

Marshall Raymond Urist

1914–2001

Professor Marshall Urist, discoverer of Bone Morphogenetic Protein (BMP) and Director of the U.C.L.A. Bone Research Laboratory, died on February 4, 2001. He was 86 years old, active in Orthopedic science until the last year of his life. He died at his home on Amalfi Drive in Pacific Palisades, cared for by his wife Alice and daughter Nancy Miller.

Marshall Urist was born on June 11, 1914 and grew up on a small farm in South Haven, Michigan. After graduating from the University of Michigan, he spent a year of graduate work with Franklin C. McLean, Professor of Physiology at the University of Chicago. Thus began a personal friendship and collaboration in bone physiology which lasted until Franklin McLean died in 1968.

From 1937–1941, Marshall Urist earned his medical degree at Johns Hopkins University in Baltimore, Maryland. After a year of residency in Orthopedics, he participated in the War effort serving as Orthopaedic Surgeon in U.S. Army hospitals in England and Germany 1944–45. Never only interested in basic research, he wrote several papers on open hip injuries and was awarded the Sir Henry Wellcome Award for his contributions.

After the war, he completed his training in orthopedics at Massachusetts General Hospital. In 1947, he moved to Chicago to resume his collaboration with Franklin McLean at the Department of Physiology and Research. His experiments focused on osteoporosis and hormone regulation of bone

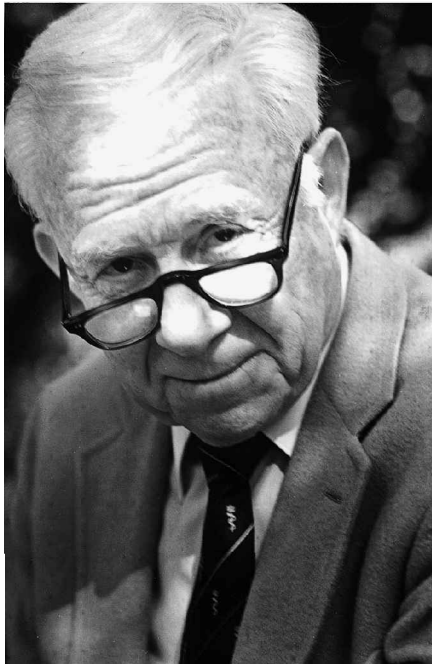
homeostasis. In July, 1948, he moved west, and set up practice in Los Angeles and secured a position on the staff at U.C.L.A. With grants from a private foundation, he set up the Bone Research Laboratory in a shed just off campus in Wilshire. His research on estrogen and calcium regulation made him an expert on the part played by the skeletal system in relation to egg production in birds. He was also interested in how fish could maintain

a constant calcium level and conducted field studies in the Pacific Ocean and on Nicaraguan fresh water sharks.

The regeneration of bone had intrigued Marshall Urist since graduate school after reading a book by Leriche and Policard, two French military surgeons, written after World War I. The authors speculated on *le jus lapidifique* (the juice of stonemaking) generating bone in muscle. The phenomenon of heterotopic bone formation was described by Neuhof in 1917 and in a beautiful series of experiments by Charles Huggins (1931) on uroepithelial tissue of dogs. In the Bone Research Laboratory, Marshall Urist devoted his energies to explaining this phenomenon by implanting

demineralized bone matrix into soft tissues of experimental animals. These experiments were reported in *Science* (1965) *Bone: Formation by autoinduction*, where Marshall Urist not only described the principle of bone induction, but foresaw the implications for developmental biology, as well as orthopedic surgery.

Marshall Urist called the bone inductive principle BMP, Bone Morphogenetic Protein, and spent the next three decades in isolating and purifying



BMP. The scientific community remained sceptical to the evidence for BMP and did not appreciate the importance of his discovery. Cloned for the first time in 1988, BMP proved to be a member of the TGF-beta (Transforming Growth Factor) superfamily of cytokines. There are now more than 30 different BMPs recognized in a variety of species, ranging from flies to mammals. BMP has been shown to play specific roles in the normal development of bones and also nonskeletal connective tissue. BMPs produced by recombinant DNA techniques are used in clinical trials to improve fracture healing and for spinal fusions.

Marshall Urist was editor of *Clinical Orthopaedics and Related Research* 1966–1993. His readiness to recognize new and creative findings led to early publication of articles, such as Charnley's total hip arthroplasty and Ilizarov's studies on distraction osteogenesis, considered too controversial by other editors. Marshall Urist's interest in history and flair for new developments were evident, with both reprints of classical articles and a strong basic science section. In CORR, the submitting authors never had to defend their submission with a paragraph denoting the clinical relevance of their experiments.

Many aspiring orthopedic surgeons and dentists from around the world spent a year or more working on the BMP saga at the Bone Research Laboratory. Marshall Urist had close ties to Scandinavia, through his 40-year friendship with Göran Bauer and many others. Gissle Bang (1965), Klas Buring (1967), Henrik Bauer (1979), and Olle Nilsson (1983) were research fellows in the Bone Lab and were welcomed into the Urist family. Marshall Urist had unique qualities as a mentor, drawing the young investigator into his thoughts and shar-

ing responsibility as well as decision making. He maintained an affectionate interest long after the research year was ended, inquiring about family and encouraging continued research.

Marshall Urist visited the Scandinavian countries on many occasions as guests of the national orthopaedic societies and the Scandinavian Orthopedic Association. Among his many honors, he was awarded a Ph.D., honoris causa at the University of Lund.

Marshall Urist had a one-track mind—and that track was science. He was fascinated by all things living and how they work and had no doubt that research was the basis for progress. On a reprint from the *J Bone and Mineral Research* (1997): Bone morphogenetic protein: the molecularization of skeletal system development, he scribbled on the front: *Dear Henrik: "The past is prologue", Devotedly, Marshall.* An enviably optimistic view of the world at the age of 83.

Although every day of the year was consumed by the quest for BMP, he had many other interests: the garden, sports, literature and the movies. Even these interests required knowledge and expertise. There was little place for amateurism in Marshall Urist's life. In 1965, he acquired an avocado ranch, Bone Hill, in the hills east of San Diego. In later years, he and Alice collected their three children, Marshall, Nancy and Baxter, in-laws and eight grandchildren for Thanksgiving, 4th of July and Labor Day weekends. His wit, intelligence and warmth will be long remembered and greatly missed by his family and friends in the orthopedic community.

Henrik Bauer and Olle Nilsson