Giants of Orthopaedic Surgery

Giants of Orthopaedic Surgery: Melvin J. Glimcher MD

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David R. Eyre was a newly minted PhD in biochemistry from the University of Leeds when he joined Melvin Glimcher's lab in 1971. Eyre's new lab in Boston, MA, USA was a far cry from his previous one in the United Kingdom, where he routinely had to hunt for well-worn equipment. Glimcher's lab

featured cutting-edge resources from state-of-the-art protein sequencers to electron microscopes and nuclear magnetic resonance equipment. There was an entire floor dedicated to biochemistry. The lab housed more than 100 scientists, a large program for its day, providing an atmosphere that encouraged collaboration. His lab was even a research center for the training of senior scientists and postdoctoral fellows who wished to develop their own research centers in the basic sciences and musculoskeletal system [9].

"The size and scale of the lab was like nothing I had ever seen before," Eyre told *CORR*® in a phone interview. "No one had a lab of this scale. It takes a quite exceptional person to lead a lab of that magnitude."

Melvin J. Glimcher MD was that person (Fig. 1). The scale of Glimcher's educational background and professional experience matched the scale of his lab. The first tenured Chair in Orthopaedic Surgery at Harvard Medical School at the age of 39, Glimcher was also Chief of Orthopaedic Surgery at Massachusetts General Hospital and Boston Children's Hospital in Boston, MA, USA. His work in orthopaedics, clinical medicine, biology, mechanical engineering, and the basic sciences

afforded him the opportunity to collaborate with exceptional scientists using the most advanced technological tools of the day.

"The lab, and more specifically, Glimcher himself, could infuse you with his enthusiasm," Eyre said. "You were on the cutting edge of everything. This was high-level basic research. It certainly sparked my interest in research."

Glimcher's decision to pursue a career in orthopaedics reportedly was based on a conversation he had with one of his professors, who told him that orthopaedics was a "barren field" [6]. But Glimcher seemed to understand the potential in orthopaedics early on, and quickly recognized where the field was headed. In 1966, Glimcher told *The Boston Globe*, "Orthopaedics in the future will not be simply surgery, or medicine, but a combination of both plus knowledge of the whole area of skeletal structure, its biology, chemistry, and biomechanics" [13].

"He thought he could really make a difference in the field," Laurie Glimcher MD, his daughter and Stephen and Suzanne Weiss Dean of Weill Cornell Medical College in New York, NY, USA told *CORR*® in a phone interview.

Note from the Editor-In-Chief: In "Giants of Orthopaedic Surgery," a columnist explores the life and achievements of an orthopaedic surgeon who changed our profession, by interviewing other surgeons whose lives the "Giant" touched through mentorship or collaboration, or by using other historical sources that provide similar insight. We welcome reader feedback on all of our columns and articles; please send your comments to eic@clinorthop.org.

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Fig. 1 The scale of Glimcher's educational background and professional experience matched the scale of his lab. Published with permission from Boston Children's Hospital.

A Broken Hip and The Boston Arm

The Boston Arm—the first artificial upper-extremity limb to use myoelectric signals from the brain to control movement—was one of Glimcher's key contributions, and by any definition, it was a difference-maker. The device moved when small electrical impulses, generated from the brain to the muscles of the residual limb, activated the prosthesis. The unveiling of the Boston Arm made national headlines, even hitting the front page of the

New York Times on September 13, 1968 [12].

The development of the artificial limb was 6 years in the making. As a consultant for the Liberty Mutual Insurance Company, Glimcher was tasked with finding an adequate way to rehabilitate those with upper extremity amputation so they could eventually rotate back into the workforce [14]. At the time, he had been frustrated by the body-powered upper extremity terminal devices available for above-elbow amputees. Users of the body-powered

devices found them inefficient and unwieldy. Luckily, Norbert Wiener had just broken his hip. Wiener was a world-renowned mathematician and considered the father of cybernetics, which Wiener defined in his book as “the scientific study of control and communication in the animal and the machine” [15]. He also happened to be Glimcher's patient. As the pair talked, they became more and more intrigued by the possibility of building a device that could be linked to the brain. Glimcher even visited the Soviet

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Union and observed a myoelectric hand prosthesis in person [14]. His discussions with Weiner eventually progressed into a joint project with MIT, Harvard Medical School, Massachusetts General Hospital, and Liberty Mutual Insurance Company [11]. Among those on the development team included MIT mechanical engineer Robert W. Mann, who had previously worked on the Sparrow air-to-air defense missile for the US Air Force [5, 7]. The team's mission was to give above-elbow amputees the opportunity to use functional devices. The developers, led by Glimcher, believed their device would do just that. At their press conference the developers called the Boston Arm "a striking example of the relatively new science of biochemical engineering" [12].

Was the Boston Arm a complete success? In practice, the battery-powered Boston Arm was bulky and awkward, requiring many iterations before amputees seriously considered using the device. When amputees donned the updated versions, users found the artificial limb helpful at work, but still rather heavy and noisy [14]. One could argue those issues still confound researchers today [1]. The value of the Boston Arm was, and still is, in its science. Myoelectric devices are now commonplace in the prosthetics field and direct descendants of the Boston Arm are still being made.

His Lifelong Passion and a Lasting Legacy

According to Laurie Glimcher MD, for all that is written about the Boston Arm, her father's research on the biochemistry of bone—how the bone calcifies and the mechanisms behind this calcification—are some of his "proudest achievements."

Glimcher spent more than five decades researching the chemistry that produces bones, publishing more than 200 articles [8]. His research included basic bone mineralization, in which he wrote seminal papers on the packing of mineral crystals in bone collagen fibrils [2], as well as structural and chemical characteristics of the calcium-phosphate crystals formed during the calcification of bone [10]. He also performed influential research on the osteonecrosis of the femoral head, which won a Nicolas Andry Award from the Association of Bone and Joint Surgeons® [3].

"If you look through his papers, the common thread, that is, what he would consider to be his lifelong work, was understanding the mechanisms and the composition of bones," Eyre said.

Marc Gryn timer PhD, Director of the Bone and Mineral Group at the University of Toronto worked with Glimcher for 5 years at his lab in Boston Children's Hospital from 1977 to 1982. He called Glimcher one of the main contributors to the bone composition and biomineralization field.

"He was completely dedicated to advancing the field," Gryn timer said. "Out of his lab came a whole new generation of brilliant scientists who continue to work on bone composition, bone metabolism, and bone evolution—how the bone evolves from an embryo to old age. That is his lasting legacy."

Mentor

Jerome L. Ackerman PhD, Associate Professor of Radiology, at the Harvard Medical School, worked with Glimcher in the latter part of his career. Already established as the preeminent name in orthopaedics, Glimcher still pushed hard, wanting more and more data, according to Ackerman.

"Every day was a fun and interesting challenge," Ackerman told *CORR*® in a phone interview. "He was a rather strong-willed individual. He could cut you down to size if he had to. But in the end, he was probably right, anyway."

Their paper [16] found that solid state-3D MRI was more advantageous than other imaging techniques for synthetic calcium phosphates and bone. They developed a new approach to "characterize bone by a method that is sensitive to the chemical composition and structure of bone apatite crystals" [16]. The novel method

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described in their paper could potentially provide the true volumetric mass densities of bone mineral and matrix, independently [16].

Like Ackerman, Jochen G. Hofstaetter MD, Associate Professor in Orthopaedics at the Orthopaedic Hospital Vienna-Speising in Vienna, Austria, collaborated with Glimcher late in his career. Whenever there was a discussion about a “hot topic” in orthopaedic research, Glimcher would pull out a paper or abstract that he published 30 years prior that dealt with a similar topic.

“For me as a young aspiring orthopaedic clinician-scientist, it was a blessing to get the opportunity to work with and learn from him,” Hofstaetter wrote in an email to *CORR*®. “He always took his time to discuss research and I greatly benefitted from his tremendous research experience, as well as his research network. The unbelievable amount and quality of research that he has done throughout his life was what impressed me the most.”

Laurie Glimcher, who has two other sisters, often visited her dad while he was in the lab conducting research.

“In his day, it was not common to mentor young women,” she said. “But he did it anyway. He was a champion for women in science. Family-wise, there was no question that my sisters

and I were expected to have careers of our own.”

Laurie and her father became the first father-daughter duo to hold a Chair at Harvard Medical School. In fact, Laurie won the Soma Weiss Award for medical student research exactly 26 years after her father won the prize. They even worked together on a paper when Laurie and her team deleted a gene called *Schnurri-3* in mice. Surprisingly, the mice started to grow bone [4].

The first call she made was to her dad.

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