A pyramid is often used to depict the method of graduate surgical education used by Dr. William Halsted at the Johns Hopkins Hospital. The base represents the interns who enter the program; over succeeding years all except one are eliminated, leaving the Resident at the pinnacle. In 1936, it was my good fortune to begin as an intern in a slightly modified Halsted program brought to the new Duke Hospital in 1930 by Dr. Deryl Hart, the first Chairman of Surgery at Duke, who had recently completed his residency at the Johns Hopkins Hospital. From 1936 to 1942 I was a member of the surgical house staff at Duke, a remarkable institution that has contributed so much to advances in medical education, research, and the delivery of health care.

In 1936 the Great Depression was easing, but one could see the signs of greater world catastrophes yet to come. Surgery was enjoying the Golden Era that had begun 90 years earlier with the discovery of anesthesia, was nurtured by advances in surgical pathology, and finally was greatly expanded by use of sterile procedures. Medical treatment, on the other hand, was for the most part ineffective; the pharmacopeia still contained Paracelsus' mercury, Withering's digitalis leaf, Ehrlich's arsenic, Peruvian bark, a few pain killers, and some laxatives. The first flicker of light on the horizon occurred in 1935 when Domagk reported that a sulfa compound, sulfachrysoidine (Prontosil), could control many previously fatal infections.1 This was the start of the phenomenal development of medical sciences that I have personally witnessed—a greater change in the last half-century than in the thirty centuries preceding.

My personal experience as an intern in 1937 emphasizes the miracle of the sulfa drugs. I admitted a middle-aged woman from Eastern North Carolina, acutely ill with recurrent lymphangitis in a post-phlebitic leg. Thirty-six hours after we started intravenous administration of the purplish-red Prontosil, her temperature became normal and the inflammation subsided. She was the first patient to receive a sulfa drug at Duke.

The New Intern Arrives

My introduction to Duke Hospital came on June 29, 1936, after an all-day train ride from Atlanta. On leaving the train, I was struck by the pervasive but not unpleasant aroma of “tobacco, toasted tobacco,” just as the Lucky Strike ads proclaimed. This pleasant odor was a marker of much of the social and economic activity in North Carolina at that time. I had never visited Duke Hospital before. When I arrived, George Joyner, the Senior Assistant Resident in Surgery, showed me my room near the hospital entrance. The next morning, I met Dr. Hart for the first time. Then, without ceremony, I was put to work by William Haltom, Resident in Urology, on the male ward of private urology service (the most difficult of the intern’s rotations). My ascent up the pyramid began in a strange place among strangers.

Before going further I need to define the terms used in 1936. An intern was a first-year house officer who hoped to serve for the next four years as an assistant resident. If successful, in year six he would be the Resident.

Indigent or ward patients, mostly supported by the local government or by a subsidy from the Duke Endowment, made up the large teaching service—about 75 beds for general surgery and nearly that many for the surgical specialties. At that time, Duke Hospital was unique in being the ultimate referral site for both poor patients and those with complicated medical problems from North Carolina, south-
Motor vehicles were fewer and less dangerous. The most interesting outpatient clinic was medical rather than surgical. Medical “S” Clinic convened on Thursday nights to give patients with syphilis Neosalvarsan and mercury. In order to care for the large number of patients, the entire Department of Medicine—senior staff, house staff, technicians and all office help—were needed. It was a social occasion for patients, many of whom lived in the area.

Life on the Surgical Wards

The wards at Duke Hospital, named for famous doctors like Halsted and William Osler, were compact and efficient, consisting of one large room divided into four cubicles of four beds each; there were several other rooms with one, two, or four beds. The Head Nurse, dressed in a starched white uniform with the white cap that identified her nursing school, presided over the unit. Each ward was self-sufficient, so ward personnel did all the cleaning, transporting of patients, and food distribution. The Head Nurse was assisted by other nurses, student nurses, maids, and a male orderly. She stood when the Staff Surgeon or the Resident came to the ward; she knew all the patients and all their problems. Head Nurses were great teachers of interns, and I particularly remember Miss Mildred Sherwood, who ran Howland, the children’s ward. Surgical house staff learned about sick children from this talented and kind lady. She was the only person I ever knew who could consistently persuade a small
child with a lye-induced stricture of the esophagus to swallow a fine silk thread (without a lead shot attached) so that esophageal dilatation could begin.

For surgical interns, the operating room was the center of excitement. It was a place of strict ritual and discipline, enforced by a clearly defined hierarchy. Miss Marian Batcheler, the operating room supervisor, was in charge. She was physically small, but she enforced strict compliance to all the rules, by everyone—surgeons, nurses and orderlies. She won their cooperation by her example of efficiency and dedication, and she would not tolerate canceling a case for anything except a medical reason.

During my six years on the house staff, anesthesia, (except for local and spinal) was administered by nurses. The inhalation anesthetics (drop ether, cyclopropane, and gas-oxygen-ether) were all highly explosive. Intratracheal tubes were rarely used even for very large goiters. I first saw intratracheal anesthesia used in 1937 for Dr. Hart’s first pneumonectomy. The bronchologist, Dr. George Ferguson, placed the intratracheal tube for the nurse. The operation was successful.

In 1936, the house staff lived in the hospital. As was the custom in most teaching hospitals, the interns received no pay. They could not be married. If they survived to become assistant residents, they got $500 per year; the Resident got $1,000 per year. Room and four meals per day were provided for the house staff (the food was excellent). At the evening meal during my first year, we sat at linen-covered tables and were served by waitresses. Our rooms were just a few steps from the wards, in what later became the psychiatric ward. The assigned room became the house officer’s home, his castle. He could entertain there whomever he pleased without regard to gender, a ruling that came about when one of the two Duke campus policemen tried to break up a mixed-gender Christmas party in the Ob/Gyn house staff quarters. Dr. Davison ruled in favor of the house staff.

What did the house staff do for fun at Duke, whose campus was in fact the suburb of a small city? Very few of us owned automobiles. Most social activities took place on the university campus. The dormitory for student and graduate nurses was next door; the women’s campus was close by. Movies were available for 25 cents twice a week in the student union (house staff could take calls there). All of Duke’s athletic facilities were available to the house staff. There was much social interchange between students, house staff, and faculty. Medical school dances were held two to three times per year, and the faculty participated actively.

The Duke Forest was the site of many outings, especially after 1936, when beer became legally available in North Carolina. The Forestry School was not quite ready to accept the idea of beer being served at parties in “their” Forest. On one occasion there was a confrontation between officials of the Forestry School and a medical student. Fortunately, the disagreement stopped short of fisticuffs, for the student was a Southern Conference heavy-weight boxing champion. Dr. Davison refused to sanction the student.

The Duke house staff were largely graduates of schools organized to follow the medical education reforms set down by Abraham Flexner and the General Education Board. Vanderbilt, Hopkins, Yale, the University of Rochester, and Cornell were represented (Figure 2). The high quality of the house staff, the day-to-day contact with other services on the wards, and the shared dining room and living quarters greatly increased our education. Several 1936 house officers attained national prominence, including Raymond Adams, who became a neurologist at Harvard; George Harrell, a noted clinical investigator and medical educator at Bowman-Gray, Florida, and Hershey; and Julia Jones, pulmonologist at Columbia.

In 1936, the hospital was nearly always full. When the 1936 intern class entered, the surgical residency program planned to have two assistant residents for years 2–4 and one for years 5–6 (Figure 2). The hospital and medical school functioned as one unit in teaching and patient care. The basic science departments did the clinical laboratory work.

Learning by Doing

The method of teaching students and house staff was brought from Hopkins. Upon leaving Hopkins for Oxford, Sir William Osler declared, “By far the greatest work of the Johns Hopkins has been [to demonstrate] to the profession...how medical studies should be instructed.... But the amphitheater clinic, the ward and dispensary classes are bastard substitutes for a system which makes the medical student himself help in the work of the hospital....” At Duke, surgery offered no formal classroom teaching. Students and house staff relied on

![Figure 2. Diagram of the pyramidal structure of the Duke Surgical Residency in 1936.](Image)
the patients to guide and stimulate learning. For house staff the only formal exercise was the Saturday morning Grand Rounds held by Dr. Hart. Surgical staff conferences took place off and on for part of the year. The various departments gave a conference each noon in the amphitheater for medical students and staff. Students on surgery ward rounds three times a week; there were no lectures or recommended textbook, and no written examinations.

Dr. Deryl Hart, in keeping with his long period of training at Hopkins, did a broad spectrum of surgery, including neurosurgery, plastic surgery, thoracic surgery, and general surgery. He was the best surgeon I ever knew, and later became the fourth President of Duke University. He was a reserved Southern gentleman, dedicated to resident education. As an example of his interest, when I took him my first paper for help he spent hours going over it word by word.

Among Dr. Hart’s many contributions was a thorough laboratory and clinical study of ultraviolet radiation to prevent airborne infections in the operating room. Before the advent of antibiotics, infection was common, even in “clean” surgical wounds. I remember a constant infection rate of about 5%, with periods of epidemic increase. After one of these infectious catastrophes in the early 1930s, Dr. Hart began an extensive study of the cause of operating room infections. He concluded that most infections of clean wounds were caused by airborne organisms. Using a team that included a physicist, a bacteriologist, and many of the surgical house staff, Dr. Hart showed that ultraviolet radiation could safely reduce the wound infection rate to about 1%. It seemed well worth the minor inconvenience of wearing skin and eye protection in the operating room.

Dr. Hart was a superb administrator, who selected competent people for positions of responsibility and then didn’t interfere with them. For example, once he selected new faculty to lead neurosurgery, plastic surgery, and thoracic surgery, he turned all specialty practice over to them. He had had a large private practice in these specialties, but no longer needed the money. Among the additional responsibilities he had was that of Secretary of the Duke Hospital. Dr. Hart showed that ultraviolet radiation could safely reduce the wound infection rate to about 1%. It seemed well worth the minor inconvenience of wearing skin and eye protection in the operating room.

The Intern’s Job

In 1936, the interns spent twelve weeks on urology and six on orthopedics and on bacteriology; the remainder of the year was devoted to general surgery. The intern was responsible for his patients 24 hours per day, seven days per week, and had to “sign out” to another intern to leave the hospital. We literally lived with our patients, for living quarters were sometimes next door to the ward. Much of the working day was filled with what is now called “scut-work.” Nurses could not inject medications, draw blood, or give parenteral fluids. In spite of many plausible arguments to the contrary, having to carry out those chores served a useful purpose by bringing the intern into contact with the patient for much of the day.
always on the lookout for sources of post-operative fever like suction, a relatively recent innovation in surgery. We were tations, blood transfusions, Fowler’s position, and nasogastric nous glucose or saline solution, subcutaneous saline solu-
four weeks. There was little we could do other than intrave-
infection and the withholding of oral feedings for three to
the onset of the abdominal pain. The mortality rate was
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most vividly is acute peritonitis. There were always two or
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a ruptured appendix, often precipitated by a laxative given at
the onset of the abdominal pain. The mortality rate was
high, but many patients were young and could tolerate the
infection and the withholding of oral feedings for three to
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busyest. Urinary tract infections were hard to control. Pa-
tients with urethral obstruction due to enlarged prostrate
were often uremic, with large, tense bladders that were
slowly decompressed. Bladder catheters were hard to keep
in place and had to be reinserted often, as there were no
balloon-tipped catheters available for this purpose.

The bacteriology rotation during the first year was one
of the most interesting. Dr. D.T. Smith was Chairman of
the Department of Bacteriology and a world-famous au-
thority on infectious diseases, particularly fungal infections.
Miss Mary Poston, bright, aggressive, and a great teacher,
had day-to-day control of the clinical laboratory. The
interns did all wound cultures, all blood cultures and all
autopsy cultures on surgical patients. They also were re-
sponsible for cross-matching, collecting, and administering blood.

Blood donors were eligible if they had a negative Wasserman
test, no history of malaria, and shared the blood type of the
recipient. The blood was crossmatched by the intern,
checked by Miss Poston, drawn from the donor, and given. Transfusions were rela-
tively uncommon, but the donors (usually house officers) welcomed the $25 fee.

We transfused blood to supply im-
mmune substances to patients with sepsis (often staphylococcal). I remember giving
many 250 cc transfusions to one of Duke’s football players who had been struck on the
chest where he had a boil. This led to septicemia and osteomyelitis of the sternum. After months of treatment, he sur-
vived. Later, interesting legal questions arose about whether he was a university employee and thus entitled to workmen’s compensa-

The surgical problems we saw were very different from
those seen today. Terrible and bizarre forms of infection
were common, including carbuncles, Ludwig’s angina, and
cavernous sinus thrombosis resulting from extension of
infection of the skin of the face. Other common infections
were pleural empyema; brain abscesses, often following a
lung abscess; subphrenic abscesses; acute osteomyelitis; and
severe lymphangitis, usually secondary to a fungus infection
of the foot or a bout of phlebitis. The infection I remember
most vividly is acute peritonitis. There were always two or
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suction, a relatively recent innovation in surgery. We were
always on the lookout for sources of post-operative fever like

acute parotitis, subphrenic and pelvic abscesses, and, rarely,
infected emboli in the portal system and liver. New sulfa
drugs appeared between 1936 and 1942, but they were not
very effective for some severe infections.

Carcinoma of the stomach was as hopeless then as it is
now, and much more common. It often led to an unreward-
ing abdominal exploration. The same could be said for
tuberculous peritonitis, although some doctors thought lap-
arotomy was actually beneficial. Colon cancer was difficult to
treat and 15-25% of those operated on died. In 1936, gastric
resection for peptic ulcers was just coming into vogue.
Surgical removal of large nodular or severely toxic diffuse
goiters was an interesting challenge. Medical therapy of
hyperthyroidism was not available until 1938-39. Severely
hyperthyroid patients were given anesthesia in their rooms,
then carried to the operating room. This was called a "thyroid
steal." My first clinical paper, which I wrote as an assistant
resident, dealt with the staged surgical treatment of severely
toxic goiters.

In the operating room, interns served as second assistants. The reward for hours
of caring for sick patients on the ward, and the hours of retractor-holding, was to be
allowed to do either an appendectomy or inguinal hernia repair at the end of the
intern year.

Shortly after I began as an intern, I
became aware of the highly competitive
class of the Duke Residency: after one
year, 6 of the 8 interns would have to find
other jobs. When the day finally came, I
was one of the two asked to stay on for
three years, but only to enter another highly
competitive contest for the Resident posi-
tion. The two interns selected to remain faced a new assign-
ment in their second year. Previously this year had been spent
entirely in Pathology, but in 1937 Dr. Hart established a
surgical research laboratory, to which each assistant resident
was assigned for six months, leaving only six months for
pathology. The clinical departments were very actively en-
gaged in research, for a school not yet six years old. In addition
to Dr. Hart’s elegant study of operating room infections, other
departments had received national recognition for their work.
I remember Dr. Ed Hamblin of Gynecology who was nation-
ally recognized for his endocrine studies; Dr. D.T. Smith and
colleagues who attracted so many patients with fungus dis-
eeases; Dr. Julian Ruffin and others who did extensive studies on pellagra.

**Beginning an Academic Career**

Dr. Hart selected Dr. Joseph Beard to organize a research
division in the department. I was assigned to Dr. Beard’s
laboratory during his first six months at Duke. He was trying to make a vaccine for equine encephalomyelitis, a common and fatal disease, but also studied the rabbit papilloma virus and the vaccinia virus. The house staff openly complained that my assignment was a long way from surgery, but working with Dr. Beard was never dull. When he arrived at Duke, his laboratory was adequate but the animal quarters were horrible. The dog compound was filthy beyond belief, and there was no satisfactory facility for small animals. The laboratory staff, in addition to conducting experiments, tore down walls, made mouse cages, and installed an animal kitchen in which Dr. Beard concocted a balanced dog ration from horse meat, black-eyed peas, vitamins, and smelly cod liver oil. This was cooked together in a large pot, making a dog stew.

Soon after Dr. Beard arrived at Duke, he and George Newton, a machinist in the Physics Shop, built a quantitative and analytical ultracentrifuge. Right now, I can see this machine, in the laboratory which overlooked the university quadrangle. Its head, spinning at thousands of rotations per minute, was suspended by piano wire from a gas-driven turbine. The instrument was partially surrounded by sand bags with a small peep-hole for viewing. Even today, I can imagine the head coming loose and sailing out the window across the quadrangle, to hit the chapel tower.

Mr. William B. Bell, for whom Duke's Bell Building is named, gave $2500 for Dr. Beard's salary and $2500 for laboratory supplies. Mr. Bell was president of the American Cyanamid Corporation, of which Lederle Laboratories was a subsidiary. Lederle wanted a new method of making the horse encephalitis vaccine. In 1938, after successfully making an equine encephalitis vaccine from chick embryos, Dr. Beard, his wife, Dorothy, and I traveled to the Lederle Laboratories at Nyack, New York, to teach them how to do it. Up until then it had been made from horse brains, but a chick embryo would yield about as much virus as a whole brain. The vaccine was on the market for spring inoculation of horses. Unfortunately, several Lederle employees developed encephalitis, and three, I believe, died. Our method of grinding embryos with sand in a hand-held glass mortar and pestle was, to say the least, messy, but we thought the virus was not infectious in humans. Fortunately, the patent held long enough to start the Joseph and Dorothy Beard Foundation. I saw one remarkable thing on the campus of the Lederle Laboratories: literally acres of land were covered with large rabbit hutches, occupied by enormous Belgian hares. The animals were the source of anti-serum used to treat pneumococcal pneumonia. Within a year or so, Domagk's sulfa drugs would shut down this extensive project entirely.

On the way back to Duke, we stopped at the Rockefeller Institute in New York City, so I could visit the tissue culture lab of Dr. Alexis Carrel where Mrs. Beard had worked. Then we went to the Princeton Branch of the Rockefeller Institute where I met Dr. Wykoff and Dr. Wendell Stanley, who later became a Nobel Laureate.

Dr. Beard—aggressive, opinionated and sometimes intolerant of others—was great fun to work with, and the most brilliant person I ever knew. He encouraged me to continue to work in the laboratory and arranged a place for me to work on my return from World War II. Dr. Beard played a significant role in establishing Duke as a major research institution.

Pathology was and still is, in my opinion, the backbone of the surgeon’s education. Over the years it has furnished great opportunities for research. My six months on pathology were most profitable, but far too short to get all I wanted from Dr. Wiley Forbus and his staff. He ingrained habits I never lost of attending autopsies and of looking at the microscopic sections of surgical specimens. Surgeons at their core are anatomists with only a veneer of physiology; thick it may be, but anatomy is still the core.

**Striving for the Apex**

During the 3rd and 4th years of the residency, we spent six months each on neurosurgery and orthopedics. These were by far the best experience of those two years. Neurosurgery became a separate division in 1937, on the arrival of Dr. Barnes Woodhall, another Hopkins graduate. Assigned to his service, I learned to do a craniotomy for extradural hemorrhage, a laminectomy, and to elevate bone fragments for skull fractures. Every general surgeon in the 1930s was expected to know how to manage extradural bleeding from the middle meningeal artery. The neurosurgical rotation was usually busy, with many very sick patients and no one to “sign out” to. There were a few unpleasant duties, like the many injections of air into the spinal canal for diagnostic radiographs. This gave the patient the world’s worst headache, and I was glad, years later, to see the technique superseded by CT and MRI scans.

Orthopedics was an interesting service, but the clinics were exhaustingly long because of the large number of patients, many with chronic osteomyelitis (fractures then were still considered to be the domain of general surgery). Dr. Lenox Baker, a 1934 Duke graduate, trained in orthopedics at Hopkins and then returned in 1938 to succeed Dr. Shands as Chief of Orthopedics. I developed a lasting friendship with Dr. Baker. Dr. Beverly Raney was active on the visiting staff. He was a scholarly and kind gentleman, whom I got to know well as an intern; when he was a Resident for Dr. Shands. Later he became the Chairman of Orthopedic Surgery at the University of North Carolina.

I spent the rest of my time as an assistant resident in general surgery, supervising (to an insignificant degree) the intern. The chain of command tended to go from the Resident to the intern, by-passing the assistant resident. The assistant resident wrote a special note, summarized the patient’s hospital stay, performed an occasional hemiorrha...
phy, appendectomy, or varicose veins excision, and made many pinch skin grafts (used to treat the large number of burn patients always in the hospital). The assistant resident was not efficiently used, but I had extra time to continue work in the laboratory. My work with papilloma and vaccinia viruses did not result in publications, but my studies of hyperthyroidism with infection on the liver were published.

In the spring of year four, Dr. Hart had to choose one of the two assistant residents to ascend to the pinnacle of the pyramid. I was the fortunate one selected. In my fifth year, as Senior Assistant Resident, I had the chance to serve as surgeon in major operations that were passed down by the Resident or came about when the Resident was away.

The 6th and final year was the reward of competition and waiting. Max Schiebel, the eighth Duke Resident, has published a wonderful account of his experiences as Duke's eighth Resident. I was the eleventh. James Gifford sums up the Resident's responsibilities on the teaching service in his book, *The Evolution of a Medical Center*. When Dr. Hart was asked what the duties of the Resident were, he said: “[The Resident] was completely responsible for the operations performed on ward patients, and was expected to know when he needed help from the senior faculty. If a man couldn’t tell when he needed help, he did not get a residency.”

The final year brought an almost overwhelming array of administrative and clinical duties, including long hours in the operating room, either as Dr. Hart's first assistant or as the surgeon operating on a variety of complicated problems. The Resident was responsible for the student schedule, for conducting some teaching rounds, and for arranging Dr. Hart’s Saturday Grand Rounds. The Resident made up the house staff rotations and assigned coverage of the ward, operating room and clinics. The day was usually capped off by scheduling the operations for all services for the next day and assigning house officers and students to assist in the operations on general surgery. After this the Resident had to supervise the interns caring for Dr. Hart’s patients as well as his own large service.

The Duke residency system meant that ward patients were assured of a competent surgeon. That was not always the case in the 1930s, when many practicing surgeons had three years or less of training. In 1942 the Resident carried out a much broader variety of operations than today, although the magnitude of some was less than then now. My experience included many thyroidectomies; a variety of plastic surgery including cleft palate and hare lip repair, skin flaps, etc.; radical neck surgery; drainage of lung abscesses and empyema; and gastrointestinal surgery. Often I found myself carrying out the same kind of operation that I had observed as Dr. Hart’s first assistant that morning, an incomparable teaching experience. But even in the last weeks of his training, the Resident watched Dr. Hart place every single interrupted fine silk skin suture and tie every single knot. When Dr. Hart was the surgeon, he did the entire operation.

### Answering Another Call

An interesting custom brought to Duke from Hopkins was that the Resident’s tenure lasted from September 1 until August 31. This allowed the Professor to have an August vacation, with the finishing Resident looking after the service. In my case, however, the pleasant and rewarding experience at Duke Hospital ended abruptly with a call to military duty on July 15, 1942, six weeks before the official end of my Resident year. My military duty began with the 65th General Hospital, staffed with Duke-trained doctors and nurses, I served as Chief of Surgery in several army hospitals including Lawson General Hospital in Atlanta; then, after discharge in 1946, I joined the faculty at Duke University Medical School and the staff of Duke Hospital.

Even in an institution that was clearly dedicated to the Hopkins plan of medical education, Dr. Hart modified Halsted's system of residency training. He kept the pyramid, but added a strict time schedule for finishing. Even before World War II, the emergence of defined surgical specialties had begun to change the system. In the wake of World War II, though, and then the Korean and Vietnam wars, the pyramidal system was finally abandoned, leaving only the requirement of individual responsibility as the remnant of the Halsted system of surgical training. Medicare and Medicaid have removed even this vestige, leaving only the illusion of the resident as responsible surgeon (see my essay entitled *Halsted Is Dead*).

In looking back at my personal experience, I am filled with admiration and appreciation for Dr. Davison, who selected Dr. Hart and the Duke Hospital staff that performed so well in Duke’s early years. This great institution survived the Depression and the disruptive years of World War II, and the Korean and Vietnam wars, laying the foundation for its great success and its present place as one of this country's and the world's great medical institutions.

### References