemistry of Harvard Medical School. It is in this laboratory that he has made, and continues to make, his major contributions to our knowledge of structure, biosynthesis, and function of complex carbohydrates. Most prominent among these are the elucidation of glycosaminoglycan structures, chiefly by methylation analysis; establishment of the structure of the disaccharide constituent of the bacterial cell-wall peptidoglycan; providing the foundation for structural studies of the carbohydrate moieties of *N*-linked glycoproteins; synthesis of many of the glycopeptide constituents of glycoproteins as well as the lipid intermediates, dolichol sugar phosphates. In addition, analysis of TA-3 glycoprotein initiated in his laboratory has led to the most detailed investigation of any tumor-

related glycoprotein thus far examined. Currently, a major interest of Jeanloz is in the biosynthesis of glycoproteins, using both synthetic donors and acceptors.

Before joining the Lovett Group, Jeanloz devoted considerable efforts to understanding the periodate-oxidation reaction and used it to study the structure of hyaluronic acid. It rapidly became evident to him that this method, as was the case in the successful determination of the structure of simpler polysaccharides (glycogen or starch), required supplementation with other methods, particularly the methylation technique. This technique had already been attempted in the field of proteoglycans, but without positive results. The main difficulty resided in the fact that degradation of a methylated polysaccharide, made of repeating units of hexosamine and uronic acid, could give rise to a large number of methylated monosaccharides, of which only a few were known. Thus it was necessary to synthesize all of the reference substances, and to separate and identify them in artificial mixtures. Jeanloz was encouraged in this long and arduous task by the knowledge that if the method could be shown to be efficient, it could be applied not only to the elucidation of the structure of the glycosaminoglycan but also other classes of more-complex carbohydrates. The methylated derivatives served as the basis of elegant studies in which Jeanloz and his colleagues unequivocally established the structure of hyaluronic acid, dermatan sulfate, and chondroitin 4-sulfate. They also clarified many confusing issues, including the position of the sulfate groups. In the course of this work they proved that dermatan sulfate contained L-iduronic acid, a sugar not known before to occur in Nature.

The methylated substances were in such demand by other laboratories for references that one research assistant worked full time solely to replenish supplies of these compounds. Jeanloz was greatly helped in this synthetic approach, which took ten years to accomplish, by a large number of associates, prominent among whom was Pierre J. Stoffyn who joined his group in 1953 and stayed until 1961. One of the many results of their productive collaboration was the Stoffyn and Jeanloz method for identification of hexosamines by ninhydrin degradation to the corresponding pentoses, which is still the simplest method to distinguish between glucosamine and galactosamine.

The synthetic studies of Jeanloz led to the solution of many other questions in carbohydrate chemistry, especially in amino sugar chemistry. These included basic questions of transformation of one sugar into another. Resulting from these studies was the synthesis of several amino sugars, some of which (e.g., D-gulosamine) had been shown to be constituents of aminoglycoside antibiotics, and others which at the time were not known to occur in Nature (e.g., D-allosamine and D-talosamine).

A number of the central themes of current glycoconjugate research can be traced to studies begun in the laboratory of Jeanloz. A prominent example was the fact that glycolipids may be antigens and that glycolipids of tumors may elicit an immune response in the cancer host. Another example is his research on the carbohydrate portion of glycoproteins, which was initiated in 1955, with special

attention to α_1 -acid glycoprotein of human plasma. This led in 1962 to the first unequivocal demonstration of *N*-acetylactosamine in a well defined glycoprotein. In this work, glycosidases (other than sialidase) were used for the first time in structural studies of glycoproteins. With much foresight, Jeanloz suggested that the carbohydrate moiety of α_1 -acid glycoprotein was composed of a small number of large oligosaccharides. At the same time, he suggested the sequence and linkage of monosaccharides of what is known today as a biantennary oligosaccharide. In addition, he proposed that the inside core, linked to the protein, was composed of two *N*-acetyl-D-glucosamine residues and D-mannose. Proof of the proposed structures was as usual sought by Jeanloz using chemical synthesis. In 1970, he synthesized $\beta\text{GlcNAc}1\rightarrow4\text{GlcNAc-Asn}$ and subsequently a large number of *O*- and *N*-linked glycopeptides.

Soon after the discovery of the dolichol sugar phosphate intermediates involved in protein glycosylation, Jeanloz undertook the chemical synthesis of these still poorly characterized molecules. The work from the Jeanloz laboratory on synthesis of dolichyl mannosyl phosphate, and *N*-acetylglucosaminyl dolichyl phosphate and pyrophosphate, are classical examples of unequivocal chemical synthesis leading the way in establishment of new metabolic pathways. The anomeric configuration of the active compounds was established, as was the dual role of phosphate diester and pyrophosphate derivatives in the overall pathway. At this particular time in the elucidation of the mode of assembly of asparagine-linked carbohydrates, the synthetic chemistry in Jeanloz's laboratory led the way and biochemistry followed.

The productivity of Jeanloz is exemplified by his bibliography of more than 400 publications. He has authored many reviews which are outstanding for their clarity, concise style, and interpretation. He has edited several books, the most notable of which is *The Amino Sugars*, edited jointly with E. A. Balazs. He is particularly concerned with the nomenclature of carbohydrates and has been instrumental in resolving key issues and introducing many new and well defined terms such as glycosaminoglycans.

In addition to his research and teaching activities at his institution and elsewhere throughout the world, Jeanloz serves on numerous committees and editorial boards. The community of carbohydrate scientists is greatly indebted to him as a central figure in the organization of the International Symposia on Glycoconjugates. The first meeting was convened in 1965 in Swampscott with Jeanloz as Co-Chairman. Jeanloz was also the prime mover in encouraging his European colleagues to organize the second and third meetings in Lille and Brighton, respectively. In 1977 he was Treasurer of the 4th Symposium held at Wood's Hole. In 1974–1975, Jeanloz was president of the National Society of Complex Carbohydrates. He has also been active for many years in the Division of Carbohydrate Chemistry of the American Chemical Society of which he served as Chairman.

His many achievements have brought him honors which include the Medal of

the Société de Chimie Biologique de France; Medal of the University de Liège; Prix Jaubert, University of Geneva; Claude S. Hudson Award, American Chemical Society; Docteur Honoris Causa, University of Paris; and recently the Alexander von Humboldt Award, Germany's most prestigious scientific award.

A frequent traveller, Jeanloz has increased awareness throughout the world for the important role of complex carbohydrates in biological phenomena. Just as importantly, he is instrumental in promoting cooperation among scientists of many countries and has served as Visiting Professor throughout Europe and Japan. He was Exchange Fellow of the U.S. and USSR Academies of Science and was a Guggenheim Fellow at the University of Geneva. This internationalization of carbohydrate research is best illustrated by the composition of Jeanloz's laboratory which has attracted well over 100 first-rate scientists from throughout the world.

The scope of Jeanloz's activities, and the knowledge and enthusiasm that he imparts to his colleagues, all combine to inspire his many students. Because of these qualities, he has not only been able to attract but also to keep many able associates in his laboratory for long periods and frequently to continue collaborations with them after they leave. The excellent training they receive from Jeanloz and the contacts and friendships made in his laboratory exercise decisive influence on their careers. The importance of applying the rigorous techniques of organic chemistry to the solution of biochemical problems is the most crucial point of this training.

The uniquely congenial atmosphere in the Jeanloz laboratory which is remembered with affection by each of us, has been and is aided greatly by the presence of his charming wife, Dorothy, an organic chemist, who has collaborated with him for many years. In spite of their busy schedules, Dorothy and Roger care for the well-being of their associates. Jeanloz's personal qualities and *bon vivant* character have endeared him to all of his colleagues.

Jeanloz is an avid skier, a lover of classical music, and an enthusiastic gardener. His love for plants came early in his life when he brought home bouquets of alpine flowers from mountain expeditions. His interest in sports can also be traced to his childhood. At the age of 12 he started playing basketball which had been introduced into Switzerland by the American YMCA. He was a member of the Geneva Basketball Club, and was selected to represent Switzerland in international games. Later he played with the University of Geneva team and his activities in basketball and other sports, in particular tennis and mountain climbing, led to his election as president of the University Sports Society.

It is appropriate to quote from one of the many letters sent to Jeanloz at a Symposium held in his honor during the *8th International Symposium on Glycoconjugates* in Houston, Texas, September 1985. Albert Neuberger writes: "His work is characterized by a mastery of all chemical and biological methods used; by reliability of the results obtained; and by careful and balanced interpretation. There is hardly any topic in this wide field which he has not touched and which has not benefited from his research . . . Roger Jeanloz has made his laboratory one of the

few outstanding centres in the field of complex carbohydrates. His combination of supreme chemical competence and biological understanding are the hallmark of his career.”

We join with the many associates and friends in wishing Roger Jeanloz a continuation of his outstanding and productive career as a scientist, scholar, and teacher.

MARY CATHERINE GLICK

R. COLIN HUGHES

NATHAN SHARON