



**SYMPOSIUM**  
**THE EXTRACELLULAR MATRIX:**  
**CHEMISTRY, BIOLOGY, PATHOLOGY**

**WASHINGTON UNIVERSITY AT ST. LOUIS, MISSOURI**  
**JUNE 5 - 9, 1982**

**A JOINT MEETING OF THE REGIONAL**  
**CONNECTIVE TISSUE SOCIETIES:**  
**EAST COAST SOUTHERN MIDWEST WEST COAST**

**MADE POSSIBLE BY A GRANT FROM**  
**THE NATIONAL HEART, LUNG, AND BLOOD INSTITUTE**

Welcome to "**The Extracellular Matrix: Chemistry, Biology and Pathology.**" We hope and believe that this meeting, the first of its kind, will be an exciting and a useful one for all of you. Our purpose in holding the meeting was to provide to all investigators — from those deeply involved in connective tissue research, to those interested in obtaining an up-to-date overview — a meeting of substantive value and a forum for valuable discussions. The regional connective tissue society meeting has traditionally combined both the formal presentation and the informal exchange of information. We have tried to keep the format of this meeting true to that tradition. Thus, whenever possible, we will have short presentations of submitted abstracts at the plenary sessions. In addition, our week-long poster session will help promote informal exchange of data between attendees with similar interests. Finally, we have arranged a set of workshops wherein informal, yet intensive, discussions of modern techniques and areas of current interest can be held.

Lastly, we are particularly pleased to be able to honor four pioneers of connective tissue research: **Professors F.O. Schmitt, Karl Meyer, S.M. Partridge, and Albert Dorfman.** These men were in large part responsible for the beginnings of rational approaches to the chemistry and biology of collagen, proteoglycans and elastin. We hope that their presence with their perspective of years, will enrich our proceedings. It is with regret that we note that Professor Dorfman, who was to be with us, is in ill health and unable to attend.

Thank you for coming. If there is anything we can do to make your stay more enjoyable, please ask.

John Jeffrey and Bob Mecham  
Co-Chairmen

# PROGRAM

## Friday, June 4, 1982

Registration: 12 noon to midnight-Wohl Center, North Lobby

Chairmen's Hospitality Room: open from 4:00 p.m. on the J-K-L Patio; beer, soda, and snacks provided.

Meal Schedule: Breakfast 7:15 - 9:00 a.m.  
Lunch 12:00 noon - 2:00 p.m.  
Dinner 7:00 - 8:00 p.m.

## Saturday, June 5, 1982

9:00 a.m. **COLLAGEN STRUCTURE,**  
Robert Burgeson, Organizer

—Robert Burgeson, Harbor General/UCLA, Torrance, CA

—Hans-Peter Bachinger, UCLA

"The Invertebrate Collagens and Type IV Basement Membrane Collagen"

—Helene Sage, University of Washington, Seattle, WA

"Collagens with Discontinuous Triple Helix"

—Joseph Madri, Yale University, New Haven, CT

"Immuno-histochemical Localization of Collagens"

12:00 noon to 2:00 p.m. **LUNCH**

2:00 p.m. **ELASTIN: STRUCTURE AND BIOSYNTHESIS**  
Judith Ann Foster, Organizer

—D.W. Urry, University of Alabama, Birmingham, AL  
"Physical Studies on the Molecular Structure of Elastin"

—R.P. Mecham, Washington University, St. Louis, MO  
"The Role of Extracellular Matrix in the Control of Elastin Gene Expression in Fibroblasts"

—Judith Ann Foster, University of Georgia, Athens GA  
"Elastin Gene Expression"

6:00 p.m. **Cocktail Reception**  
Sponsored by Beckman Instrument Co.

# PROGRAM

**Sunday, June 6, 1982**

**9:00 a.m. GLYCOSAMINOGLYCANS AND PROTEOGLYCANS**

**Lennart Rodén, Organizer**

- William J. Whelan, University of Miami, Miami FL  
"Glycogen: A New Member of the Proteoglycan Family"
- Lennart Rodén, University of Alabama, Birmingham, AL  
"Regulation of Proteoglycan Biosynthesis"
- Nancy Schwartz, University of Chicago, Chicago, IL  
"Structure and Biosynthesis of Proteoglycan Core Proteins"
- Ulf Lindahl, Uppsala University, Uppsala, Sweden  
"Polymer Modification in Heparin Biosynthesis"

**LUNCH 12:00 noon to 2:00 p.m.**

**2:00 p.m. MATRIX DEGRADATION,**

**Edward D. Harris, Jr., Organizer**

- Arthur Z. Eisen, Washington University, St. Louis, MO  
"Chemistry and Enzymology of Human Skin Collagenase"
- Jerome Gross, Massachusetts General Hospital, Boston, MA  
"Epithelial-Mesenchymal Interactions Regulating Collagenolysis"
- Stephen M. Krane, Massachusetts General Hospital, Boston, MA  
"Biological Modulators of Collagenase Production"
- Carlo Mainardi, University of Tennessee, Memphis, TN  
"Degradation of Types IV and V Collagen"

**6:30 p.m. Cocktail Reception - Bear's Den, Wohl Center  
first floor**

**7:30 p.m. Banquet, Honoring Professors  
F.O. Schmitt  
Karl Meyer  
S.M. Partridge  
A. Dorfman**

**Wohl Center, Line A, second floor**

# PROGRAM

**Monday, June 7, 1982**

**9:00 a.m. COLLAGEN BIOSYNTHESIS/GENE STRUCTURE**

Paul Bornstein, Organizer

- Janet Monson, Zymos Corporation, Seattle, WA  
"Collagen Gene Structure"
- Paul Bornstein, University of Washington, Seattle, WA  
"Translational Regulation of Collagen Synthesis"
- Sherrill Adams, University of Pennsylvania, Philadelphia, PA  
"Transcriptional Regulation of Collagen Synthesis"
- Richard Berg, Rutgers University, Piscataway, NJ  
"Post-translational Regulation of Collagen Synthesis"

**LUNCH 12:00 noon to 2:00 p.m.**

**2:00 p.m. Current Technique Workshops and  
Special Interest Discussion Groups**

**Tuesday, June 8, 1982**

**9:00 a.m. CELL ADHESIVE PROTEINS**

John McDonald, Organizer

- John McDonald, Washington University, St. Louis, MO  
"Cell Adhesion: Mechanisms and Consequences"
- Kenneth Yamada, National Institute of Health, Bethesda, MD  
"Fibronectin"
- Tyl Hewitt, National Institute of Health, Bethesda, MD  
"Molecular Interactions Between Cells, Adhesive  
Proteins and Collagen"
- Magnus Höök, University of Alabama, Birmingham, AL  
"Bacterial Attachment to Connective Tissue Components"

To be followed by a Panel Discussion open to the audience.

# PROGRAM

12:00 noon to 2:00 p.m. **LUNCH**

2:00 p.m. **DEVELOPMENTAL BIOLOGY OF  
THE EXTRACELLULAR MATRIX**

Bryan P. Toole, Organizer

- Klaus Von Der Mark, Max Planck Institute, Munich, Germany  
"Role of Laminin in Adhesion and Fusion of Myoblasts"
- Merton Bernfield, Stanford University, Palo Alto, CA  
"Remodeling of the Basal Lamina as a Morphogenetic Mechanism"
- Bryan P. Toole, Tufts University, Boston, MA  
"Pericellular Hyaluronate and Morphogenesis"
- A. Hari Reddi, National Institute of Health, Bethesda, MD  
"The Role of Extracellular Bone Matrix in Bone Differentiation"

## Wednesday, June 9, 1982

9:00 a.m. **CONNECTIVE TISSUE PATHOLOGY**

George R. Martin, Organizer

- Peter Byers, University of Washington, Seattle, WA  
"Molecular Mechanisms of Inherited Collagen Disorders"
- Eugene Bauer, Washington University, St. Louis, MO  
"Diseases of Collagen Degradation as Manifested in Tissue Culture"
- Steven Rennard, National Institute of Health, Bethesda, MD  
"The Cellular and Biochemical Basis for Fibrosis in the Lung"
- John Hassell, National Institute of Health, Bethesda, MD  
"Diseases of Proteoglycan Biosynthesis: Macular Corneal Dystrophy"

**POSTER SESSIONS WILL BE IN FRIEDMAN  
FORMAL LOUNGE ON THE LOWER LEVEL OF THE  
WOHL STUDENT CENTER.**

**SYMPOSIUM HONOREES:**

Professor F.O. Schmitt

Professor Karl Meyer

Professor S.M. Partridge

Professor Albert Dorfman

BIOGRAPHIES OF THE HONOREES.....

## — Francis O. Schmitt —

Francis Otto Schmitt, a native of St. Louis, received his A.B. degree at Washington University in 1924, and his Ph.D. degree in Physiology (Medical Sciences) in 1927. Two of his teachers at the Physiology Department at the Medical School were Joseph Erlanger and Herbert Gasser, both eminent neurophysiologists, who, in 1944, shared the Nobel Prize in Physiology for their work on single nerve fibers. Schmitt remained on intimate terms with these two men who undoubtedly had a great effect on his future development.

Armed with a National Research Council Fellowship, Schmitt did postdoctoral work with G.N. Lewis at the University of California, with J.G. Drummond at University College, London, and with O. Warburg and O. Meyerhof at the Kaiser Wilhelm Institute in Germany. On his return, he joined the Zoology Department of Washington University and rose quickly through the academic ranks, becoming full professor in 1938. On the retirement of Caswell Grave in 1940, Schmitt became head of the department, only to leave a year later for the Massachusetts Institute of Technology, where he served as Chairman of the Department of Biology from 1942-1955, then as Institute Professor to 1969. Since then he has been Director of the Program in Neurosciences and Emeritus Professor at MIT.

At the end of the highly productive St. Louis period, Schmitt and collaborators had published some 100 papers dealing with a variety of problems, among which structure analysis of tissues with physical and physico-chemical methods seemed to emerge as the predominant interest. His emphasis was clearly shifting toward the molecular level. The time was ripe for analysis of the structure of collagen and other fibrous proteins by electron microscopy, a subject which was to occupy Schmitt's interest for many years.



In 1942, using one of the first electron microscopes made commercially in this country, Schmitt, Hall and Jakus discovered the periodic cross-striations in collagen fibrils, and soon were using heavy metal electron stains for the first time to reveal greater fine structural detail. Schmitt and his associates, J. Gross and J.H. Highberger embarked upon a systematic analysis of the *in vitro* reconstitution of cross-striated fibrils from solutions of purified collagen molecules. They provided the first indications that structural macromolecules in random dispersion could, under appropriate environmental conditions, be brought together to reconstitute in a variety of highly ordered supramolecular fabrics, including striated fibrils identical with the native form. In the early fifties, Highberger, Gross, and Schmitt described the unusual Long Spacing structures into which they forced collagen molecules to self assemble *in vitro*, which experiments led them to propose the correct dimensions of the collagen molecule (later visualized directly by C.E. Hall) which they called "tropocollagen". From these studies, they developed the "quarter-stagger hypothesis", later elucidated in greater detail by Hodge and Schmitt, describing the manner in which the molecules aligned in the fibril to give rise to the characteristic 640 Å axial periodicity.

Although F.O. Schmitt turned away from clinical medicine after two years of preclinical training in favor of a career in basic biological sciences, his contribution to medicine as trustee of the Massachusetts General Hospital, and as advisor, mentor, and colleague of numerous M.D. postdoctoral fellows at MIT provides strong evidence for his deep and continuing interest in medicine. There is no doubt that his contributions to fundamental biology have had a powerful impact on medical science and have amply justified his early decision. Although the scientific contributions of Francis O. Schmitt are numerous and outstanding, perhaps his major influence has been felt in the powerful stimulus he has given to the field of tissue fine structure, or, as he would phrase it, "analytical cytology", and to the large number of students and fellows who have been trying to follow in his footsteps.

## — Karl Meyer —

Karl Meyer, born in the German province of Westphalia in 1899, undertook a medical education and an internship in Cologne. As with some other, now famous, young physicians of the period, his aspiration for a research career led him to seek scientific training at the University of Berlin, leading to a PH.D. degree. He served as assistant to Otto Meyerhof, and in Richard Kuhn's laboratory in Zurich, applied the then new manometric techniques to chemical studies of auto-oxidation. In 1930, he emigrated to America. Following a brief stay at Assistant Professor at the University of California, he moved to Columbia University College of Physicians and Surgeons. He served there from 1933 until his retirement in 1967 as Professor of Biochemistry, initially in the Eye Institute, subsequently in the Department of Medicine. In 1967, he assumed a professorship in the Graduate College of Yeshiva University and has more recently started a third career in the Eye Institute of Columbia University. He remains active in research.

In his earliest work at Columbia on vitreous humor, Dr. Meyer isolated and characterized a polysaccharide he named hyaluronic acid. He studied its catabolism by bacterial and mammalian hyaluronidases, then known as "spreading factor." These experiments soon broadened to include studies of the related polysaccharides of other connective tissues. Eventually, starting with hyaluronic acid and the earlier described chondroitin sulfate, he was responsible for delineation of all of the presently recognizable classes of mammalian acid mucopolysaccharides (GAGs). This work, which was executed with simple techniques and few associates, was marked by outstanding energy, remarkable personal laboratory capability, and astute biological intuition. Dr. Meyer's unique contributions on the isolation, characterization, structural studies, tissue localization, and mode

of catabolism of the acid mucopolysaccharides represents the foundation for our present understanding of the proteoglycans. Additional areas of his scientific interest throughout a long and fruitful career have included, among others, studies of lysozymes, penicillin, sialic acid, and sulfated glycoprotein. Among his many areas of non-scientific interest should be particularly mentioned his enthusiastic involvement in the study of Jewish life and history.

## — Miles Partridge —

Dr. Miles Partridge was born in 1913 in New Zealand. He received his higher education in England, obtaining his Ph.D. in Chemistry from Battersea College of Technology in 1937. After spending a portion of the war years in India as an advisor to the Indian Government, he returned to the Low Temperature Research Station in Cambridge, in 1946. His interest in connective tissue developed early; in 1948 he published the first of what was to be a series of papers on the chemistry of connective tissue. This culminated in his review in 1962, of the then current state of knowledge of elastin, a work which remains one of the most comprehensive treatises on the subject. At the same time, he was one of the pioneers in the use of synthetic ion-exchange resins for the chromatographic separation of amino acids, peptides and proteins. These two interests were combined in the isolation of the crosslinking regions of elastin, and, in 1963, together with Thomas and Elsdon, he published the structure of the desmosine crosslinks. Dr. Partridge and his collaborators were subsequently instrumental in showing the derivation of the desmosines from lysine residues in the protein and the effect of lathyrogens and copper deficiency on the formation of these crosslinks.

When the Low Temperature Research Station at Cambridge was closed in 1968, Dr. Partridge moved to the more rural atmosphere of Langford, near Bristol, to the newly established Meat Research Institute of the Agricultural Council. There, he continued his work on elastin, contributing to the isolation and characterization of tropoelastin and the knowledge of the physical chemistry and structure of the protein. In 1968, he became Head of the Department of Biochemistry and Physiology of the Meat Research Institute, a position which he held until his retirement in 1978. In

1970, he became professor of Biochemistry at the University of Bristol, and, in the same year, received the notable honour of election as a Fellow of the Royal Society of London. Although now officially retired, Dr. Partridge still takes an active interest in the biochemistry of connective tissue, as well as acting as Chairman and Chief Warden of the Millstream House Trout Conservation Authority of Cheddar.

## — Albert Dorfman —

Albert Dorfman was born in Chicago on July 6, 1916. After primary and secondary education in Chicago public schools, he entered the University of Chicago in 1932, influenced in this decision by an English teacher who was herself a graduate student at the time. Dorfman received the B.S. degree in 1936, and continued his graduate training in the Department of Biochemistry, where he received the Ph.D. degree in 1939, before his 23rd birthday. Shortly after completing his thesis work, Dorfman established the role of pantothenic acid as an essential bacterial growth factor, an early accomplishment which was duly recognized and credited in Lipmann's Nobel address. Among other contributions from this time should be mentioned studies of the role of biotin in aspartic acid synthesis and the early suggestion that sulfa drugs might be effective by virtue of their ability to act as competitive enzyme inhibitors. For a long time, Dorfman had been interested in medicine and had actually been enrolled in the medical school of the University of Chicago since 1935. His interest in medicine was nurtured by a period of exposure to the hospital world through work as a biochemist in the Zoller Dental Clinic and by the difficulties he encountered in finding a suitable position with potential for advancement in a biochemical career. He, therefore, completed his medical training and received the M.D. degree in 1944. After an internship in internal medicine at Beth Israel Hospital in Boston, and residency in pediatrics at the University of Chicago, Dorfman joined the Army of the U.S. in 1946, and worked as Chief of Biochemistry in the Army Medical Department of the Research and Graduate School of the Walter Reed Medical Center until 1948. This is where Dorfman's interest in connective tissue research started to grow strong, and when he returned to the University of Chicago as Assistant Professor of Pediatrics, he

decided to develop a research group in the area of connective tissue diseases. Before long, Dorfman became Director of Research at the La Rabida-Jackson Park Sanitarium, which was devoted to the treatment of children with rheumatic fever. During this period, Dorfman was involved in one of the first clinical trials of ACTH in the treatment of rheumatic fever. Reflecting Dorfman's academic training, his research has always encompassed both clinically oriented studies and fundamental investigations of the biology of the connective tissues, with major emphasis on their proteoglycan components. From its modest beginnings in the early 1950's, the "Chicago group" moved rapidly to become one of the leading laboratories in the world in this area, and for many years it seemingly held a monopoly on studies of mucopolysaccharide biosynthesis. The Dorfman laboratory continues to lead in this area, and was the first to report the cell-free translation of mRNA for cartilage proteoglycan core protein a few years ago. In addition, important contributions have been made over the years in the area of chemical and physicochemical structural analysis. It may well be that the major strength in Dorfman's approach to research is his outstanding ability to apply, immediately and in a productive manner, the knowledge gained in the basic science area to the solution of clinically oriented problems. Following the advent of modern tissue culture techniques, Dorfman, in the mid-1960's, renewed his attack on a problem to which he had a deep commitment of long standing, i.e. the nature of the basic defects in the crippling and usually fatal diseases termed mucopolysaccharidoses. Among the first to use tissue culture methodology in the study of genetic diseases, Dorfman's group conducted a series of important investigations in this area which culminated with the finding that the Hurler syndrome is caused by a deficiency of L-iduronidase, one of the many lysosomal hydrolases participating in the catabolism of connective tissue proteoglycans. The Dorfman laboratory today remains at the forefront of connective tissue research and is engaged in the development and application of monoclonal antibody techniques for the study of proteoglycans and the cloning of the Type II collagen gene.

This marks the 50th anniversary of Dorfman's affiliation with the University of Chicago, where he has held many important positions, e.g. as Chairman of the Department of Pediatrics (1962-1972) and where he is currently the Richard Crane Distinguished Service Professor of Pediatrics and Director of the Joseph P. Kennedy, Jr. Mental Retardation Center. During his distinguished career, Dorfman has been the recipient of many awards and honors, among which may be mentioned election to the National Academy of Science. Most recently, Dorfman was the recipient of the Joseph Bolivar DeLee Medal for Humanitarian Accomplishments (1982).