



THE FACULTY OF MEDICINE
Harvard University

Paul Myron Gallop



The lives of some scholars are remembered for their public accomplishments, some for their teaching, some for their humanity, few for their selflessness. Paul Gallop is remembered for all of these qualities.

Paul was born in New York City on November 24, 1927. An A.B. in chemistry from the University of Pennsylvania was followed by a Ph.D. in Biophysics from MIT. Between 1957 and 1963 Paul Gallop rose from Assistant Professor to Professor of Biochemistry at Albert Einstein College of Medicine. In 1972 he was recruited to Harvard as Professor of Biological Chemistry at the Harvard School of Dental Medicine (HSDM) and Harvard Medical School. In 1974 he became Head of the Department of Oral Biology and

Pathophysiology at HSDM, in 1976 Professor of Biological Chemistry in the Harvard-MIT Division of Health Science and Technology, and in 1982 Director of the Laboratory of Human Biochemistry at Children's Hospital, all posts he held until his death on August 20, 1996 at the age of 68.

Throughout his scientific career Paul Gallop approached biology with an intense mix of chemistry and biochemistry and found them interdependent and autocatalytic. The recurrent theme and focus of his highly original research was on novel covalent modifications of protein structure. His conceptual contributions and new experimental findings were often preceded by the development of novel analytical methods. For example, he developed the application of the Lossen rearrangement of protein dinitrophenylhydroxamates to determine modification of gamma carboxyl and beta carboxyl groups of glutamate and aspartate residues, respectively, in proteins, the use of tritiated borohydride for the reduction of aldehydes in proteins for quantitation and functional characterization, a redox cycling assay with glycine and a tetrazolum dye for the analysis for pyrroloquinoline quinone (PQQ), and the reaction of diphenylborinic acid with amino acid residues and the crosslinking components of proteins for automated

*In tribute to their dedicated efforts to science and medicine, deceased members of the Harvard Faculty of Medicine (those at the rank of full or emeritus professor) receive a review of their life and contributions with a complete reflection, a **Memorial Minute**.*

analysis of these constituents.

From the application of these novel methods came an impressive series of new insights into protein structure. In semi-chronological order some of these included the following.

- Enzymatic demonstration that the collagen chains had the triad covalent structure of repeating Gly-X-Y in which the second position is frequently proline.
- The nature of the chemical crosslinks in collagen and their formation from aldehydes formed by oxidation of lysine residues, findings that occurred when almost the only recognized crosslinking residues in protein were the sulfhydryl groups of cysteine residues. These findings and methods provided the biochemical basis for elucidation by others of several genetic disorders of connective tissue protein structure.
- Discovery with Bookchin, Bunn and Gabbay that human hemoglobin A1c is derived from the nonenzymatic post-translational addition of glucose as a Schiff base to the N-terminal valine residues of globin β -chains. The importance of this discovery in monitoring glucose control in patients with diabetes mellitus was then demonstrated by Gallop and his colleagues and independently by Cerami's group.
- Based on the findings of Stenflo and Suttie on the gamma carboxylation of certain glutamate residues in prothrombin and the calcium binding properties of this structure, Gallop and Hauschka postulated and then found a protein in bone containing Gla residues. This protein, osteocalcin, is now used extensively as a plasma marker for bone formation in clinical and pharmacological studies.
- Development of the hypothesis that PQQ or a closely related compound is involved in complex I of the mitochondrial electron transport system. From this Gallop developed a theory explaining the actions of rotenone and thyroxine on respiration.
- Pioneer in emphasizing the importance of progressive post-translational modifications of proteins with aging.

This is an incredible array of scientific accomplishments which will clearly have a lasting impact on biochemistry and medicine. However, Paul Gallop will also be long remembered for qualities of his person. Paul Goldhaber, Dean Emeritus of the School of Dental Medicine, gives us his remembrance as follows.

“The decision to bring Paul Gallop to Harvard was one of the best I was ever involved in during my tenure as Dean of the Dental School. The expertise of Paul and his key associates, Mercedes Paz and Peter Hauschka, in the field of connective tissue and

bone filled a significant gap within the spectrum of research and teaching covered by our Department of Oral Biology and Pathophysiology. As Head of this Department, Paul brought a new dimension to the learning opportunities of both our predoctoral and postdoctoral students. His team frequently served as research mentors and many students and fellows were stimulated to pursue academic careers, subsequently.

“At our Executive Committee deliberations, his voice carried much weight because his arguments were always based on an intelligent blend of the highest standards of excellence, common sense, and concern for the welfare of individuals, be they faculty members or students.”

Other colleagues and friends have remembered Paul as follows.

Professor Pepper Davis of Albany Medical School: “Paul was the most creative scientist I know, and so wonderfully immersed in chemistry and in the excitement and joy of discovery. He understood with uncanny accuracy how things worked or could work. He was also without pretense in an era when self-absorption can become a regrettable personality trait.”

Professor Irving London of Harvard and M.I.T.: “Paul Gallop’s character and personality were reflected in his research and teaching. He was extraordinarily kind, generous and modest. He was inspirational to his colleagues, co-workers and students. He bubbled with an enthusiasm that was contagious. His wide-ranging intellectual curiosity and imagination were combined with intuition, originality and scientific rigor.”

Professors Ephraim Katchalski-Katzir and Avraham Patchornik: “Whenever we meet, here at the Weizmann Institute or in our homes, we always recall Paul’s scientific achievements, the many episodes in which he was involved, and his warm, friendly attitude toward everyone with whom he came in touch. We both loved Paul, admired him as an outstanding scientist and had the highest regard for his integrity, his love of people and his respect for the Jewish heritage.”

Professor H. Franklin Bunn of Harvard: “He infused his students, his own research group, and his colleagues with confidence that a knowledge of chemistry could unlock many secrets that were critical in understanding important biological and medically relevant problems.”

Dr. Mercedes Paz of Harvard: “Paul was never a follower; he always wanted to tackle new problems and create the tools to pursue new routes. His appetite for science was insatiable, and his curiosity had no limits. His capacity to remember reactions and

pathways was extraordinary, and he could establish relationships between old and new findings with remarkable naturalness and modesty. He was a constant source of inspiration and amazement.”

Dr. Peter Hauschka of Harvard: “Paul Gallop was the consummate scientific storyteller. He had a breadth of knowledge and insight which allowed him to present virtually any topic in chemistry, biology, or medicine as a rich tapestry of historical events, colorful personalities, and unusual or serendipitous discoveries of toxic agents. But the student would come away with something far greater than a scientific fact; one could not help but be overwhelmed by the eloquence, the scholarly integrity, and the gentle humanity of this superb teacher.”

Members of Paul’s family: “I’ve listened with pride (if not full understanding) as he synthesized information across disciplines, as he made connections no one ever made before, as his ideas catapulted through the air, fueled by his passion and conviction. I am so proud that his enthusiasm was always sustained by the most rigorous discipline and attention to the scientific method he respected and loved.

“Scientist, family man, humanist, lover of life, Dad embodied Aristotle’s dictum that happiness derives from the full use of one’s faculties along lines of excellence.”

Mel Glimcher, Gallop’s long-term friend and colleague at Children’s Hospital, captured the sense of many. “Paul’s arrival in our laboratories in the Department of Orthopedic Surgery not only stimulated a surge of original discovery and interaction amongst our faculty, but with his catholic, broad interest in all fields of biochemistry he catalyzed wide interactions among young scientists in many departments. He was forever enthusiastic and excited to learn of new advances in both science and music, and he always had time to discuss, to give insightful advice, and to listen.”

Respectfully submitted,

Elkan Blout

Melvin Glimcher

Paul Goldhaber

Irving London

Sam Seifter

Armen Tashjian, *Chairperson*

June 4, 1997