

Belding Hibbard Scribner—Better Known as Scrib

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It is particularly appropriate the Hall of Fame series should honor Belding Scribner in 2010, 50 years after he developed the device that first allowed treatment of irreversible chronic renal failure (Figure 1). Now, in 2010, there are between two and three million dialysis patients alive worldwide, and the global market for dialysis equipment and supplies is of the order of 69 billion dollars.

Scribner, better known as Scrib, was born in Chicago on January 18, 1921, and named Belding after his mother, Mary Elizabeth Belding, and Hibbard after his godfather, Jack Hibbard. From an early age, he disliked his first name because it was unique and because his family shortened it to “Bel,” which sounded like a girl’s name. He soon started to call himself Scrib, and was called this throughout his life by almost everyone.

Scrib graduated from the University of California in Berkeley in 1941. He had been a sickly child, suffering from severe asthma, hay fever, eczema, and from a congenital eye disease, keratoconus, and his health was one factor that made him want to be a physician. He went to Stanford Medical School in San Francisco, where his mentor was Thomas Addis, the developer of Addis counts and the “urea ratio” that ultimately led to the concept of clearance, and a leader in the study of glomerulonephritis. While working with Addis, the measurement of chloride by titration was described, and Scrib developed his first bedside test to measure this.

He graduated M.D. in 1945, interned and was a resident at San Francisco Hospital, and in 1947, became a fellow at the Mayo Foundation. There, in 1950, he heard John Merrill lecture on the Kolff rotating drum artificial kidney and saw its potential as both a research tool and a treatment for acute renal failure (1). This was about the time his eyesight had deteriorated to the point he had one of the early corneal transplants that saved his vision. Over the years, with further transplants, his eyes became very scarred, and the only person he trusted to make his contact lenses was a technician at Moorfields Eye Hospital in London. The technician wore a red cap; Scrib adopted this, and it became famous in Eli Friedman’s photographs (Figure 2).

In 1951, he was appointed Director of General Medical Research at the new Seattle VA Hospital and soon persuaded the

VA to buy a Skeggs-Leonards artificial kidney. He chose this because of its small blood volume, low internal resistance, and hydrostatic rather than osmotic ultrafiltration. For the next several years, he treated acute renal failure in local hospitals, bringing the equipment in a panel truck. He also refined his bedside tests and developed a Syllabus for Fluid and Electrolyte Balance to teach medical students a simple and effective way to manage such problems.

In 1957, he was awarded a Markle Scholarship and worked in London with Malcolm Milne on nonionic diffusion. He also visited France and discovered fine French wines.

In 1958, he became head of the new Division of Nephrology at the University of Washington. Here he expanded the acute renal failure program, and, after Paul Teschan’s report on prophylactic dialysis for acute renal failure, he developed a continuous dialysis system (2). This used Skeggs-Leonards dialyzers and a Sears Roebuck freezer modified by Wayne Quinton, the talented engineer who ran the hospital’s instrument shop, to keep the dialysate at 4°C for 12 to 24 hours of dialysis. With Tom Marr, his first fellow, he also studied gastrodialysis as a treatment for acute renal failure (3).

In March 1960, Scrib transformed clinical nephrology with what came to be called the Scribner shunt. At that time, maintenance dialysis for irreversible kidney failure was not done, because with the then available cannulas, a fresh cutdown on an artery and vein was required for each treatment, and a patient soon ran out of blood access sites. Scrib came up with the idea of connecting the arterial and venous cannulas by a short shunt between dialyzes to preserve the blood access. Although he didn’t know it, this had been tried by Nils Alwall and others, using glass, rubber, or plastic tubing, but had required heparinization and invariably failed. The difference this time was using polytetrafluoroethylene (Teflon) tubing for the cannulas and shunt. Quinton designed the device and tools to bend the tubing. Then, on March 9, 1960, David Dillard, a pediatric cardiac surgeon, implanted a shunt, made at the bedside by Quinton, into the forearm of Clyde Shields, a 39-year-old machinist dying of chronic renal failure secondary to chronic glomerulonephritis (Figure 3). The details of this event are described elsewhere (4). Clyde lived for 11 years on dialysis, latterly on home dialysis, returned to work, and died from severe cardiovascular disease.

At the April 1960 meeting of the American Society for Artificial Internal Organs (ASAI), it was too late to get a report on the program, so Scrib took Clyde and his wife and Quinton to the meeting. He presented Clyde, Quinton, and the shunt at

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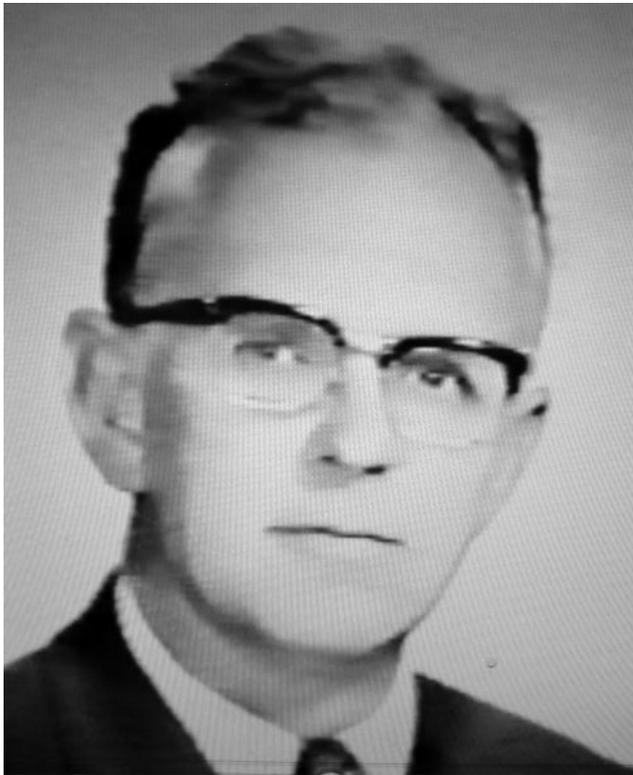


Figure 1. Scrib in 1960.



Figure 2. Scrib in his red cap in the 1990s (photo courtesy of Dr. Eli Friedman).

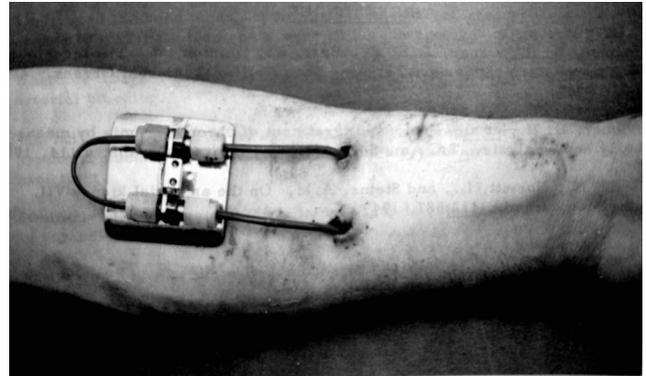


Figure 3. The shunt in the arm of Clyde Shields.

private meetings with a few physicians interested in dialysis including Merrill, Kolff, Schreiner, and Teschan. Although a formal presentation had not been made, Schreiner allowed publication of the two classic papers on the shunt and the treatment in the 1960 *Transactions of the ASAIO* (5,6). Even so, acceptance of chronic dialysis was slow in the United States and Europe, and the nephrology leaders, most of whom were renal physiologists, were very unimpressed. By the time of Scrib's Presidential address to the ASAIO in 1964, there were only between 50 and 100 patients in the United States living on dialysis or with a transplant (7).

During the first 3 years, the frequency and length of dialysis was increased from once every 5 to 7 days to twice a week, overnight, for 12 to 16 hours to control uremic symptoms. Severe hypertension was controlled by a low-salt diet and ultrafiltration, because at that time, no good anti-hypertensive drugs were available. Until the end of his life, Scrib always believed in the importance of sodium restriction in dialysis patients. When calcium deposits developed, they were resolved with phosphate binders, and peripheral neuropathy responded to more hours of dialysis. Quinton modified the shunt and replaced all but the tips with flexible Silastic tubing, prolonging cannula survival. On a trip to Europe, Scrib saw the Kiil dialyzer that had characteristics similar to the Skeggs–Leonards dialyzer but was much easier to assemble. He brought one back and arranged for its manufacture in the United States, and this became the workhorse of the Seattle program until the advent of disposable dialyzers.

Four patients started treatment in 1960, and Scrib wanted to expand the program, but the hospital administration would not allow it. Consequently, he approached the King County Medical Society and, with their aid and a grant from the Hartford Foundation, the Seattle Artificial Kidney Center (SAKC) opened in 1962 (8). This was the first out-of-hospital community-supported dialysis center in the world and used nurses rather than physicians to do dialysis. The selection process by a lay committee for the few beds available was described in *Life Magazine* later that year (9), and the resulting vigorous discussion played an important role in the development of bioethics (10).

In 1963, with Les Babb, a professor of engineering, the first proportioning pump system to prepare dialysate from concentrate was developed for the four-station hospital unit (11). The

following year, when a 15-year-old girl was turned down by the SAKC committee, the group miniaturized the system to make the first single patient monitored proportioning system designed for home hemodialysis and the prototype for most dialysis machines in use today. Home hemodialysis worked (12), and after Shaldon introduced overnight home hemodialysis, this became the treatment for 90% of SAKC patients, because patients were better rehabilitated at lesser cost and therefore more patients could be treated with available funds.

In 1962, Fred Boen, a pioneer in peritoneal dialysis, joined Scribner's program, and 2 years later, he was joined by Henry Tenckhoff. Boen developed a closed automated system for in-hospital peritoneal dialysis and showed peritoneal infection could be minimized by inserting a new peritoneal catheter for each treatment rather than using an indwelling device. The delivery system was modified, and the first patient was sent home on peritoneal dialysis in 1964 (13). Tenckhoff went on to develop his well-known peritoneal catheter (14) and to develop two peritoneal dialysis machines for home and center use. In 1976, these were superseded by development of continuous ambulatory peritoneal dialysis by Moncrieff and Popovich; Popovich was one of Babb's ex-fellows.

In 1961, Scrib and Bob Hickman used a modification of the Seattle pumpless system to dialyze six children between 7 months and 9 years of age with acute renal failure (15). Hickman also treated the first pediatric patient with chronic renal failure.

In 1965, Scrib noted that peripheral neuropathy and other complications seemed less of a problem in peritoneal dialysis patients, although their urea and creatinine levels were higher than in hemodialysis patients. He suggested the more permeable peritoneal membrane allowed greater clearance of what he described as "middle molecules." Babb and Scrib developed the square meter-hour and the middle molecule hypotheses (16) and the dialysis index, the first quantitative measure of dialysis adequacy (17). However, Kt/V_{urea} , a measure of small molecule clearance described about the same time, was adopted generally as a measure of adequacy. Scrib always believed Kt/V and the appeal of shorter dialysis to uninformed patients and for-profit dialysis centers resulted in underdialysis of most U.S. patients, and he enjoyed quoting the Tassin survival results with thrice weekly 8-hour dialyses that were derived from the Seattle experience in the 1960s. Consequently, he was delighted years later with the development of more frequent hemodialysis, and in his last public statement to the 2003 Annual Dialysis Conference, he noted that the "resulting healthy, well-nourished, normotensive hemodialysis patients will incur lesser additional health care costs than their sickly, malnourished, hypertensive counterparts on short three times weekly hemodialysis."

In the early 1970s, there were problems with blood access for parenteral nutrition. Scrib became interested and first thought of using a modification of the shunt to dilute the hypertonic solution. This did not work well, and therefore, the group began to experiment with right atrial catheters. This led to development of the Hickman catheter (18) that has since become one of the most widely used devices for long-term blood

access for parenteral nutrition, cancer chemotherapy, and many other uses. The Renal Division ran a parenteral nutrition program for several years, but Scrib's name for the procedure, "the artificial gut," was not popular with gastroenterologists.

Scrib was always interested in the big picture. In 1961, he was espousing development of dialysis centers but progress was slow. By 1965, he had seen the success and cost savings with home hemodialysis and was urging its use to enable more patients to be treated. Senator Henry Jackson, who had a childhood friend on dialysis, introduced the first legislation for government support of dialysis and transplantation in 1965. Scrib's views were also a major influence on the Gottschalk Committee that looked at the potential role of government in 1967. He, among others, helped to get Congress to pass legislation for the Medicare End Stage Renal Disease Program in 1972, but later became disillusioned as he saw the large profits in the early years and the growth of for-profit dialysis organizations. He said that what he had regarded as "a noble experiment" had become a vehicle fueled by greed rather than concern for providing the best treatment for patients. He continued his interest in renal politics for the rest of his life.

Scrib had other interests outside medicine (19). He loved sailing and, from the mid-1960s, lived on a houseboat on Lake Union across from the hospital and used his canoe to travel to and from work. He became a connoisseur of French red wines, and because there were no wine shops in Washington State in the 1960s and wine was only available through state liquor stores, he and friends illegally imported fine wines from California. When caught and convicted, the publicity resulted in the state legislature passing a bill allowing wine to be sold by private dealers. He was interested in flying and learned to fly a glider in college, but because of his eyesight problems could not fly real planes. His solution was to fly very large radio-controlled model seaplanes from his houseboat, and he was delighted when one of these crashed in Lake Union, and a passing yachtsman reported the crash to the Federal Aviation Agency.

His many honors included presidencies of the American Society for Artificial Internal Organs and the American Society of Nephrology and honorary degrees from the University of Göteborg and the Royal Postgraduate Medical School of London, and in 2002, he shared the Albert Lasker Award for Clinical Medical Research with Willem Kolff.

Scrib always said he had been lucky all his life, but he was successful because of his perseverance in problem solving and his delight in tinkering with devices. He was a great teacher and leader and a generous person. His first concern was always for patients, and his other major concerns included for-profit dialysis, the future of U.S. medicine, and the future of the world.

In his last years, he had cardiac and bone disease but remained mentally unimpaired. He died on June 19, 2003, when he drowned after falling from his houseboat. Ironically, a number of years earlier, John Merrill had drowned after falling from a dock. Scrib was survived by his wife, Ethel, and four children from his first marriage and three from his marriage to Ethel.

Claude Jacob, an old friend from Paris, gave what I believe to be his best epitaph: "Scrib was one of the few 'Great Men'

whom I have had the privilege to personally know and appreciate during my lifetime. As a physician, visionary, mentor, friend, and man I owe him very, very much and will to my last day be grateful to him."

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Disclosures

None.

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