Carl W. Walter, MD: Surgeon, Inventor, and Industrialist

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Carl Waldemar Walter—I met him first in the dog surgery course at Harvard Medical School in 1942. We had smeared an unpleasant mix of lamp black and salad oil on our hands and forearms and were blindfolded. He told my fellow students and myself to step to the surgical scrub sink and show him that we could scrub clean our hands and arms. My first attempt was extremely poorly performed, and Carl Walter let me know in his inimitable style, that I would have to do a better job of scrubbing if I were to carry my patients through operations without the occurrence of sepsis and possibly death. I then lost track of him for several years, but when I returned to the Brigham in 1948, there he was again, pleading, cajoling, and even sermonizing in a messianic manner in his crusade against sepsis in the operating room. He had startling slides that showed things the eye cannot catch; swirling currents of bacteria-laden air passing from patient to patient and from surgeon to patient, down hospital corridors, and into "clean" operating suites. In later years, he once told me that he derived the normal satisfaction that comes from helping sick patients on a one to one basis but that his greatest joy was in the knowledge of his contributions to many thousands of patients through his work in controlling operating room environmental sepsis.

Carl Walter was born in Cleveland in 1905, the son of Carl Frederick and Leda Agatha Walter. His paternal grandfather was a German evangelical Lutheran preacher from Prussia. His father, early on, was a minister himself, then a sales engineer and finally in later life a stockbroker (Figure 1). His mother, a one-time schoolteacher, was a proponent of women's liberation.

Carl went to high school in Cleveland and worked as a telephone company lineman during most of his spare time; however, he also found time for the track team. As a quarter miler with good grades, he caught the attention of Dr. Elliot C. Cutler, then professor of surgery at Western Reserve University and chairman of the Harvard Club and the Cleveland Scholarship Committee. Carl had applied to Yale and Michigan and received a promise of handsome scholarships at each of those illustrious institutions; however, he chose to go to Harvard where the scholarship was less impressive. To help pay his way through college, he did house painting, clean-up jobs, gardening, was a dishwasher at Harvard Law School, and did odd jobs there. He says that Lincoln's Inn was noted for its "exquisite garbage." He managed the security staff ticket takers, and ushers at the Harvard stadium. He also ran the quarter mile during his freshman year. As Carl put it, "What else did I do in college? I got sophisticated and educated and came to know classmates such as educator William Saltonstall, lawyer Donald Hurley, newspaperman Victor Jones, real estate man Bob Henneman, and former Harvard University president Nate Pusey."

Graduating cum laude from Harvard College in 1928, he thought briefly of a career in his undergraduate major, chemistry, but instead, applied to Harvard Medical School. Dr. Elliot Cutler had decreed that his protege would "go to medical school instead of being a chemist," and wrote a letter to Dean Worth Hale to expedite the inevitable. Carl Walter was interviewed on May 1st and admitted on May 5th, a significant variation on the admission theme of today. While in medical school, Carl worked in the chemistry laboratory of Dr. Al Hornor. An attempt was made by Dr. William E. Ladd, pediatric surgeon at the Children's Hospital, to inveigle him into pediatric surgery, but Dr. Cutler "usually got what he wanted," so Carl Walter ended up as a surgical intern at the Peter Bent Brigham Hospital in 1933. He remained there for 40 years, until his retirement in 1973.

It was in his early years at the Brigham that Carl became interested in the problem of surgical sepsis. On Dr. Henry Christian's medical service, intravenous fluid therapy was not allowed because of the pyrogen reactions that resulted. Often, patients would be transferred to the surgical service for fluid therapy and then returned to the medical service after correction of their fluid needs. Carl decided to try to eradicate the common problem of chills and fever that resulted from parenteral fluid therapy.

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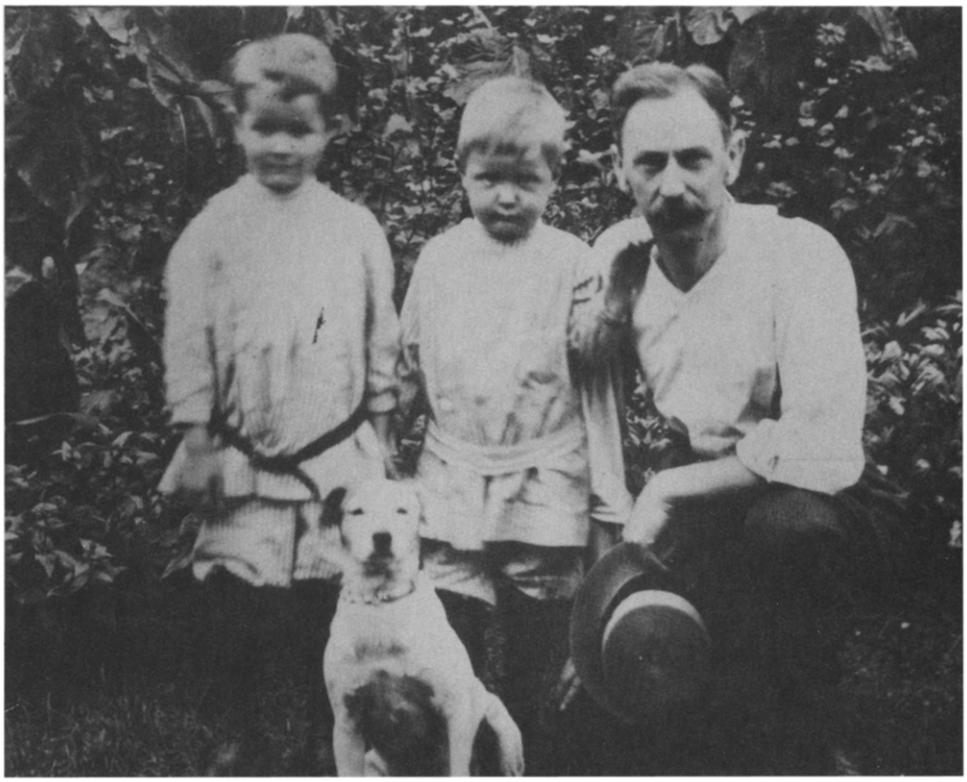

Figure 1. Two of Carl W. Walter's persistent avocations, gardening and dogs, are illustrated in this photograph taken in 1912 at the Walter home in Cleveland, Ohio. Left to right, Carl, brother Paul, father Carl Fredrick Walter, and foreground, the family dog, Gyp. Ulceration due to a rubber band encircling Gyp's leg kindled Carl's interest in medicine.

Having a flair for things mechanical, he immediately went to work devising tubing, vents, flasks, and needle adapters. The MacAllister-Bicknell Company accepted his designs for production, and later, Corning Glass adopted his design for flasks that could be easily sterilized and centrifuged. Carl Walter described a patient of Harvey Cushing's who had a cerebral aneurysm and was losing blood. An attempt was made to give the patient a direct transfusion, but the operating room looked like a slaughterhouse before the surgery was over, and the patient received very little of the blood into his bloodstream. During World War I, the Rockefeller Foundation had developed a sodium citrate blood collection technique. Carl, who was then assistant resident, applied the technique to developing a blood bank at the Brigham. From those early innovations came his flourishing interest and productivity in the allied fields of intravenous therapy and control of environmental sepsis.

I interviewed Carl in his office at the Medical School where he is presently chairman of the Harvard Medical Alumni Fund. There is a large potted snowflake aralia in one corner of his office and on the wall, two excellent drypoint etchings by dentist-artist Lawrence Baker, one of Dr. A. Lawrence Lowell, a former patient of Carl's, and the other of Charles Darwin. Behind Carl's desk, on one of the bookshelves, a 1947 *Fortune* ad showing Chesney Bonstell's conceptualization of a lunar landing and beneath it the words, "Fenwal will be aboard."

In the early 1930s, Carl became intrigued with providing the proper conditions—mainly sublethal temperatures—to stimulate melanomas in golden moons, a delicate breed of fish. As it happened, Carl became acquainted with William J. Turenne, who had developed a high precision thermostat, and the two men worked to adapt it to control the temperature bath for the fish. This was the serendipitous beginning of a close association and partnership that was later to develop into a large business enterprise. Thomas Legare Fen, a Boston investment counselor, joined the group, assuming, in part, the role of financier. This small company was named Fenwal. Its humble origins were in Newton, Massachusetts in 1935. It later moved to Danvers, Massachusetts and since 1938, has been located in Ashland, Massachusetts.

One of the new firm's specialties was the thermostat concept which, based on the differential expansion of two metals interacting on each other, allowed the making and breaking of an electrical circuit as the temperature increased and decreased. In 1938 and 1939, Fenwal thermostats solved the problems

that the British Allison engine in the Spitfire plane was having—stalling on diving due to poorly controlled temperature regulation. Fenwal thermostats were used successfully in these planes during the war. The concept was next utilized by the Bell Telephone Company for temperature control of crystal ovens. Later, thermostats based on this simple principle came to be used on many airplanes and still are.

The thermostat concept was only part of the Fenwal Company's production. Carl Walter continued his major contributions to the control of environmental sepsis. His early work with parenteral fluid tubing and flasks expanded to include aseptic collection, storage, and infusion of whole blood. In the late 1940s, he developed the concept of a nonbreakable plastic bag for colloids and blood that was extensively used during the Korean War. The plastic bag and fluid therapy concept were bought, in part, by the Johnson and Johnson Company in the early 1950s, and then that company sold its half and Fenwal sold its half to the Baxter-Travenol Company in 1956.

The detailed development of the plastic blood bag is an entire story in itself. Steam sterilization too often resulted in concentrated or discolored solutions, burst bags, collapsed tubes, or adherent surfaces. Ultimately, a turbulent mixture of air and steam, the antithesis of conventional steam sterilization, was invented that would sterilize both empty bags and those containing liquid. A programmed sterilizing process shifted the partial pressures of air and steam during the sterilizing cycle to affect timely exchange of heat or air through the plastic without altering the contents or damaging the structure of the bag or its complex of pouches, tubes, satellites, and cannulas. There were other problems. There was a need to formulate a plastic, the texture and change of whose surface affected clotting, hemolysis, and longevity of the red cell. A proper plasticizer was required to provide hemorepellance and protection of the red cell membrane. The choice of material for labels for the bag was dictated by the discovery that thermoduric fungal spores persisted in paper made from southern pine. Labels made from pine grown in the state of Maine could be sterilized. The mold and slime found in some packages of bags stored for several months was prevented by proper pasteurization of the sterilized bags after packaging in a hermetically sealed container. The bags had to be made strong enough to prevent rupture. Bag sealing techniques had to be devised. All of these investigative efforts were carried out at the Peter Bent Brigham Hospital where the first clinical trials took place. That sepsis-free utilization of parenteral fluids and blood components is common-place today stems, to a large degree, from the early inventive work done at Fenwal, and today it is estimated that over 150 million plastic blood bags have been produced and sold, as well as untold numbers of plastic bags for crystalloids and colloids.

In the late 1940s, Fenwal opened plants in England, France, and Italy, and in 1960, another plant began production in Japan. The company was bought by Walter Kidde and Company, Inc. in 1966, but the germinal Ashland plant retains its original managerial and production staff, maintaining its independent identity in the Kidde Company structure. During the economic decline in 1974, there was no dip in Fenwal's production. Instead, there was the usual yearly 15 to 20 percent increase in production, and more, not fewer, employees were hired.

Since the middle of the 1950s, the company has been involved in researching, developing, and manufacturing high precision heat detection equipment and explosion protection and supression equipment. Fenwal thermostats (fire and overheating detection devices) are in many of the jet engine-driven airplanes in which we all fly, in missiles, in many of the copying machines we all use, and in furnaces that were once dependent on a pilot flame principle but are now controlled by Fenwal electronic ignition systems. Fenwal explosion detection equipment triggers large freon-containing "bombs" that respond within six one-thousandths of a second to suppress an explosion after it starts. Fenwal's most recent production is of electronic thermisters made by the Fenwal electronics division. Today, Fenwal Laboratories produces 80 million dollars worth of revenue through its thermostat and fire explosion systems in the United States, 25 million from its electronic thermister system, and another 25 million dollars from its thermostat and fire explosion equipment made in Japan.

Carl Walter's wish for the future is an opportunity to increase the size of his Ashland plant. I went out to the plant the other day. It is a 30 minute drive from the Brigham. Carl is presently chairman of the board, spending "the minute half" of his time there and "the larger half" as chairman of the Harvard Medical School Alumni Fund. We walked through the plant, which is a veritable maze of machinery and personnel. I watched the workers assembling delicate plastic cards with complicated circuits, circuit breakers, minute thermostats, and large thermostats; I saw machines driven by computers producing other components with amazing sequential precision. Carl seemed to know many of the workers by name—workers of a dozen different nationalities living and working together, as he said, in "general happiness and harmony."

Carl likes to say that what is presently an over 100 million dollar a year production quota, with approximately 2,000 employees producing literally thousands of different small and large components, began 40 years ago when they had "$2,000 and three good ideas." Carl tried to explain all these things as we wandered through the factory sections: research,

publicity, marketing, and production. "It is a beautifully coordinated enterprise," I thought, "and clean—no major environmental septic problems here." Carl pushed open the door to the men's room. "See how clean these workers keep things," he said. "Why can't we train our hospital personnel to keep their environment similarly clean?"

While Fenwal was becoming well established, Carl Walter did not abandon his clinical work. Although not an extremely busy general surgeon, he was an excellent one. He combined his knowledge of general surgery with fracture surgery as a very successful teacher-clinician at the Brigham. He also maintained his close association with environmental infection problems that related to the operating room to such an extent that today, he is considered the leading authority on operating room infection control. As he points out, "a mop reaches the wound more often than any surgical instrument." Early in his career he devised a method of properly sterilizing instruments using high pressure steam, and then later, ethylene oxide for those substances that could not be placed in a fluid medium for sterilization. His book *The Aseptic Treatment of Wounds*, which is in every operating room library throughout the country, and his concepts of control of airborne particulate infection are fundamental to most hospitals. Carl also made fundamental contributions to the development and use of the artificial kidney, working with John Merrill on dialysis concepts first developed by Kolff. In the laboratory, he set up a dog model that showed the effect of combining hypotension, acidosis, and a circulating blood pigment on the development of acute tubular nephrosis.

In 1960, his physician told him to find some diversion from his activities at Fenwal and the Brigham. With his partner at Fenwal, Ed Poitras, he bought some land in Vero Beach, Florida. There he developed a 70,000 tree orange and grapefruit grove, which he visited every couple of months. "It was good psychotherapy for us all," he has said. The fruit grove was sold in 1978.

Carl has been head of the Harvard Medical School Alumni Fund since 1972. Under his leadership, alumni donations have gone from $173,000 to $3.7 million a year. During his tenure, Carl has been a most prolific giver himself, and as he approaches retirement from his position as head of the alumni fund this year, there is no question that we can look back upon his record and say "well done."

Carl Walter's story typifies what we mean by the free enterprise system, which is so unique to Western civilization. Carl says that there are six different ingredients to successful industry: an inventor, an entrepreneur, someone's savings, consumers, a cooperative community, and human resources. He stands opposed to that type of "economy that is based upon spending what many others have earned." He has contributed much more than many ever will through his development of transfusion and parenteral therapy equipment, protection of patients against sepsis, and through his part in developing modern heat indication and control, and explosion detection and suppressive devices. He recently told me that he estimates that products produced as a result of ideas emanating from Fenwal contributed about $330 million to our nation's gross national product last year, and Fenwal is up there, even now, aboard the Telstar satellite for all to see.

In 1929, while still in medical school, Carl Walter married Margaret Davis, a public health nurse. Carl and "Petey" have brought up a family of six. One is a pathologist, and the others are not in the medical field; however, all are busily engaged in interesting pursuits. The Walters have 13 grandchildren and 4 step-grandchildren. Tall, trim, and younger than his 78 years, Carl is still a hard working person whose advice is widely sought. He still drives a white car but instead of a white Chrysler Imperial, which he drove in earlier days, he now drives a white Cadillac. Traveling extensively he has brought his ideas to people around the world. He is positive and direct in expressing himself. He has a strong dislike for inaccuracy and incompetence, which sometimes comes out explosively, and has a robust sense of humor. He sometimes riles his colleagues, but those who have known him through the years have tremendous admiration for his intellect, brilliance, innovative thoughts, and for his genuine devotion to his friends.