Presidential Address

Wangensteen's Surgical Forum: A legacy of research

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Let me congratulate the Initiates who have this evening entered into Fellowship in this great College, as well as your husbands and wives, parents, and children who have helped and cheered you every step of the way.

You will be relieved to know that I am not going to talk to you about Canada's health care delivery system. Nor will I lecture you on physician reimbursement, managed care versus single payer schemes, and especially not sickness care versus health care. I shall, instead, examine that basic and original principle of the American College of Surgeons that urges Fellows to make continuing efforts to improve their knowledge of surgery through research.

This article discusses the Forum on Fundamental Surgical Problems, or "Wangensteen's Surgical Forum," as the ACS Board of Regents has now renamed it.

In a curious way, of course, this topic is related to reimbursement because, as I will remind you, almost every act that we perform today originated with a patient's problem. The problem prompted an idea of a solution and a commitment of time and effort to explore this idea—in short, research.

Dr. Wangensteen, while a fellow in surgery at the Mayo Clinic.

Wangensteen's philosophy

No one understood this sequence better than Owen Wangensteen. In his first budget to Dean Lyon at the University of Minnesota for the year 1930-1931 he, at the age of 32, defined the aims of the department of surgery to train not only good practical surgeons, but also men and women who would contribute to the development of surgery.[1]

Owen Wangensteen was born in Lake Park, MN, where his father, an immigrant from Norway, was a merchant and farmer. The young Wangensteen helped on the farm especially when his father was occupied with his mercantile endeavor in Lake Park. During his junior year in high school, their herd of 50 sows was unable to farrow their young and a local veterinarian recommended that they be sent to slaughter. After the death of two sows, Owen succeeded in delivering a litter of five piglets from the third sow by manual extraction. During the next three weeks, he delivered more than 300 piglets in the same manner. The father thought immediately that he should study medicine. The son later agreed after an especially hot summer cleaning out the barn. His training on the farm was invaluable. As he stated many times, he shared the profits with his brothers. They learned to hunt, he learned to work, and he always added, "I think I got the best of the deal."[2]

Opposite page: Dr. Owen Wangensteen exuding the cheerful enthusiasm that so characterized him.

Disordered physiology

At the medical school George Fahr is credited with inspiring Owen Wangensteen to undertake a career of investigation and teaching. Working with Einthoven, Fahr had described the method for calculating the electrical axis of the heart and was the first to report the value of the electrocardiogram in recognizing cardiac arrhythmias. Week after week, Wangensteen recalled, George Fahr, then a young professor, returned with fresh, interesting, brilliant information tracing the historic development of his subject, pointing out the important contributors and often adding much of interest about the men and women themselves. Wangensteen noted that Fahr always related signs and symptoms of disease to disordered physiology.[3]

Upon completion of an internship, Wangensteen graduated first in his class as Doctor of Medicine in 1922, and then he started postgraduate training at the University of Minnesota. He spent one year at the Mayo Clinic and obtained a PhD in surgery in 1925. Dr. Leonard Larson, a classmate and later president of the American Medical Association, said of Wangensteen's PhD examination, "The examiners finally gave up. They couldn't ask anything he couldn't answer."[1] He had a phenomenal memory. His first year elementary school teacher was delighted to note that he could read a page and then recite it verbatim.

On one memorable occasion, he invited all residents and fellows in training to a luncheon to meet Dr. Lester Dragstedt. We were 60 in number, and he introduced us all, first and last names, without error. Dr. Dragstedt was most impressed and said that he couldn't have introduced his own family that well.

Wangensteen studied in Europe in 1927, was promoted to associate professor upon his return in 1928, and was appointed department head in 1930.

When he started as department head there was one resident, who threatened to resign if another was appointed, two interns, and patients in 130 beds. At his retirement in 1967 there were 100 surgical fellows, 18 interns, and 200 surgical beds. His spirit and accomplishments have been carried on magnificently by his successor, Dr. John Najarian.

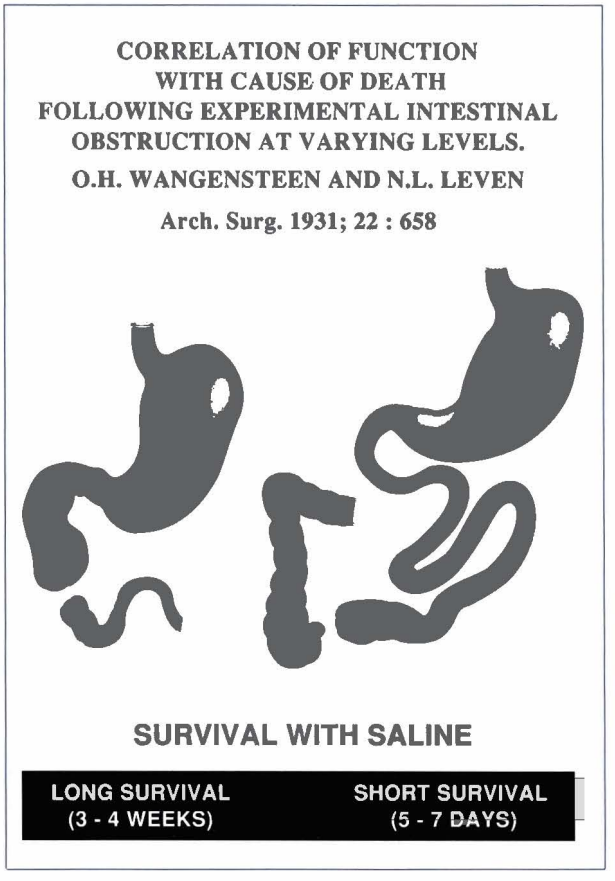


Figure 1. In 1931 Wangensteen and Leven reported experiments that confirmed that subcutaneous saline prolonged survival to three to four weeks in animals with upper jejunal obstruction. The same treatment did not protect animals with low ileal obstruction.[8] Used with permission of the American Medical Association, Chicago, IL.

Problem of intestinal obstruction

One of the first clinical problems Wangensteen encountered while he was still in training was intestinal fistulas and peritonitis in patients who had undergone enterostomy to relieve bowel obstruction. At that time, surgical intervention, which was the only effective treatment, carried a 40 to 50 percent mortality rate, which had not changed from the turn of the century.[4]

Surgeons of the day found that an enterostomy into the obstructed small intestine could relieve

the distention and edema with resolution of the obstruction without further surgery in many instances. The usual technique was to bring a loop of distended intestine to the surface to create a fistula. Wangensteen adopted the technique of Witzel, whereby he brought out only the catheter used to decompress the bowel. He reasoned and later proved that most of the distention was from swallowed air. If the air could be removed directly from the stomach via a nasogastric tube, the requirement for operation might be entirely avoided and the high mortality ameliorated.

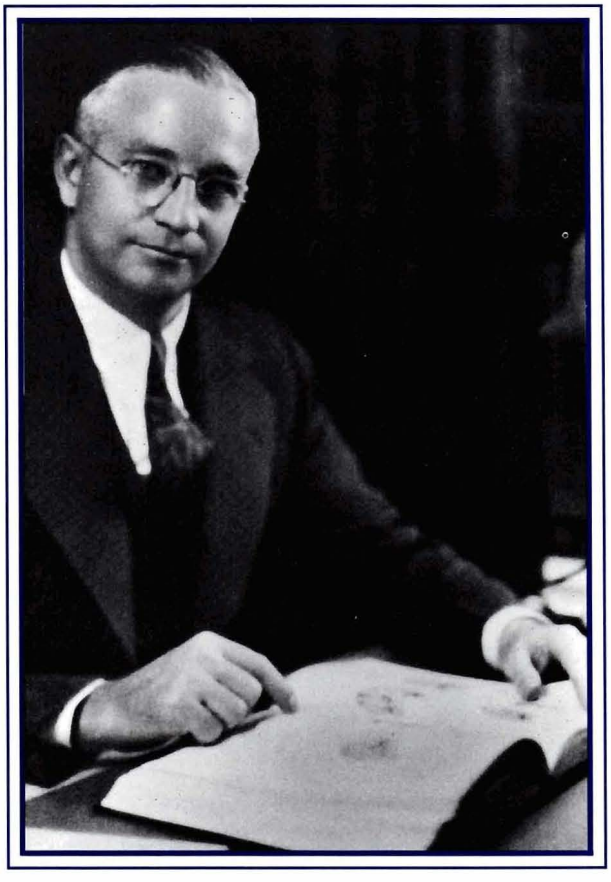
He asked precise questions and wasn't afraid to take small steps toward their solution. He first concentrated on early diagnosis, noting the frequent occurrence of colicky abdominal pain without localizing signs in these patients especially associated at the height of the pain by loud peristaltic rushes that could be heard with or at times even without the stethoscope. He listened to the abdomen of patients frequently and for several minutes at a time.

He was first to advocate X ray examination as an important aid in diagnosis. In the laboratory, working with medical students and residents, he showed that distention in simple small bowel obstruction was obvious on X ray only four or five hours after onset. Serial X ray exams have since become commonplace, and the special features of distended small and large bowel that he described are still used today to determine the location of the obstruction. As he would put it, "The verdict of the roentgen ray determines whether intestinal stasis is present and the stethoscope tells us whether it is mechanical or paralytic."[5]

In the late 1920s, death from intestinal obstruction was believed due to a toxic factor, even though Hartwell and Hoguet had shown that the lives of animals with small bowel obstruction could be prolonged significantly by the administration of subcutaneous saline solution.[6] Wangensteen and Chunn showed that intestinal content rendered sterile by Berkefeld filtration was toxic to normal animals whether it originated from normals or those with advanced intestinal obstruction.[7]

The miracle-like role of saline in high jejunal obstruction unfortunately had no counterpart in low ileal or colonic obstruction and suggested a mechanical factor to Wangensteen. Furthermore, over the previous decade, the use of saline clinically had not changed the impressive mortality rates of simple small bowel obstruction regardless of the location[4,8] (Figure 1, p. 10).

He reasoned that distention itself due to accumulated secretions and air must play an important role, especially in distal obstruction that was not as readily relieved by vomiting. In several crystal clear experiments it was demonstrated that if swallowed air could be excluded,



Dr. Wangensteen circa 1935, at the time he received the Samuel D. Gross Prize in Surgery for his many contributions that changed our understanding and treatment of intestinal obstruction.

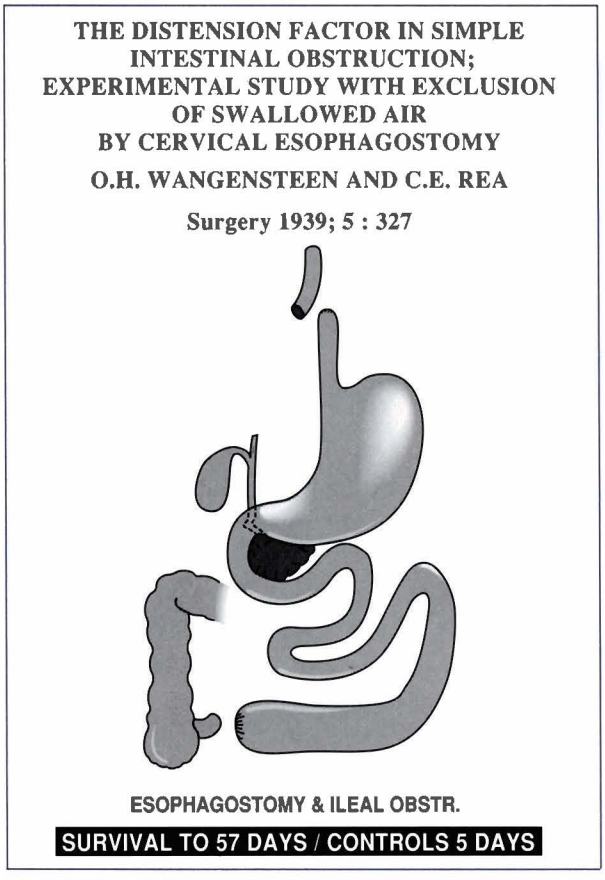


Figure 2. Wangensteen and Rea showed that exclusion of swallowed air in lower intestinal obstruction greatly prolonged survival to 57 days without development of distention. Saline alone without exclusion of swallowed air failed to prolong life beyond five days in experimental animals.[9] Used with permission of C.V. Mosby Co., St. Louis, MO.

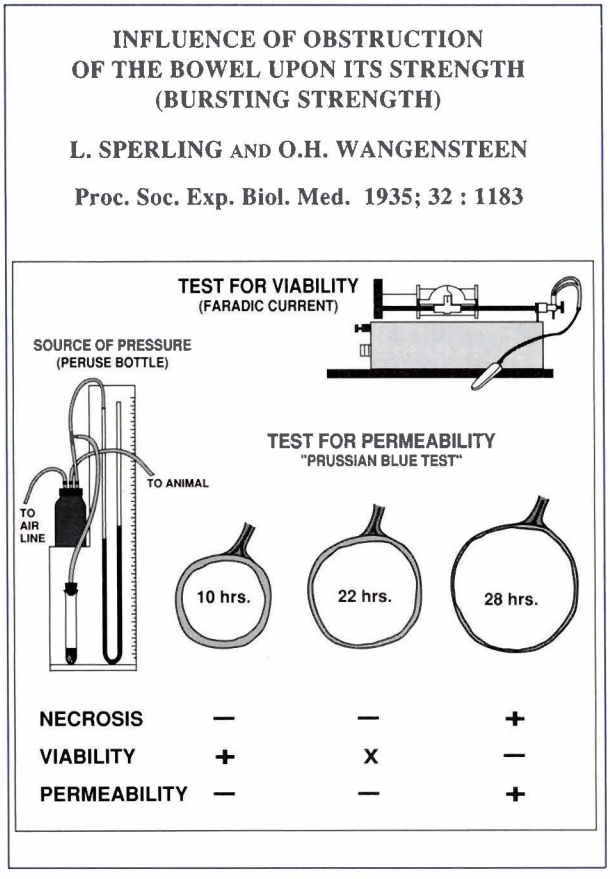


Figure 3. Intraenteric pressure of 20 cm of water was well tolerated for 10 hours; caused a measurable decrease in viability after 22 hours; and necrosis, nonviability, and measurable permeability after 28 hours. Necrosis was detected by histologic examination; viability by response to faradic stimulation; and abnormal permeability by penetration of potassium ferocyanide that is converted to the ferric salt by daubing ferric chloride on the serosal surface of the bowel revealing the Prussian blue color.[12] Used with permission of Charles C. Thomas, Springfield, IL.

the distention of distal small bowel obstruction was markedly diminished, and survival was prolonged to 57 days. Saline alone without exclusion of swallowed air failed to prolong life beyond five days in experimental animals[9,10] (Figure 2, above).

The average sustained intraenteric pressure in patients with low ileal obstruction was between 4 and 18 cm of water. In colonic obstruction in humans, these pressures were even higher—12 to 52 cm water. Intraenteric pressures of 20 cm of water maintained for 10 hours was well tolerated. The same pressure for 22 hours caused impaired viability. The same pressure for 28 hours induced necrosis, loss of viability, and detectable permeability[11] (Figure 3, above). The passage of bacteria into the bloodstream or into the peritoneal cavity occurred only when the bowel wall

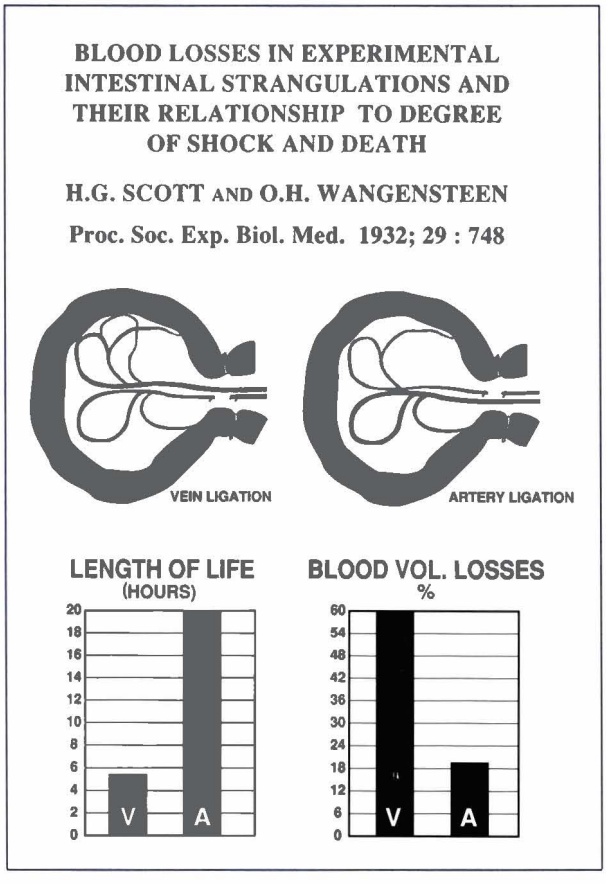


Figure 4. Scott and Wangensteen showed that survival was decreased and blood volume much more adversely affected by mesenteric venous occlusion compared to mesenteric arterial occlusion.[13] Used with permission American Medical Association, Chicago, IL.

viability was seriously and grossly compromised. Wangensteen dispelled the old adage that high obstructions are the most dangerous with the demonstration that low ileal and colonic obstructions were truly "closed loop" in nature "and associated with intraenteric pressures that could impair venous return and lead to nonviability" and even to rupture of the viscus.[12]

He recognized early that mesenteric venous obstruction was frequently associated with cardiovascular instability due to hypovolemia, which responded to blood transfusions as preparation for prompt surgical intervention. If venous return was compromised to a four foot loop of bowel, death occurred in five hours due not to increased permeability but due to hypovolemia. Animals with arterial occlusion to the same length of intestine lived much longer[13] (Figure 4, this page).

Comprehensive treatment

In the spirit of the American College of Surgeons, Owen Wangensteen treated the whole patient before, during, and following the operation. He recognized the necessity for correction of fluid and electrolyte abnormalities long before it became fashionable. The importance of correction of hypovolemia before surgery and performance of the simplest operation in that preantibiotic era was his strong advice. He recommended saving the drowning victim before starting the swimming lessons.

All of these discoveries on the fundamentals of bowel obstruction were made between 1928 and 1935. Over that period, the hospital mortality rate for all types of intestinal obstruction dropped from 50 percent to 18 percent at the University of Minnesota.

The rationale of well-directed therapy, reduction of intraenteric pressure by suction syphonage, and subsequent release of the cause of the obstruction in a deflated bowel, if necessary, was widely adopted for small intestinal obstruction. The theory of mechanical distention as the mechanism of death in bowel obstruction quickly replaced the toxic theory.

Claude Welch, writing on historic milestones in surgery, credits Wangensteen and John Paine with the proof that continuous gastroduodenal suction drainage relieved obstruction and distention and saved innumerable lives both in patients with mechanical obstruction and with paralytic ileus.[14]

Resistance to innovation

There has always been resistance to new ideas, especially when they come from younger members of the profession. After publication of the discovery of the circulation in *De Motu Cordis* in 1628, William Harvey met fierce opposition and his practice suffered. There was even opposition

to anesthesia for the relief of pain. The great discovery of prophylactic antisepsis by Semmelweiss was opposed publicly but often adopted privately.

Wangensteen himself had great difficulty publishing his clinical results on intestinal obstruction though they won the Gross Prize in Surgery. Even Nobel Prize winners have been known to open their dissertation by reading a letter from a journal editor rejecting their initial seminal work.

A forum for young investigators

It is upon this background that Owen Wangensteen sought to establish a forum for young investigators in surgery. He wished to encourage in others the enthusiastic originality he himself possessed.

He sought to improve the field of surgery as well as to enlighten surgeons with graying hair and other eloquent marks of advancing years. As he stated, "It is important that young and productive workers in surgery be provided an opportunity early in their career for active participation in surgical meetings before the ravages of time dampen their enthusiasm."[15]

The Surgical Forum originated with an editorial in *Surgery* in 1940 entitled "The Society of University Surgeons and the need for a Surgical Forum."[16] His basic ideas were: the advancement of new knowledge should take precedence over dissemination of old ideas; exclusiveness of membership should not be a requirement but encouragement should be given to all young investigators who are presenting to a forum of their peers what is new and best in surgery each year. He thought the presentations should be on original clinical or experimental research, they should be precise, they should be published at the time of presentation (that came later), and they should encourage discussion.

I and many of the older Fellows made our first scientific presentations to the Surgical Forum. We were often amazed at how much others knew about our subject.

This forum, Wangensteen predicted, would capture the imagination of better surgeons. He was convinced that surgery is advanced more by its science than by its art. There is no reason the two can't coexist. Dr. Norman Shumway, a famous graduate of the Wangensteen school and frequent contributor to the Surgical Forum, was called "the world's best first assistant" at his retirement dinner earlier this year. What he had learned was the great advantage of allowing young minds to contribute incrementally to the continuous improvement of the care of patients.

In my lifetime, most advances in surgery have been presented initially to Wangensteen's Surgical Forum.

In the foreword to the first published volume of the Forum in 1951, Evarts Graham called it a unique institution that is not found in any other country and that represents a potent factor in making American surgery the strong and innovative profession that it is. If the young contributors lack the experience of their elders they also lack the inhibitions that often stifle the development of new ideas.[17]

During my period of formal training (1950-55), the Surgical Forum was our central focus. During that time, the first successful cardiac pacemaker was described for cardiac standstill associated with hypothermia. Intracardiac surgery was reported using inflow stasis with hypothermia. There followed a year later the experimental and clinical experience using controlled cross-circulation based on the azygos flow principle. We heard of the first attempts at myocardial revascularization using an implanted internal mammary artery and accurate coronary angiography in the dog.

Pre- and postoperative care became a reality. Total body water, extracellular water, and total exchangeable chloride, sodium, and potassium were measurable for the first time. The puzzling retention of sodium postoperatively was shown to be due to an increased excretion of aldosterone or electrocortin, as it was then called. The first use of the mass spectrometer to monitor continuously alveolar carbon dioxide, which permitted early detection of respiratory acidosis, was clearly presented. A later comparison of manual lung ventilation to machine-controlled ventilation in 70 patients undergoing thoracotomy incredibly favoured the machine.

Studies on gastric secretion were of great interest. Gastrojejunostomy caused a surprising increase in acid secretion. Preparations from vari-

ous locals in resected stomachs of patients with duodenal ulcers produced marked acid production in experimental animals if the source of the material was from the human gastric antrum. We now know this material was gastrin.

Shock and burns were studied with emphasis on plasma expanders. However, even at that early time, careful experimental work showed that while saline solution didn't restore colloid osmotic pressure after hemorrhage as compared with dextran, it did restore blood volume and vital signs if given in sufficient quantities. The dangers of vasopressors used to treat hypotension were documented, and the importance of blood flow over blood pressure as a guide to therapy was just around the corner.

Malnutrition was recognized as a risk for surgical intervention, and the first studies using litter mate animals showed an effect of intravenous protein in the form of plasma. Studies were reported in which 100 grams of protein, alcohol, and sugar—to provide 1,800 to 2,400 calories per day—were given intravenously. The authors did not at that time think that they had achieved success because the patients remained in negative nitrogen balance, just as they do today.

Transplantation projects first appeared during the five-year period that described the normal pattern of rejection in animals with renal allografts or homografts, as they were then called. The report of the very notable and successful human renal transplant between identical twins first appeared at the Surgical Forum.

The importance of antibiotics in strangulating obstruction and the basis for prophylactic antibiotic regimens were reported.

The Surgical Forum now consists of 26 sessions of three and one-half hours each and ranks second only to postgraduate courses in time allotted to the program of the Clinical Congress. Many young surgeons became Fellows of the College to participate in the free exchange of ideas promoted so effectively by these sessions. Many of us now bask at the Ciné Clinics but acknowledge that the basic ideas and research frequently originated at the Surgical Forum.

The legacy

Shared opportunity was Owen Wangensteen's byword. He truly created an atmosphere that was friendly to learning both at his own school and through the Forum at the American College of Surgeons as well. Some would say he revelled in challenging accepted concepts of disease and its treatment.

He had the willingness to recognize every type of talent regardless of how well it was disguised, and had the ability to encourage and stimulate all of us. Residents in training responded with vigor, doing a significant portion of the basic investigation underlying the development of open heart surgery, pre- and postoperative care, and surgical oncology.

When residents came out of the laboratory, they were ready to operate on humans. During the period of which I have personal knowledge, residents in training at the University of Minnesota did the first successful resection of an abdominal aortic aneurysm, the first pelvic exenteration, and the first Roux-en-Y reconstruction after total gastrectomy at that institution. The requirements were simple—a patient with an appropriate lesion, an absent interested staffman, and a faultless result.

Wangensteen emphasized the Socratic method wherein students became their own teachers. He often said the struggle to keep abreast of progress is not likely to result from the apprentice system but rather from a system that encourages independent thought and research. The ACS Board of Regents agrees and have established a fund for the direct support of surgical research for those very individuals who contribute so productively to the Surgical Forum and to our future as surgeons. This fund is appropriately named The Wangensteen Fund for Surgical Research.

Wangensteen believed that surgeons could be divided into two groups: those who see what they believe, and those who believe what they see. Through research, he tried to produce the latter. He always listened attentively but eventually asked, "Where is your evidence, where are your data?"

As we approach the 21st century, it is a question that is becoming asked more frequently of everyone in medicine. I hope that all of you will be active in preparing the answers in surgery. Ω

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