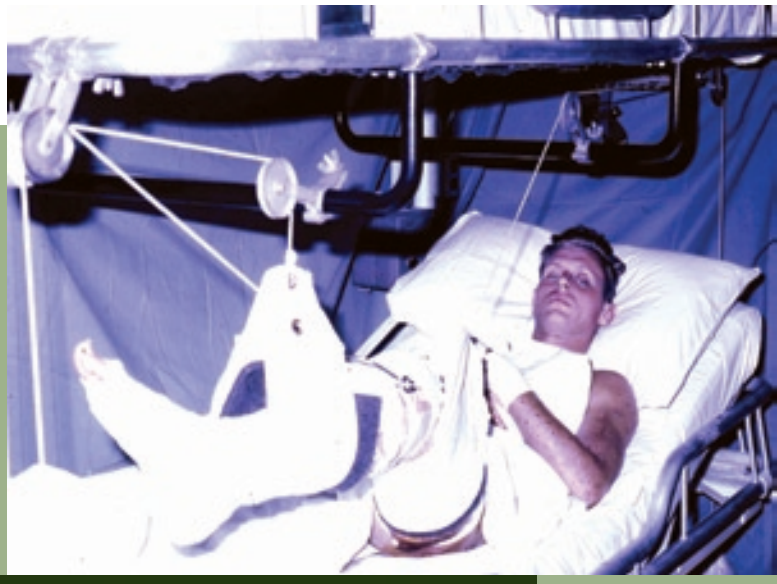
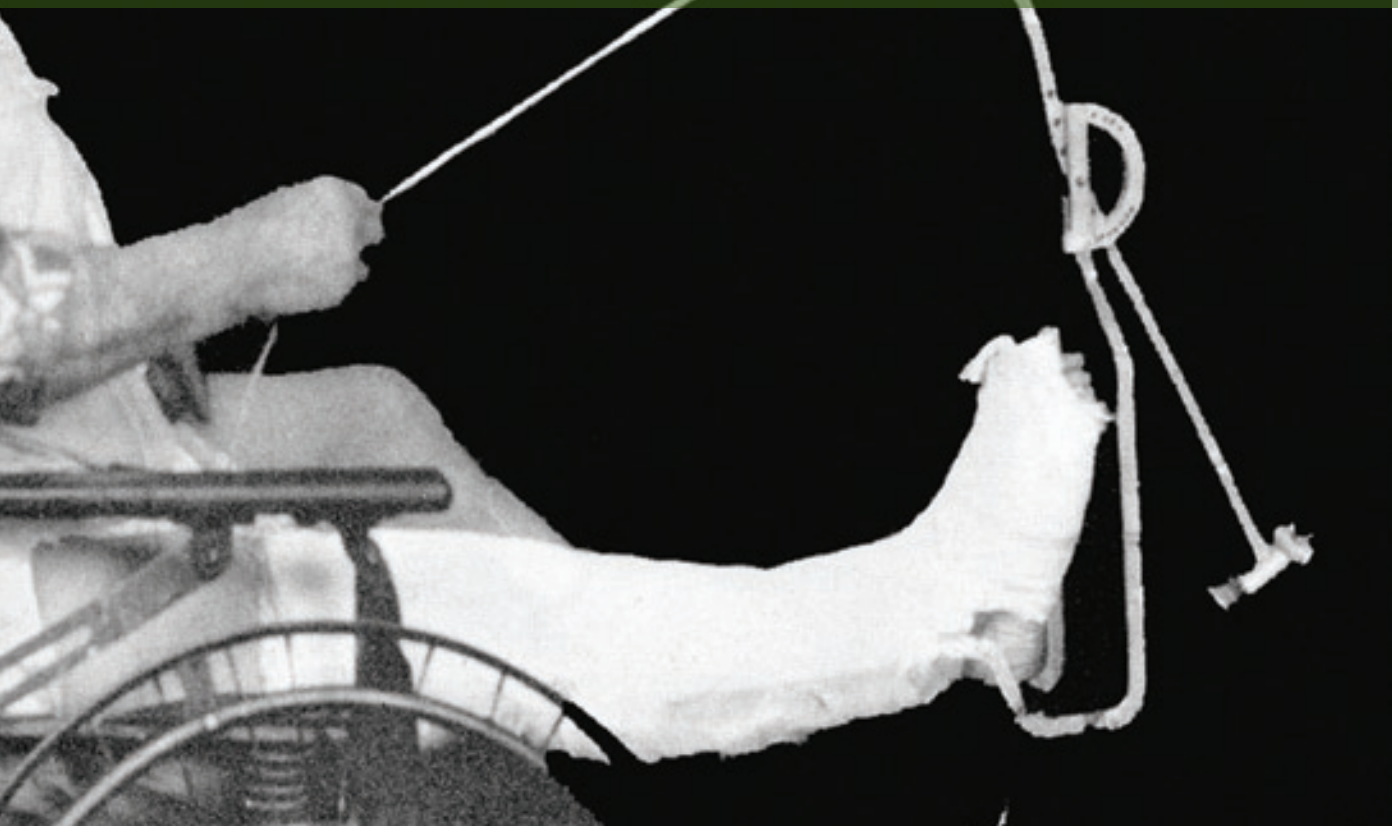
THE REWARDS OF CURIOSITY





▲ The inspiration for Dr. Brighton's research dates to 1962 when, on rounds with department chair Paul C. Colonna, M.D., a patient visit dramatized the need to find a way to help patients with nonhealing fractures. [Colonna, Paul C. *Regional Orthopedic Surgery,* p. 425, Fig. 320. W.B. Saunders Co., 1950.]

While the USS Sanctuary was in New Orleans, preparing to sail for DaNang, Dr. Brighton directed the design, manufacture, and installation of traction devices for use in treating open fractures of the femur.

Carl T. Brighton, M.D., Ph.D. has been interested in science ever since he received a Gilbert chemistry set one Christmas when he was 10 or 11 years old. Dr. Brighton hasn't been far from a laboratory since. In 1953 he graduated from Valparaiso University in Valparaiso, Ind. where he majored in both chemistry and zoology.

He gravitated east to the University of Pennsylvania School of Medicine (Penn), Philadelphia, where he earned his medical degree in 1957, and spent the first 5 of the next 10 years in the U.S. Navy at the Philadelphia Naval Hospital, completing his residency in orthopaedic surgery in 1962. Except for the 5-year active duty component of his Navy service that followed his residency, Dr. Brighton treated patients, taught, and conducted research at Penn continuously from 1968 until 1993. Currently the Paul B. Magnuson Professor Emeritus of Bone and Joint Surgery, Dr. Brighton joined the Penn Department of Orthopaedic Surgery faculty in 1968 as an assistant professor and director of orthopaedic surgery research, and set up the department's laboratory. He moved up the academic ladder steadily, and in 1977 was named department chair. Dr. Brighton continued as department chair and director of the research lab until 1993, when he became editor of *Clinical Orthopaedics and Related Research*, the official journal of the Association of Bone and Joint Surgeons, a position he held until 2003.

THE BRIGHTON RESIDENCY MODEL

When Dr. Brighton was named department chair at Penn, programs across the United States included 2 years of internship/general surgery followed by 3 years of orthopaedic studies with no research requirement. Against this template, which is still the norm, Dr. Brighton pared back Penn's clinical education requirement to make room for a 1-year research rotation. The resulting program at Penn was: 1 year of general surgery, 1 year of orthopaedic research, and 3 years of clinical orthopaedic surgery training.

▲ Carl T. Brighton, M.D., Ph.D., 2009 recipient of the ORS–OREF Distinguished Investigator Award.

"I decided that all residents should go through a program where they can learn to conduct basic research because it teaches them to think critically. Finding the funding wasn't easy, but it was worth it to be able to invest in the next generation," said Dr. Brighton.

According to a survey published in *Clinicial Orthopaedics and Related Research* in 2006,* 75 or 59% of Penn residents who graduated during Dr. Brighton's tenure as chair, took faculty positions following completion. Today, those faculty members include a fair number of department chairs: eight and counting. While Dr. Brighton did not envision his residency curriculum as a way to cultivate academic orthopaedists, the fact that he trained and mentored so many is one validation of the model.

Dr. Brighton remains actively engaged in the work of the research lab he established at Penn. He continues to conduct basic research that shows that specific electrical fields regulate selected gene expression in bone and articular cartilage cells.

Dr. Brighton has participated in and served as an officer for a range of professional and scientific societies and committees. He has served as president of the Bioelectrical Repair and Growth Society and the Orthopaedic Research Society (1981); as chairman and on the AAOS' Advisory Committee on Research (1974-1981) and Basic Science Committee (1979-1985); and on the Merit Review Board for Rehabilitative Engineering Research and Development Service, Veterans Administration. He also served as a member of the NIH National Institute of Arthritis and Musculoskeletal and Skin Diseases Advisory Council.

Photos provided by Carl T. Brighton, M.D., Ph.D.

HONORED AS 2009 ORS-OREF DISTINGUISHED INVESTIGATOR

Following many earlier honors, Dr. Brighton's long and productive career as an orthopaedic surgeon, researcher, mentor, leader, and academic colleague led to his being named recipient of the 2009 ORS-OREF Distinguished Investigator Award given annually by the Orthopaedic Research Society (ORS) and OREF.

The award reflects his foundational work as a clinician scientist in electrobiology, including basic and clinical research that established electrical stimulation as an effective therapy for nonunions. Treatments uncovered through Dr. Brighton's research have restored mobility to patients who otherwise might be seriously impaired.

THE ENCOUNTER THAT LAUNCHED A LIFE'S WORK

Dr. Brighton's seminal "aha" moment came in his fifth year in residency at Penn while making rounds with Department Chair **Paul C. Colonna, M.D.** "We came to a patient who was sitting in a wheelchair with one leg in a cast, fully extended," Dr. Brighton recalled. "Connected to the cast was a rig with a long arm suspending a hammerhead. The patient tugs on the rope to pull the hammerhead back, then releases the rope and the hammerhead strikes his heel through a hole in the cast at that location. I said, 'Dr. Colonna, what in the world is going on here?'"

Dr. Colonna's explanation, that he used this treatment as a response to the patient's delayed healing of the tibia as a means of stimulating a union, piqued Dr. Brighton's curiosity. "I said, 'How does that work, Dr. Colonna?' He said he didn't know but that obviously a physical force must somehow be stimulating a physiological response that has a positive effect on fracture healing." This was the beginning of a lifelong interest of Dr. Brighton in biophysics and how it can be applied to bone and cartilage growth and repair.

UNCLE SAM'S PLAN

In 1962, upon completing his residency training at Penn, Dr. Brighton was ordered to the Great Lakes Naval Base located north of Chicago to fulfill his commitment to 5 years of active duty as part of the Navy Medical Corps.

At first, the caseload was modest. The United States had begun ramping up its presence in South Vietnam, but was 2 years away from dispatching combat troops. Dr. Brighton decided to pursue a Ph.D. in biophysics at the University of Illinois, Chicago Circle.

A NEW SOURCE OF HEALING

Dr. Brighton devised a series of in vitro experiments that he hoped would establish a cause-and-effect relationship between the use of electronegative stimulation and bone growth, and in 1965 successfully applied for an OREF Research Grant. This study led to a simplified method for studying the effect of direct current on bone formation in the medullary canal of the rabbit tibia and proved to be the foundation for uncovering new alternatives for patients with nonhealing fractures.

Soon, a steady stream of seriously wounded service personnel began arriving at Great Lakes. "Wounded Marines would undergo initial surgery and debridement in Vietnam, then be flown to the United States and arrive at one of the big naval hospitals, usually within 36 hours. Marines from the Midwest would end up at the Great Lakes Naval Hospital," explained Dr. Brighton. "That's where I learned how to deal with traumatic amputations and battlefield wounds."

A NEW THEATER OF OPERATIONS

As the war intensified and the number of wounded troops increased, medical teams were needed in the war theater. In 1966, Dr. Brighton bid farewell to his wife, Ruth, and their four children and went to New Orleans where he boarded a hospital ship, the USS Sanctuary. Destination: DaNang, Vietnam.

"I was chief of the orthopaedic service and the only orthopaedic surgeon on the ship, but was fortunate enough to have **Ralph Wicker, M.D.**, a second-year resident in neurosurgery as my assistant. Together with 22 hospital corpsmen, we formed the Orthopaedic Division of the ship."

The ship was well equipped, but not fully ready to accommodate corpsmen with traumatic orthopaedic injuries. "I noticed right away the ship didn't have traction devices for use in treating open fractures of the femur. If a femur is shattered from a gunshot or land mind, the muscles

of the thigh tend to shorten up and it's hard to keep the bone lined up. So while we were still in New Orleans, we designed a bar with pulleys to be clamped to the underside of a bunk bed to provide needed traction for the patient in the bunk below."

Once in theater, the Sanctuary's orthopaedic division admitted a steady stream of patients. "The ship would slowly sail from DaNang north to the DMZ (demilitarized zone) and back," Dr. Brighton said. "Along the way, helicopters would fan out to pick up the wounded and bring them to us. The ship would keep sailing back and forth between DaNang and the DMZ until there was no longer any room for additional patients. The ship would then sail to the Philippines, where the wounded would be off-loaded to be flown back to the United States."

Twelve hours on, 12 hours off was the routine schedule for all surgeons aboard. But when the ship was attached to Operation Hickory Nut in the spring of 1967, Dr. Brighton consulted with his assisting surgeon, Dr. Wicker, and they agreed that to keep up with the expected number of incoming orthopaedic trauma patients from that battle, they had to operate continuously.

"I told the commanding officer of the Sanctuary's hospital, 'We're going to operate throughout the whole duration of the military operation.' He said, 'You might be operating 36 hours in a row.' I replied, 'I know that, but that's what we'll have to do. If we can have a hot meal sent down to the OR for Ralph and me every six hours, I think we can keep going.' We did that twice through two different battles. We did get tired. But we were so ginned up when we saw the severity of the wounds we were dealing with that we were energized to keep going. Later we learned that less than 1% of the wounded who were alive when the helo landed on the ship's deck died from their wounds."

BACK TO THE PENN LAB

In 1967, having fulfilled his military obligation, Dr. Brighton returned to civilian life and his professional home, the Penn Medical School. While he was still on the ship he applied for a Special Postdoctoral Research Fellowship from the NIH, to be activated when he returned home. "I was fortunate enough to receive the research fellowship, such that I could complete the research required for the Ph.D.," said Dr. Brighton.

The NIH has been among the constants in Dr. Brighton's career, providing nearly continuous funding for his research from 1971

COLD WAR OR NUCLEAR WAR?

Having entered the U.S. Navy right of out of medical school in 1957, Dr. Brighton was winding up his residency at the U.S. Naval Hospital in Philadelphia in 1962, knowing he would soon begin serving 5 years of active duty somewhere on the globe.

In the fall of 1962, the United States learned that the Soviet Union and Cuba had placed nuclear missiles in Cuba. By October, the United States and the Soviet Union were on the brink of nuclear war.

"We were put on alert, but didn't know why," Dr. Brighton recalled. "A few days later, the alert level escalated. Then, all of a sudden, we were told to leave the hospital, go home, and make sure we had a signed power of attorney statement in place. By the time I got back to base we were on two-hour alert, which quickly turned to one-hour. We knew we were going into combat or on our way to treat wounded Marines somewhere."

"We got the 'go' signal. I said goodbye to my wife and kids. Our trauma team sat on the shipping dock at the Philadelphia Naval Hospital all morning, just waiting. We couldn't move because Strategic Air Command bombers had taken over the Philadelphia International Airport. We were told that those bombers all had atomic missiles. So, we sat some more. Finally, the Russian ship carrying atomic missiles to Cuba stopped, turned around, and went home. So we could go home. That's how close we came to an atomic war."

As of this writing, eight current and former orthopaedic department chairs performed 1-year research rotations as part of their training at Penn:

John M. Cuckler, M.D.
University of Alabama

Ranjan Gupta, M.D.
University of California, Irvine

Joseph P. Iannotti, M.D., Ph.D.
Cleveland Clinic Foundation

Richard D. Lackman, M.D.
University of Pennsylvania

Joseph M. Lane, M.D.
University of California, Los Angeles

Claude E. Nichols III, M.D.
University of Vermont

Yoichi Sugioka, M.D., Ph.D.
Kyushu University, Japan

Sam W. Wiesel, M.D.
Georgetown University

▲ On board the USS Sanctuary, Dr. Brighton, chief of orthopaedic service (center, front row), Dr. Wicker, assistant chief (left, front row), and the hospital corpsmen of the ship's orthopaedic division.

*Bernstein J, Ahn J, Iannotti JP, Brighton CT. The Required Research Rotation in Residency: The University of Pennsylvania Experience, 1978–1993. *Clinical Orthopaedics and Related Research*. 2006;449:95–99.

***The Journal of Bone and Joint Surgery*, 2008.

to 1998 through multiple awards and grants, including the prestigious Method to Extend Research in Time (MERIT) Award. Other sources of funding for Dr. Brighton's research include Kappa Delta, OREF, and ORS.

MORE BRIGHTON MARKS OF DISTINCTION

Dr. Brighton is also distinguished by his success in securing a steady and significant stream of funding for the Penn laboratory. "During my last 5 years as chair, our Department of Orthopaedic Surgery at Pennsylvania was ranked No. 1 for total funding awarded by NIH," said Dr. Brighton.

Penn-trained orthopaedic surgeons recall other lessons learned from Dr. Brighton. **Sam W. Wiesel, M.D.** was among the first residents trained by Dr. Brighton, at Penn from 1971 to 1976. Today, Dr. Wiesel is professor and chair, Department of Orthopaedic Surgery, Georgetown University, Washington, D.C. "Dr. Brighton was totally involved with the research on how bone healed. But my real memory of our time together was that he was always upbeat," recalled Dr. Wiesel. "Regardless of what was happening — for example, having to close the lab after it was compromised by fungus — Dr. Brighton remained positive. His glass was always half full. As he used to tell me, 'optimism is a weapon.'"

Starting with healing a 15-month-old ankle fracture of the medial malleolus in 1970 — the first successful treatment of a human nonunion through electric current — Dr. Brighton has developed effective electrobiological therapies for patients whose bones fail to heal.

Along the way he has secured a wealth of patents, all assigned to Penn. Dr. Brighton cites a series of six patents, issued from 2006 through 2008, that represent a new method of treating osteoarthritis (OA). With specific, small electric fields, the expression of selected genes that make articular cartilage can be up-regulated and the expression of selected genes that destroy cartilage can be down-regulated in full-thickness articular cartilage OA explants obtained at the time of total knee replacement.** ■

Photo provided by Carl T. Brighton, M.D., Ph.D.