

January 1989

Part II: Basic Sciences — Chapter 5: Department of Physiology (pages 158-181)

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Department of Physiology

LEONARD M. ROSENFELD, PH.D.

A physician's physiology has much the same relation to his power of healing as a cleric's divinity has to his power of influencing conduct.

—SAMUEL BUTLER (1835–1902)

ALTHOUGH it has been said that scientific physiology emerged when primitive man first began to measure, correlate, and repeat experiences,¹ the development of medical science and its associated institutes was quite slow in Britain's thirteen North American colonies. An extensive medical treatise, with seven books devoted to physiology, was written by the noted French physician, Jean Fernel (Fernelius), as early as 1554. In 1659, Walter Charlton wrote the first English text on physiology.

The first curricular recognition of physiology was granted by the University of Edinburgh in 1726 with the appointment of Andrew Sinclair as Professor of the Institutes of Medicine. The term *Institutes of Medicine* is usually taken to mean physiology, but in practice it has actually been a composite of physiology, hygiene, physical diagnosis, experimental pathology, and even medical history and jurisprudence. The exact requirements of the Institutes were determined by the interplay between the needs of the institution and the specific interests and aptitude of the occupant of the Chair of Institutes of Medicine.

The Institutes of Medicine

In Philadelphia, a growing interest in medical affairs and progress led to the founding of Pennsylvania Hospital in 1751, its library (the first exclusively medical library in the country) in 1762, and the first school of medicine in the American colonies at the College of Philadelphia (University of Pennsylvania) in 1765. Even though the founders of the school, John Morgan and William Shippen, as graduates of the University of Edinburgh were well educated in physiology and undoubtedly shared their physiological knowledge and experiences with their students, no formal recognition of the teaching of physiology was made until Casper Wistar was appointed Professor of the Institutes of Medicine in 1789.

Once started, the medical educational infrastructure in this country developed rapidly. A medical department was established at King's College (Columbia) in 1767 and at Harvard College in 1782. As with their colleagues in Philadelphia, formalized courses in physiology were either sporadic or nonexistent for decades.

The founding of the College of Medicine of Maryland (forerunner of the University of Maryland) in 1807 established physiology as a pillar of medical education. The preamble to its charter states “that the science of medicine cannot be successfully taught under the usual organization of medical schools; that without the aids of physiology and pathology, either associated with anatomy or as a separate chair of the Institutes, the philosophy of the body in sickness or in health cannot be understood.” This visionary and forceful statement of principle unfortunately was not vigorously applied in practice.

■ Physiology Formalized

Physiology was taught to the students of Jefferson Medical College at its inception, but as with other institutions of the era the subject was not presented either in depth or as a formal curricular entity. Among the tickets issued for the initial course of lectures were those bearing the inscription, “Lectures of Anatomy and Physiology by Geo. McClellan, M.D.”² Although these lectures were undoubtedly structural in nature, with functional considerations lightly interspersed, it is nevertheless interesting to note the nineteenth-century recognition of the simultaneous consideration of structure and function (anatomy and physiology) as being the natural order. This was not a phenomenon unique at Jefferson but, rather, was the generally accepted curricular reality of the time. Later the two disciplines would go their separate ways, reuniting briefly with the reintroduction of a coordinated, integrated structure-function curricular concept nationally in the 1960s and at Jefferson in the 1970s.

Following McClellan’s initial effort, whatever limited physiological instruction was presented during the organizational phase of Jefferson’s existence was successfully presented by Drs. Benjamin Rush Rhees and John Revere. Revere, the youngest son of Revolutionary War patriot Paul Revere, was given the chair of Theory and

Practice of Physic and as such was responsible for instruction in physiology, pathology, and therapeutics. He developed a deep interest in chemistry. In his course description, Revere identified as a prime object “. . . to point out to the student the actual state of Science; to avoid, as far as practicable, hypothetical assumptions; and to assist him in distinguishing what is known from what is conjectured.”

From its inception, the Jefferson system of education combined pedagogy with practical medicine and formal lectures with exposure to actual clinical cases in both medicine and surgery. This concept was revolutionary. Belief of “the eye to be the most important organ in the acquisition of knowledge”² led to establishment of a prominent museum containing an extensive collection of anatomical and pathological specimens in 1834. Professors made liberal use of these specimens in illustrating their formal lectures and encouraged their students to make additional detailed observations. It was the faculty’s position that they lay the foundation upon which the student subsequently, by his own diligence, observation, and study, sharpened his skills and enhanced his standing in the profession of medicine. Furthermore, as early as the academic year 1833–1834, the faculty identified the need to enhance personal interaction between professor and student. Accordingly, a series of Medical Conversaciones was established, informal gatherings of students and professors on Saturday evenings in the Hall of the Museum. The hours were 8 to 11 P.M., and light refreshments were served. The aim was to foster a unity of spirit and purpose between professor and student, stimulate enhanced diligence to study, inspire confidence, convey medical knowledge, and develop personal relationships.

Robley Dunglison, M.D., First Chairman (1836–1868)

Recognizing “the progress of Medical Science,” the Board of Trustees established physiology, for the first time, as an independent course of study via the creation of a seventh Chair, a Professorship in the Institutes of Medicine and Medical Jurisprudence. Dr. Robley Dunglison³ (Figure 5-1), distinguished physician and generally accepted

“Father of American Physiology,” was elected to this chair in June, 1836. Dr. Granville Sharpe Pattison, then Professor of Anatomy at Jefferson and initiator of the negotiations that led to Dunglison’s move from the University of Maryland to Jefferson, explained in a June 24, 1836, letter to Dunglison that his chair would be entitled Institutes rather than Physiology or Materia Medica so as to allow maximal latitude for his instructional program.

An Englishman by birth, Robley Dunglison studied medicine in Edinburgh and Paris, passed the examinations of the Royal College of Surgeons and the Society of Apothecaries in London, and

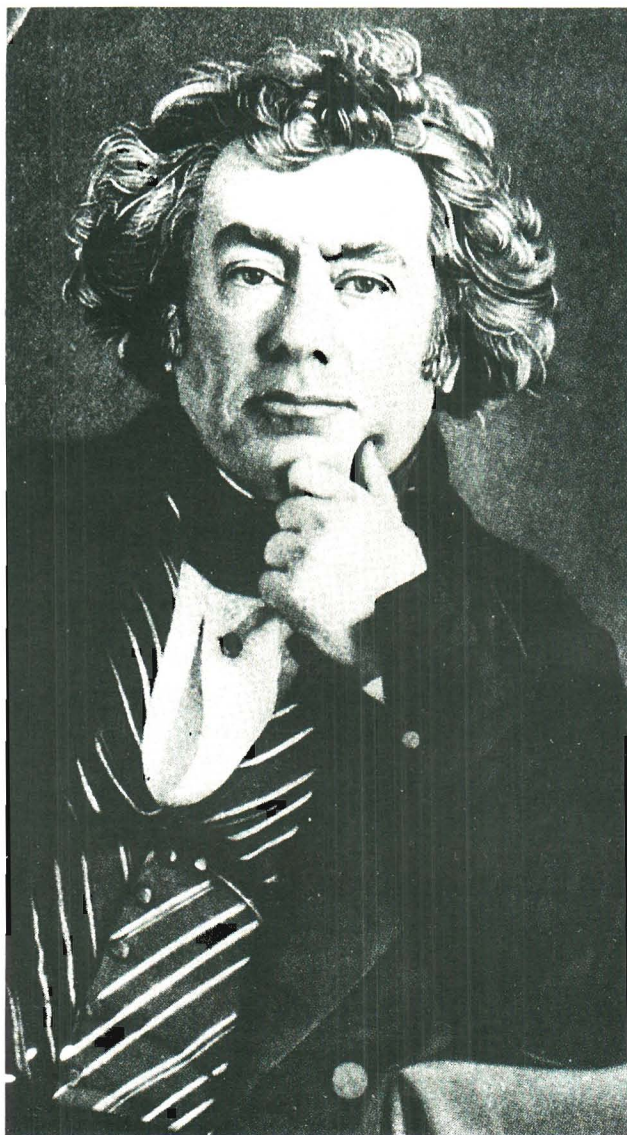


FIG. 5-1. Robley Dunglison, M.D., Professor of the Institutes of Medicine and Medical Jurisprudence (1836 - 1868).

then acquired an M.D. degree at the University of Erlangen, Bavaria, in 1823. The following year, as George McClellan set out to create a new school of medicine in Philadelphia, to the south the former president, Thomas Jefferson, was establishing a medical department in the University of Virginia, already founded in 1819. The University was to open with professors of ancient and modern languages, mathematics, natural philosophy, anatomy, and medicine. To fill this latter chair, Thomas Jefferson brought from England the young, broadly trained, and, for his youth, remarkably well-known and respected physician, Robley Dunglison.

■ **Dunglison, Physician to Presidents**

At its inception, and for the first two years of his nine-year tenure, Robley Dunglison alone was the School of Medicine of the University of Virginia. In 1827, Dunglison’s responsibilities were somewhat refined as he was named Professor of Physiology, Theory, and Practice of Medicine, Obstetrics, and Medical Jurisprudence. A Professor of Chemistry and Materia Medica was simultaneously added, as was a Demonstrator of Anatomy and Surgery. A close personal and professional relationship developed between the young physician and the aging former president. Dunglison became personal physician to Thomas Jefferson, tending to his ills during the last two years of his life and actually spending the last eight days of Jefferson’s life by his side. Death came to Jefferson on July 4, 1826, fifty years to the day after the signing of the Declaration of Independence. This relationship was especially unique in that, throughout his life, Jefferson was reported to have had a deep distrust of physicians.⁴

In 1833 the interaction of professional challenge, financial advancement, and desire to remove Mrs. Dunglison, who suffered from imperfect health, from the relatively primitive living conditions of Charlottesville to a different climate led to his acceptance of the professorship of Materia Medica

in the University of Maryland at Baltimore. At this time, Dunglison's reputation was assured in America by the publishing in 1832 of his *Human Physiology*, a text that was to go through eight editions and become the standard in the field for many years.

In 1835 Professor Granville Sharpe Pattison set in motion forces that resulted in the Dunglisons' relocation from Baltimore to Philadelphia and the establishment of a vital role in the development of Jefferson Medical College over a period exceeding 30 years. Dunglison's establishment of a Department of Physiology was well received. Jefferson's *Catalogue of Instruction* (1839) demonstrated obvious pride when it stated, ". . . the department of physiology has been largely expanded, and it is now regarded as indispensable to make the healthy manifestations the point of departure for all enlightened pathological deductions. . . . Medical Jurisprudence, long taught in the school of continental Europe, has also taken its place as a department of instruction in our medical college."

■ Dunglison and Beaumont

When Dunglison accepted the Institutes chair at Jefferson, he ceased practicing medicine. By devoting all his efforts to academic pursuits, he thus personified the first full-time American physiologist. Dunglison's keen mind and extensive experience continued to be highly respected in practical medical affairs, nevertheless, and resulted in 1842 in the publication of his *Practice of Medicine*. He was not an experimentalist, and he lived in an age not known for its great laboratory strengths. It is important to recognize, however, that Dunglison was involved in perhaps the most exciting and brilliant experimental contribution to the physiology of the period, the work of Dr. William Beaumont.⁵

Beaumont was the American military physician who treated woodsman Alexis St. Martin for an accidental shotgun wound. St. Martin recovered, but a permanent gastric fistula remained.

Beaumont took St. Martin into his home and personally cared for him. An inquisitive mind led Beaumont into a series of innovative experiments with St. Martin that resulted in a heightened understanding of the basic physiology of the stomach. Samples of gastric juice were sent to Dunglison while he was still in Charlottesville and to Dr. Silliman at Yale. Both reported the presence of free hydrochloric acid. Dunglison and Beaumont subsequently carried on a running correspondence that Beaumont acknowledged was of great value in guiding future researchers. On at least one occasion, they met in Washington, D.C., to discuss the accumulated data and to devise additional experiments.

■ Dunglison and Mitchell

Dunglison, the nonexperimentalist, was also a vital stimulant in the development of perhaps the greatest experimentalist, who bridged physiology and experimental medicine in the mid-nineteenth century. That man, Silas Weir Mitchell (Figure 5-2), was the son of Dr. John Kearsley Mitchell,



FIG. 5-2. S. Weir Mitchell, M.D., early American physiologist.

Professor of Medicine in the famous faculty of 1841. After graduating from Jefferson in 1850, Mitchell spent a year in Paris. Here he was greatly influenced by Claude Bernard, a founder of experimental medicine and originator of the *milieu interieur* concept. After investigating with Bernard the properties of rattlesnake venom, Mitchell returned to Philadelphia to continue his research. He extensively explored the physiology of the central nervous system and, via skillful union of physiology and experimental medicine, is generally credited with being the “Father of Neurology.” Mitchell’s experiments were revolutionary for his era. His publication in 1864 of *Gunshot Wounds and Other Injuries of Nerves*, based on his Civil War experiences and scientific observations, laid the foundation for much of the modern knowledge of neurologic symptomatology. Mitchell never held an academic appointment in physiology. A man of many talents, world-renowned clinician, premier experimental physiologist of the 1850–1875 period, man of letters and literature, he nevertheless was an unsuccessful candidate for Chairs in Physiology when those ultimately became open at the University of Pennsylvania (1863) and at Jefferson (1868). Despite this lack of a formal credential, Mitchell’s influence on an emerging generation of young physicians made Philadelphia a focus of developing interest in experimental physiology.

James Aitken Meigs, M.D., Second Chairman (1868–1879)

Upon Dunglison’s retirement in 1868, two of the prime candidates to succeed him were former students of his at Jefferson: Silas Weir Mitchell (Jefferson, 1850) and James Aitken Meigs (Jefferson, 1851) (Figure 5-3). Both had international reputations, Mitchell as an experimentalist and Meigs as an ethnologist. It was an era of American medicine in which there was little prestige in research. Clinical practice and teaching ability assumed much priority over the talent for investigation. Accordingly, the Trustees awarded the Chair of the Institutes of Medicine and Medical Jurisprudence to Meigs with the commencement of the 1869–1870 academic year.

Following his graduation from Jefferson, Meigs, a Philadelphian, held a series of junior teaching appointments at the Pennsylvania Medical College

(founded by Dr. George McClellan) and the Philadelphia College of Medicine. He lectured at the Franklin Institute and was an active and prominent member of the Academy of Natural Sciences. Meigs had a deep interest in anthropology, and his anthropological papers were widely respected in Europe as well as in the Americas. He maintained a large private practice, which was most active in obstetrics.

In the field of medical education, Jefferson had been a leader in the concept of integrating direct clinical experience with the didactic elements. With Meigs’ assumption of the Institutes Chair, his was

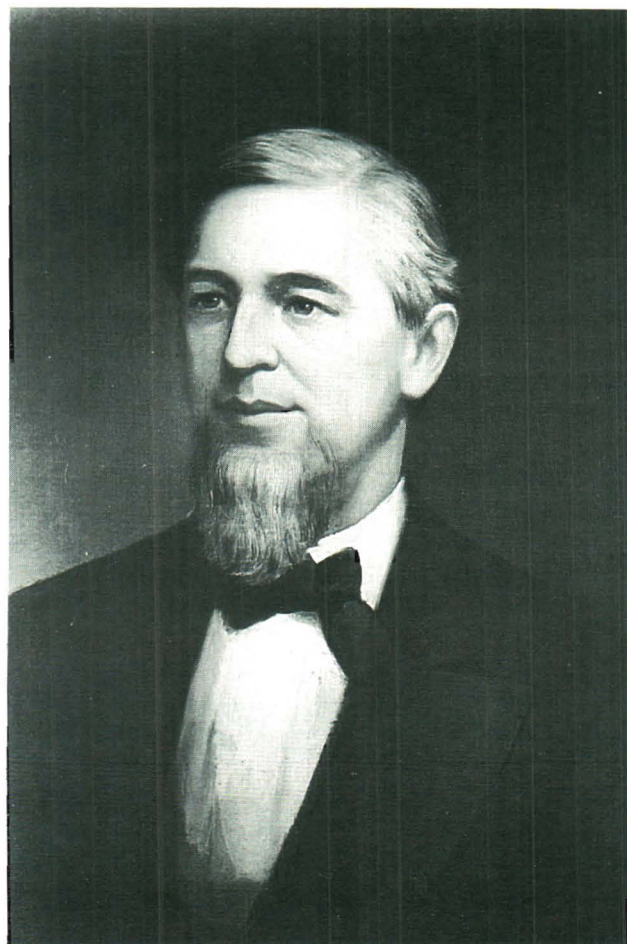


FIG. 5-3. J. Aitken Meigs, M.D., Chairman, Institutes of Medicine (1868–1879).

among the first physiology departments to use animals in demonstrations before the class. The introduction of anesthesia (ether, chloroform, nitrous oxide) further facilitated these demonstrations—such use of live animals without their suffering was quite progressive. Nevertheless, a strenuous antivivisection movement quickly developed and persisted to this day. Among those who spoke most forcefully in defense of enlightened vivisection was Silas Weir Mitchell.

Although not nearly as prolific an author as Dunglison had been, Meigs⁶ nevertheless published some 30 papers, edited the American edition of Kirke's *Handbook of Physiology*, and assisted in the production of Carpenter's *The Microscope and Its Revelations*. Jefferson was among the earliest institutions to utilize seriously the microscope in medical education. A course in practical microscopy was inaugurated under the direction of Meigs as the Professor of Physiology and conducted by a Demonstrator in Histology. The laboratory was reported to be amply provided with microscopes and all other appliances requisite for thorough practical instruction.

Long a leading member of the Academy of Natural Sciences, Meigs was asked to give the address at the laying of the cornerstone of its new building in Philadelphia in 1872. He died suddenly on November 9, 1879. In April, 1880, eight recent Jefferson graduates formed in his honor the Meigs Medical Association for continuing friendship and education, which has flourished and is now one of the oldest associations of its kind in existence.⁶

Henry Cadwalader Chapman, M.D., Third Chairman (1880– 1891)

With Meigs' death, the responsibilities of the department fell in midterm on his teaching assistant, Dr. H. C. Chapman. Born in

Philadelphia, Henry Cadwalader Chapman (Figure 5-4), was educated at the University of Pennsylvania and its School of Medicine (M.D., 1862). Following a residency at Pennsylvania Hospital, Chapman went abroad for three years of study in London, Paris, Berlin, and Vienna. Upon his return to Philadelphia, he was named prosector (person to prepare material for demonstrations) for the Philadelphia Academy of Natural Sciences and for the Zoological Society. The latter group provided an abundance of animal material for dissection. In this work, Chapman was associated with the distinguished anatomist Dr. Joseph Leidy, of the University of Pennsylvania. The results of these studies, often performed at the Zoological Garden, appeared in the *Proceedings of the Academy of Natural Sciences*.

In 1878 Chapman was appointed Demonstrator in Physiology under Meigs and curator of the museum. He assumed complete departmental responsibility with Meigs' death. After successfully performing the duties of that department, Chapman was unanimously elected to the Chair of Institutes of Medicine and Medical Jurisprudence by the Trustees on April 12, 1880.



FIG. 5-4. Henry Cadwalader Chapman, M.D., Third Chairman (1880–1891).

Chapman's association with Jefferson represented historical irony. Henry Chapman was the grandson of Dr. Nathaniel Chapman. When George McClellan was struggling to establish his unprecedented second medical school in Philadelphia, it was Nathaniel Chapman who rallied his fellow faculty at the University of Pennsylvania School of Medicine to oppose Jefferson's creation. Within a year of Dunglison's arrival in Philadelphia, each of the professors of the University of Pennsylvania had paid social calls of welcome except for one: Dr. Nathaniel Chapman, despite the fact that they had previously known each other. Chapman had been entertained at Dunglison's home when he lived in Baltimore and Dunglison had visited Chapman in Philadelphia. It must be pointed out, however, that Nathaniel Chapman's opposition to Jefferson Medical College was based on purely ethical convictions. It did not tarnish his achievements as a master clinician, engaging teacher, founder of the *Philadelphia Journal of the Medical and Physical Sciences* (which became the *American Journal of the Medical Sciences*), and first President of the American Medical Association in 1847. A resolution by the Dean and Faculty of Jefferson at Nathaniel Chapman's death in 1853 attested that outward ill will no longer persisted between the two rival schools:

“At the semi-annual meeting of the Faculty of Jefferson Medical College, held on the second day of July, 1853, the announcement of the decease of Professors Horner and Chapman having been made, it was resolved *unanimously*, that the Faculty, in common with their medical brethren, deeply deplore the loss to science of two individuals, the better part of whose valuable lives had been spent in the successful teaching of a profession of which they were distinguished ornaments, and to the advancement of which they had both so largely contributed. Resolved that a copy of this resolution be sent to the families of the deceased, and be published in the medical journals (Extracted from the minutes, R. M. Huston, M.D., Dean of the Faculty).”

The grandson's appointment to Jefferson caused no untoward reaction in either school.

As curator of the museum, Henry Chapman added significantly to its collections. When space became a problem, appropriate building modifications were made. Despite Chapman's background in prosection, he did not pursue Meigs' use of animals in teaching demonstrations

with equal vigor. His postgraduate travels in Europe led to increasing utilization of the modern mechanical apparatus that was then coming into vogue for teaching purposes.

Throughout its history, Jefferson held a position of prominence in the publication of texts for medical education. Dunglison had published the standard texts in physiology and in hygiene and his *Medical Dictionary* maintained a position of supremacy for decades after his death. Meigs, in his turn, edited American editions of leading European texts. In 1887, Henry Chapman published *Human Physiology*. Subsequently, Chapman wrote the memoirs of his close friend and colleague in research, Joseph Leidy, Professor of Anatomy at the University of Pennsylvania.

S. Weir Mitchell and the American Physiological Society

The experimental elements in physiology had their foundation in Europe, primarily under the influence of Johannes Müller in Germany and Magendie and Bernard in France. With the notable exceptions of the remarkable work of Beaumont and of the enlightened S. Weir Mitchell, the experimental traditions of physiology in America would wait for the late 1870s when, almost simultaneously, three independent physiological laboratories were established: at Harvard Medical College under Bowditch, at the Graduate School of Johns Hopkins University under Newell Martin, and in physiological chemistry at Yale University under Chittenden. Within a decade of the establishment of these laboratories, a sufficient critical mass of investigators and trainees had been established, supplemented by the young medical graduates in Philadelphia, who, under the influence of S. Weir Mitchell, had sought further specialized training in physiology and medicine in Germany and France, sufficient to warrant formation of a national society of physiologists.

president. Mitchell served for two terms (1888–1890), when he again declined election to Council in order to serve as president of the Triennial Congress of Physicians and Surgeons. The American Physiological Society represented one of the affiliated societies of the congress, which significantly assisted the interaction between basic physiological research and experimental medicine.

At the conclusion of the inaugural meeting of the American Physiological Society, the group adjourned for the purpose of visiting Chapman's laboratory at Jefferson.⁸ Seven years later, the eighth annual meeting of the Society (1895) returned to Philadelphia at the University of Pennsylvania on December 27 and at Jefferson on December 28. At this meeting, Chapman addressed the Society on "Methods of Teaching Physiology." The talk was demonstrative, illustrated by apparatus that he had previously devised. He urged the value of the comparative method and displayed a series of mammalian brains, together with other comparative anatomical preparations. Assisted by his able Demonstrator, Dr. Albert P. Brubaker, Chapman featured extensive demonstrations in digestion and absorption and in circulation, respiration, calorimetry, secretion, the nervous system, vision, voice, and hearing.

These demonstrations were effective, but Chapman and Brubaker continued to advocate that medical students perform their own laboratory experiments and thereby acquire for themselves the essential fundamentals of physiology and experimental medicine. In 1899, such a student laboratory in physiology was established at Jefferson, funded by Louis Clarke Vanuxem, Esq., a Trustee.

As reported in the February 1900 issue of the undergraduate publication, *The Jeffersonian*, the organization of the laboratory was entrusted to Professor Chapman and Dr. Brubaker, who, in conjunction with Messrs. Williams, Brown, and Earle, designed the plan, tables, and apparatus. The laboratory, 76 feet long by 22 feet wide, simultaneously accommodated two sections of 50 students each: a freshman section to investigate the fundamentals of physiological chemistry, movements of the heart, circulation of the blood, and respiration; and a section for second-year students investigating the nervous system, muscles, and special senses. From the top of each table rose substantial cases provided with sliding glass doors in which all the apparatus required by each student was kept. This obviated the necessity of carrying the apparatus from a storage room and

The American Physiological Society was formed on December 30, 1887. Although it is difficult to determine the exact origin for the concept of such a society, Howell, in the *History of the American Physiological Society*,⁷ reported that the idea of forming a society of physiologists originated with Dr. S. Weir Mitchell. In November 1887, invitations to a December 30 organizational meeting were sent out over the signature of S. Weir Mitchell, H. N. Martin, and H. P. Bowditch, in that order. The organization meeting was held at the College of Physicians and Surgeons in New York with Mitchell presiding.

Of the 28 men identified in the minutes as original members of the society, three had Jefferson connections—in addition to Silas Weir Mitchell and Henry Chapman, Dr. Hobart Amory Hare was on the list. A Philadelphian by birth, Hare was educated at the University of Pennsylvania, where he received degrees in arts and in medicine (1884). Inspired by Mitchell, he pursued postgraduate experimental physiology in Leipzig and Berne and returned to Philadelphia as Lecturer in Physiology at the University of Pennsylvania. In 1890, Hare was appointed Clinical Professor of Diseases of Children at the University of Pennsylvania and in 1891 commenced a long affiliation with Jefferson as Professor of Therapeutics and Materia Medica and one of the leading medical writers in this country. Sustaining Jefferson's reputation as a leader in the publication of texts in medical education, Hare's *Practical Therapeutics* went through 22 editions.

Jefferson's importance to the founding of the American Physiological Society is further demonstrated by its hosting the first annual meeting of the Society on December 29, 1888. Mitchell was probably the most distinguished and widely known member of the Society at the time of its formation and he was elected to Council at the organization meeting but declined the offer. Had he accepted, there is little doubt that Mitchell would have been chosen president, based on his eminence and seniority of service. At the first annual meeting he was again elected to Council, accepted election, and was subsequently elected

prevented loss of time and breakage. Each case contained a kymograph, induction coil, moist chamber, electrodes, muscle levers, dissecting apparatus, physiological solutions, and drugs. For purposes of stimulating muscles and nerves, the electricity, instead of being derived from cells, came from the house current and was distributed by a controller to each station. The controller also provided each student with light, a unique feature. *The Jeffersonian*, with justifiable pride, identified this laboratory as “second to none in this country.” It was a most auspicious manner in which to enter the twentieth century.

Chapman retained his chair until the conclusion of the 1908–1909 academic year, when he was made Emeritus Professor. His period of retirement was all too short, and he died on September 9, 1909, in Bar Harbor, Maine. Chosen as Chapman’s successor was his long-time associate, Dr. Albert P. Brubaker. Brubaker’s title was modified to that of Professor of Physiology and Medical Jurisprudence.

Albert P. Brubaker, M.D., Fourth Chairman (1904–1927)

The son of a general practitioner, Dr. Henry Brubaker of Somerset County, Pennsylvania, Albert P. Brubaker (Figure 5-5) attended Jefferson and graduated with honors in 1874. Following postgraduate training in clinical medicine at the Charity Hospital, he associated himself with Dr. Wharton Sinkler of the University of Pennsylvania at the Orthopedic Hospital. Their work involved a study of the anatomy of the nervous system and its relation to physiological and pathological processes in the body. In 1881, Henry Chapman appointed Brubaker as Demonstrator of Physiology, a position to which in 1884 Histology was added, with the further addition of Experimental Therapeutics in 1885.

When, on October 27, 1890, Jefferson’s Trustees voted to vacate Dr. Roberts Bartholow’s Chair of Therapeutics’ Materia Medica, and Hygiene, a decision was made to postpone the election to the Chair for a year. In the interim, Brubaker was selected to give the course, the Chair of which was awarded to Dr. Hobart A. Hare in 1891.

In 1899, Brubaker was named Adjunct Professor of Physiology and Hygiene, and in 1904, Professor of Physiology and Hygiene.⁹ It was the first

instance of the department having two professors simultaneously. Chapman and Brubaker both gave lectures in physiology and shared duties in the weekly recitations. In addition, Brubaker gave the course in hygiene (exercise, diet, bathing and sanitation, water supply, drainage, and ventilation); Chapman gave the course in medical jurisprudence. Increased emphasis in the course of hygiene relative to the prevention of disease by measures to control microorganisms and the spread of infectious disease led to the development of later courses in bacteriology.

In addition to teaching physiology at Jefferson, Brubaker also taught at the Pennsylvania School of Dentistry and the Drexel Institute in Philadelphia.



FIG. 5-5. Albert P. Brubaker, M.D., Fourth Chairman (1904–1927).

lectures was evidenced in both texts. This talent for organization led to his success in numerous faculty committees and his ultimate selection as Chairman of the Faculty.

■ The Unique Dr. Lucius Tuttle

To assist with the duties of his department, Brubaker in 1911 appointed Dr. Lucius Tuttle as Demonstrator in Physiology. Tuttle had the distinction of the longest association of any individual with the Department of Physiology, exactly fifty years (1911–1961). He was a tall, thin, moustached man, strong in mathematics, and with an introverted personality. Brubaker presented all of the lectures in physiology, while Tuttle handled the weekly recitations. Laboratory responsibilities were shared; the experiments dealt with the functions of muscles, nerves, the spinal cord, and heart, circulatory, and respiratory apparatus, as well as the pharmacological action of the more important drugs of the day.

Lucius Tuttle (Figure 5-7), a graduate of Yale,

Upon Henry Chapman's relinquishment of his chair in 1909, Brubaker was elected in his stead. Brubaker was known as a kindly and fatherly person whose pedagogic style was clear, simple, and direct. Before class he would draw illustrations for the students in contrasting colors and append a synopsis to which he would strictly adhere. He was always available to his students, and in 1927 was honored by the Class of 1929 for fifty years of teaching (Figure 5-6). In keeping with the Jefferson tradition of textbook generation, Brubaker authored a *Textbook of Physiology*, which went through eight editions. In addition, to complement the emerging student laboratory in physiology, Brubaker published a *Compendium of Physiology*. A superb clarity of his



FIG. 5-6. Cup presented in 1927 honoring Professor Brubaker's fifty years of teaching.



FIG. 5-7. Lucius Tuttle, M.D., Physiologist, Physicist, Mathematician.

received his M.D. degree from Johns Hopkins in 1907. His initial postgraduate position was as Assistant Demonstrator of Pathology at the University of Pennsylvania (1908–1910).¹⁰ Having been appointed Demonstrator in Physiology at Jefferson in 1911, Tuttle's position was broadened in 1914 to Demonstrator of Physics and Physiology in recognition of his considerable mathematical aptitude. In 1915 he was named Associate in Physics and Physiology and published *Introduction to Laboratory Physics*, followed by *The Theory of Measurements* in 1916.

■ First Graduate Education at Jefferson

In February, 1913, Jefferson's Trustees approved a resolution permitting the use of the college laboratories for holders of the bachelor's degree in arts or in science who wished to engage in special research deemed of interest and importance to medicine and surgery. This was Jefferson's first

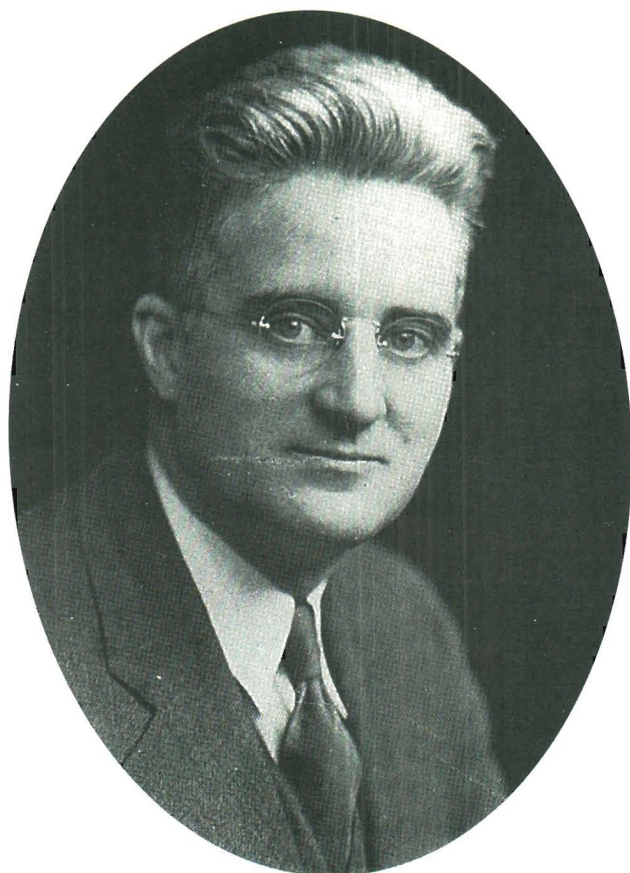


FIG. 5-8. J. Earl Thomas, M.D., Fifth Chairman (1927–1955) and Experimental Physiologist.

attempt at graduate education. Such persons at the end of one full year's work might be recommended by the faculty to the Trustees for the degree of Master of Science and, at the end of three years, the degree of Doctor of Philosophy. Beginning with the academic year 1914–1915, the entrance requirements for admission to Jefferson's medical course were advanced. In addition to an accredited four-year high school course, one full year of collegiate work in chemistry, physics, biology, and either German or French was necessary. In 1915, Olaf Bergeim (B.S., M.S., University of Illinois) became the first recipient of a Ph.D. from Jefferson. His dissertation, in physiological chemistry, was entitled "A Study of Calcium Metabolism in Certain Pathological Conditions." Between 1915 and 1926, a total of three Ph.D., four M.S., two D.Sc. and two B.S. degrees were awarded. After this period, graduate education did not reappear at Jefferson for over 20 years.

At the conclusion of the 1926–1927 academic year, Dr. Albert P. Brubaker retired as Professor of Physiology and Medical Jurisprudence at age 75 to become Emeritus Professor. For 30 years Brubaker was president of the Meigs Medical Association, and the Class of 1926 presented his portrait to the college. Brubaker died in 1943 at the age of 91.

J. Earl Thomas, M.D., Fifth Chairman (1927–1955), Research Innovator

As Brubaker's successor, Jefferson chose Dr. J. Earl Thomas (Figure 5-8), a graduate (B.S., M.S., M.D.) of St. Louis University School of Medicine. Selecting an academic career, Thomas served as Instructor and was promoted to Assistant Professor of Physiology at St. Louis University School of Medicine (1918–1920). After an Associate Professorship in West Virginia School

of Medicine (1920–1921), he returned to St. Louis University (1921–1927).

Jacob Earl Thomas^u was a noted experimentalist, skillful experimental surgeon, and ingenious designer of research equipment. This talent for designing and making numerous pieces of laboratory equipment that came to be widely used in teaching and research has been ascribed to his boyhood experience as an apprentice in the mechanical trades. The author of more than 200 scientific papers, primarily concerning the physiology of the digestive system, Thomas materially enhanced understanding of the regulation of gastric emptying, the filling and evacuation of the gallbladder, the autoregulation of gastric secretion, the complexities of the enteroenteric reflexes, and the mechanisms of pancreatic secretion. Instrumentation and techniques that he developed to aid these advances include the Thomas drop recorder, the Thomas wrench, the Thomas intestinal cannula, the Thomas gastric pouch, and the Thomas pancreatic fistula.

In Thomas' department Tuttle assumed responsibility for approximately one-third of the lectures: the physiology of blood, muscle, and nerve, electrophysiology, and the physiology of sensation, with appropriate demonstrations to the class. In 1929, Tuttle was named Assistant Professor when Jefferson moved into the 1025 Walnut Street College. The new physiology laboratory provided facilities that fostered student experiments on larger animals and in wider variety than the earlier laboratory of 1899.

In 1931, Thomas expanded the full-time department faculty to three with the appointment of Dr. Joseph Otterbein Crider as Associate Professor. At this time Crider was already a mature academician. Born in Harrisonburg, Virginia, he received his M.D. degree in 1912 from the University of Virginia School of Medicine, Charlottesville, the institution that Robley Dunglison had first established for Thomas Jefferson. After an initial appointment as Associate Professor of Physiology and Pharmacology at the University of Virginia (1912–1913), he moved to

the University of Mississippi School of Medicine where he successively served as Associate Professor of Physiology and Histology (1913–1916), Professor of Physiology and Histology and Assistant Dean (1916–1924), and Professor of Physiology and Dean (1924–1930). At Jefferson, he was concomitantly Assistant Dean. In a deep southern accent, Crider did most of the interviewing of prospective Jefferson students as admissions officer under Dean Ross V. Patterson.

Crider joined Thomas in presenting lectures and demonstrations on the physiology of the major organ systems. Recitations were conducted by Thomas, Crider, and Tuttle—the latter two shared the responsibilities of the student laboratory. As early as 1928, Thomas had introduced research as a student option: “Students may, at the discretion of the member of the staff concerned, be permitted to act as voluntary assistants in the research of the department.” Such an enhancement of the program became possible not merely as a result of Thomas' interest in research but also as a reflection of the maturation of the college and of its student body. In 1929, three years of collegiate work became a prerequisite for admission to Jefferson. In 1930, these options were further enhanced by the announcement that “properly qualified candidates may, at the discretion of the Department and College administration, be granted fellowships for full or part-time research or teaching.” Christopher J. Morgan, M.D. served as a Research Fellow in Physiology (1931) and assisted with both recitations and the student laboratory.

J. Earl Thomas was a man who was intellectually curious and had a deep commitment to experimental physiology. Nevertheless, he never failed to devote himself wholeheartedly to teaching. His lectures were always exceptionally well organized on small note cards and were clear, concise, and easily understood. A significant amount of material was contained within each lecture but was so well paced that the student could take excellent notes. Thomas always exhibited a sympathetic attitude toward those in scholastic difficulties and never was too busy to help a student.

■ The Physiological Society

In 1932 Thomas assumed the presidency of perhaps the oldest local physiology society in the nation,

the Physiological Society of Philadelphia. Founded October 10, 1904, as the Society of Normal and Pathological Physiology at the medical laboratories of the University of Pennsylvania, this originally “in-house” discussion group was to evolve into a strong regional and national influence in the growth and advancement of the profession. Lucius Tuttle, while still on the faculty of the University of Pennsylvania, appears in minutes of the meeting of November 23, 1908, as a guest of the society. Interestingly, the minutes of this same meeting contained an affirmation “to extend membership and usefulness outside the University of Pennsylvania.” Tuttle was elected to active membership in the society on March 1, 1909. (Brubaker would appoint Tuttle to the Jefferson faculty in 1911).

The name Albert P. Brubaker first appears in the minutes of the society as a guest at the meeting of March 22, 1909. Thereafter, he was a frequent discussant of members’ presentations and was elected to full membership on March 25, 1913. The January 1916 membership list of the society contained the name of Olaf Bergeim, first recipient of a Ph.D. from Jefferson (1915). On December 15, 1919, the society adopted its current name of the Physiological Society of Philadelphia.

Thomas served as president of the society, 1932–1934. He was influential in enhancing its regional status and membership. Under his auspices, the first meeting of the society at Jefferson occurred on January 16, 1933. He established the role of the Physiology Society of Philadelphia as an international forum for the most advanced physiological thought of the day. At a special meeting of the society on April 18, 1933, Sir Henry H. Dale addressed an audience of 350 on “Progress in Autopharmacology.” The next year, at a similar special meeting of the society held on April 3, 1934, Dr. Corneille Heymans (Professor of Pharmacology, University of Ghent) discussed “The Role of the Carotid Sinus in the Regulation of Blood Pressure and Heart Frequency” before an overflow crowd of 400.

The society progressed, retaining its sturdy foundation at the University of Pennsylvania but incorporating the physiological strength of the entire region. Thomas had been the first Jeffersonian to lead the Physiological Society of Philadelphia, but he would not be the last. For the next 50 years, the further development of the society would be intimately intertwined with significant names of physiologists at Jefferson: Friedman, DeBias, Siegman, and Lefer.

■ New Relationships

The year 1940 marked the beginning of a decade of significant expansion of the Department under Thomas. The appointment of a number of truly outstanding fellows, with joint responsibilities in the Departments of Physiology and Medicine, and the expansion of the full-time faculty resulted in meaningful and continuing research that incorporated basic and clinical science. Among the earliest and most productive of these fellowships was that awarded to Dr. Karl E. Paschkis.

Viennese by birth, Karl Ernst Paschkis received his undergraduate and medical education at the University of Vienna. Following graduation (1919) he accepted positions as Assistant in Anatomy, University of Vienna Medical School (1920), and a clinical appointment at Kaiser Franz Joseph Hospital (1920–1924), and as Acting Director of its Department of Pathology (1924–1925). He held subsequent clinical appointments in the Department of Medicine at Vienna’s University Hospital (1925–1931), and Allgemeine Poliklinik (1931–1938). As the political climate of Austria turned increasingly unsettled, Paschkis, at 42 years of age and with an established academic and professional reputation, emigrated from Austria to the United States.

Arriving in Philadelphia, Paschkis became a Research Associate at the Fels Institute (later a part of Temple University), where he expanded his horizons by engaging in endocrine physiological research. In 1940 he came to Jefferson as Teaching and Research Fellow in Physiology and Medicine. In the Department of Physiology, Paschkis assumed the responsibility for the lectures in endocrine physiology. His research in endocrinology developed along interdepartmental lines and resulted in Jefferson’s Endocrine Clinic becoming widely recognized as an important center for research, clinical treatment, and training in endocrinology. Karl Paschkis was appointed chief of this clinic in 1942 and Associate in Physiology in 1944. As his research became more directed toward endocrinological aspects of carcinogenesis, still greater interdepartmental

activity resulted, leading to eventual formation of a Division of Endocrine and Cancer Research in 1949 with Karl Paschkis as director. Principal collaborators in these interdepartmental efforts were Paschkis (physiology/medicine), Abraham Cantarow (biochemistry), and Abraham Rakoff (obstetrics/gynecology). Additional important collaboration was supplied by Romano DeMeio (biochemistry), Adolph Walkling (surgery), and Joseph Rupp (medicine). Over 100 research publications resulted from these collaborative efforts.

■ Clinical Physiology

At the time of Paschkis' initial appointment in 1940, two outstanding young physicians were similarly named fellows, with joint responsibilities in both the Departments of Physiology and in Medicine: Drs. C. Wilmer Wirts and J. Edward Berk. Both men shared Thomas' interest in gastroenterology and devoted their careers to its advancement in education, research, and clinical training. Aside from postgraduate training in Chicago, London, and Paris, Wirts (Jefferson, 1934) maintained his Jefferson affiliation in excess of 40 years, enhancing clinical research and training in the Gastrointestinal Division of the Department of Medicine. A pioneer in gastrointestinal endoscopy, Wirts authored approximately 150 publications and was instrumental in obtaining the first National Institutes of Health fellowship training grant in gastroenterology in Philadelphia for Jefferson. He served as president of both the American Gastroscopic Society and of the American College of Gastroenterology.

J. Edward Berk (Jefferson, 1936) took his postgraduate training at the Graduate School of Medicine of the University of Pennsylvania and at the Albert Einstein Medical Center of Philadelphia before being named a Ross V. Patterson Fellow in Physiology at Jefferson in 1940. Subsequently, Berk held academic positions at the University of Pennsylvania, Temple University (Assistant

Director, Fels Research Institute), Wayne State University, and the University of California, Irvine (Head, Division of Gastroenterology, and Chairman, Department of Medicine). He authored over 250 publications. In recognition of his many talents, Berk was elected governor of the American Society for Gastrointestinal Endoscopy, chairman of the Section of Gastroenterology of the American Medical Association, president of the Bockus International Society of Gastroenterology, and president of the American College of Gastroenterology. He received the Jefferson Alumni Achievement Award in 1977.

While attending the March 1941 meetings of the Federation of American Societies for Experimental Biology in Chicago, Thomas and Crider encountered Dr. M.H.F. Friedman, then a Research Associate in Physiology at Wayne State University. Impressed with his background, and the manner in which Friedman handled potentially sensitive issues at the meetings, Thomas offered Friedman a position in his department.

A Canadian by birth (Montreal), Moe Hegby Fred Friedman was educated at McGill University (B.Sc., 1930), University of Western Ontario (M.A., 1932), and then again at McGill University (Ph.D. in Physiology, 1937). At Jefferson, Friedman's initial responsibilities included participation with Thomas, Crider, and Tuttle in recitations and with Crider and Tuttle in the physiology laboratory and demonstrations. His investigative interests, as with Thomas, focused on gastrointestinal physiology. While at Wayne State, Friedman had worked with an extract of urine that was reported to inhibit gastric secretion and to offer therapeutic possibilities for ulcer treatment. This was the work that he reported in Chicago before Thomas and Crider. At Jefferson he worked to develop a method of isolating rather pure secretin from pig intestine, a method that Wyeth Laboratories ultimately utilized as the first commercially successful method of obtaining secretin in this country. It was this preparation that Thomas and Crider utilized in their pioneering studies of pancreatic physiology.

At the outbreak of World War II (the academic session of 1941–1942), many of the staff physicians joined the Jefferson Hospital Unit. Friedman often went to the Gastrointestinal Clinic to aid the remaining short-handed staff. These contacts led to lifelong relationships that resulted in clinically relevant joint investigative projects.

Concurrent with Friedman's joining the department in 1941, Thomas named Irwin Jack

Pincus (Jefferson, 1937) as Patterson Fellow in Physiology. Pincus' postgraduate training was at the University of Pennsylvania and in Los Angeles. Following his fellowship year of 1941–1942, he accepted clinical appointments at Valley Forge General Hospital, Philadelphia General Hospital, and the Philadelphia Veterans Administration Hospital before returning to Jefferson in 1946 as Instructor in Physiology. While maintaining a clinical practice, Pincus investigated the properties of glucagon, its role in carbohydrate metabolism, and its potential relation to the etiology of diabetes mellitus.

In 1945, Thomas appointed William J. Snape (Jefferson, 1940) as Associate in Physiology. As with Pincus, Snape maintained a clinical practice while pursuing studies of gallbladder function and biliary secretion, using a newly developed type of biliary fistula (developed by Snape in cooperation with other departmental members). In addition, Snape, who went on to become Chief of Gastroenterology at Cooper Hospital (Camden, New Jersey) engaged in cooperative studies with Drs. Friedman and W. Addison Clay (Public Health Service Fellow in Physiology, 1949–1951) concerning the effect of certain antihistamines on gastric secretion, particularly the secretion induced by histamine or by gastrin.

By 1945, the effects of age and chronic illness led Lucius Tuttle to conclude that he could no longer maintain the full-time involvement in the department that he had sustained since 1911. There being no pension plan in force at the time, nor social security or other income, Tuttle was retained on the departmental roster as Assistant Professor and his salary was maintained. This special arrangement was confirmed by the Trustees on October 27, 1947, and continued until 1961 (50 years from the date when Tuttle first joined the department). On March 27, 1961, the Executive Faculty named Lucius P. Tuttle an Honorary Professor of Physiology, and on May 4, 1961, Tuttle succumbed in Jefferson Hospital.

■ Postwar Developments

Further expansion of the Department resulted with the appointment in 1946 of Irving H. Wagman as Associate, in 1947 with Jerome M. Waldron as Instructor and Samuel Stinger Conly, Jr. as Demonstrator. A native of New York City, Dr. Wagman received his Ph.D. in Physiology in 1941 from the University of California, Berkeley.

Trained as a neurophysiologist, Dr. Wagman initiated studies at the University of California and subsequently at the National Institutes of Health in vision and oculomotor mechanics. On arriving at Jefferson, Wagman joined Thomas in an investigation of degeneration and regeneration of the vagus nerves growing out of Dr. Thomas' interest in vagotomy as a potential treatment for peptic ulcer. In addition, Wagman obtained a U.S. Public Health Service grant to study the problems of aging, specifically to determine the changes that occur in the functional capacity of peripheral nerves and reflex centers from infancy to old age. In cooperation with members of the Department of Biophysics at Johns Hopkins, Wagman extended his earlier work on the function of the extraocular muscles in relation to eye movement and the measurement of light threshold of the visual sense organ.

Following graduation from the University of Pennsylvania School of Medicine (1943), Dr. Jerome Michael Waldron interned at Fitzgerald–Mercy Hospital (Darby, Pennsylvania), followed by a Fellowship in Medicine at Pennsylvania Hospital. At Jefferson, Dr. Waldron collaborated closely with Dr. Garfield Duncan of the Department of Medicine, studying the hypercoagulability of blood and the heightened danger of thrombosis following the ingestion of significant amounts of dietary lipid. Within the Department, Waldron joined Drs. Friedman and Snape in their studies on the secretion and activity of pancreatic and other digestive enzymes.

■ Dr. Samuel S. Conly, Jr.

When Samuel Stinger Conly, Jr., and his classmates entered the first-year class at Jefferson in September, 1941, this country was about to enter World War II. As the international climate degenerated and hostilities broke out, Jefferson adjusted its curriculum to meet the emergency. Physicians were needed in large numbers and quickly. The curriculum was modified to accommodate two classes a year. Conly's class

graduated in September, 1944, rather than June, 1945. At the end of their junior year most of the class entered the Army (AST, Army Student Training Program) as privates. Every morning, before class, drill was held on a field at Lombard Street between 10th and 11th Streets. After an abbreviated internship (twelve-month program shortened to nine months), they became first lieutenants. Conly interned at Bryn Mawr Hospital and then went into the Army for two years. Upon returning he informed Dr. Thomas of his interest in biology, whereupon he was offered the position of Assistant Demonstrator. Conly joined Dr. Crider in studying the secretion of bicarbonate by the pancreas in dogs with experimentally induced acidosis. For three years (1947–1950), Conly split his efforts between a developing private practice and his departmental responsibilities. This dual arrangement proved to be excessive, causing Conly to relinquish his position within the department in order to devote full time to his practice (1950–1953). In 1953 he reassumed his affiliation with the Department as Assistant Professor. Shortly thereafter, Dean George Bennett offered Conly a joint appointment in the office of the dean, and in 1956 Conly became Assistant to the Dean, reestablishing a relationship that had been held by Dr. Joseph O. Crider until 1952.

■ Graduate Education Formalized Again

Jefferson's postwar development was coincident with an increasing role for research. Thomas was part of the faculty nucleus of active researchers. At the time, there were concerns about how research was to be fostered as well as about the actual training of potential researchers. These concerns came to a head during Thomas' tenure as Chairman of the College Faculty. At a January 31, 1949, meeting of the faculty, chaired by Thomas, a recommendation was approved in support of Jefferson offering graduate training leading to the degrees of Master of Science and Doctor of

Philosophy for qualified students in the basic medical sciences. Authority for such programs was vested in the full university charter under which Jefferson Medical College had functioned since its independent charter of 1838. This proposal was unanimously endorsed by the Board of Trustees at its meeting of February 15, 1949, providing "that the work done in these subjects shall not constitute credits for the degree of Doctor of Medicine. . . ." Thomas appointed a faculty committee, the chairs of the basic science departments, to draw up the plans for reinstitution of graduate education after a 20-year hiatus. This committee evolved into the Board of Regulation of Graduate Studies.

Throughout the decade of the 1940s Thomas had significantly enhanced the Department of Physiology by the selection of a number of truly outstanding Fellows: Paschkis, Wirts, Berk, and Pincus. In 1951 Thomas continued this tradition with the appointment of Frank Pickering Brooks as Fellow in Physiology. A 1943 graduate of the University of Pennsylvania School of Medicine, Frank Brooks took a rotating medical internship and then a two-year residency in radiology at the Hospital of the University of Pennsylvania. Following two years of active duty in the Navy (1946–1948), Dr. Brooks spent two additional years in postgraduate training as a Fellow in Gastroenterology at the Lahey Clinic, supplemented by another year of medical training at the Hospital of the University of Pennsylvania. Earl Thomas played a key role in Brooks' professional development. The year spent with Thomas (1951–1952) was pivotal in directing Brooks into a career that combined clinical medicine with investigative medicine and physiology.

At Jefferson, Brooks studied the effect of gastric juice and alcohol on pancreatic exocrine function. Returning to the University of Pennsylvania in 1952, Brooks held joint appointments in medicine and physiology, attaining the rank of professor in each in 1970. From 1962 to 1972 Brooks served as Chief of Gastroenterology at the Hospital of the University of Pennsylvania. His active research program continued the work of Thomas' laboratory: neurohumoral control of gastric secretion and the regulation of pancreatic exocrine function. The editor of several textbooks on gastrointestinal physiology and pathophysiology, he maintained an active role in national and international aspects of clinical gastroenterology and gastrointestinal physiology. Brooks served as

Chairman of the Gastrointestinal Section of the American Physiology Society, Chairman of the Gastroenterology Research Group, National Commission on Digestive Diseases, and President of the American Gastroenterological Association.

The period of the early 1950s was one of political turmoil in the United States. In reaction to the international spread of communism, a virulent movement developed, with its purpose the ferreting out of “un-American” elements from our society. Senator Joseph McCarthy became a symbol of this movement. Mere accusation, or the holding of unpopular ideas, could cost individuals their positions. It was a difficult time for civil liberties. Jefferson did not escape this turmoil, nor did the Department of Physiology.

Refusing to sign a loyalty oath in 1953, Dr. Irving H. Wagman, Associate Professor, was one of Jefferson’s faculty members whose loyalty was questioned. The Medical College on reviewing Wagman’s case dismissed him from the faculty. Dr. Thomas strenuously defended Wagman and was bitterly disappointed by his dismissal. After leaving Jefferson, Wagman moved to the Mount Sinai Hospital in New York City in 1954, where he pursued investigative studies on the control of eye movements. Wagman was recognized for this work by election to the Harvey Society of New York, the Association for Research in Nervous and Mental Diseases, the American Academy of Neurology, and the American Neurological Association. He was especially proud of his membership in the latter two organizations because he was one of the few basic scientists to be so recognized by these clinical societies.

Returning to California in 1961 to join the research faculty at the University of California in San Francisco, Wagman studied cutaneous sensation and sensorimotor integration. A desire to once again become involved in undergraduate teaching led Wagman in 1965 to relocate to the University of California, Davis, where until his death in 1977, he was instrumental in developing a high-caliber curriculum that included sophisticated laboratory courses and self-paced learning programs to supplement the lecture courses. In addition, he continued his research on somesthesia and somatic reflexes.

To replace Wagman, Thomas was able in 1954 to obtain the services of neurophysiologist Eugene Aserinsky as Instructor. Awarded the Ph.D. degree from the University of Chicago in 1953, Aserinsky, while still a graduate student, had been the discoverer of rapid eye movement (REM). In

addition to the physiology of sleep and the role of REM therein, Aserinsky’s investigative studies ranged from the activity of the spinal cord, retinal potentials in man, and the pathophysiological effects of electric shock to the nature of rhythmic biological phenomena in man.

M.H.F. Friedman, Ph.D., Sixth Chairman (1955–1974)

Not long after the Wagman incident Thomas’ health deteriorated. Suffering from ulcer disease, he was advised to take a prolonged rest, whereupon he departed for a lake in Northern Ontario for a period of approximately six months. With improved health, Thomas returned to Jefferson for a final year, after which he accepted the less taxing position of Chairman of the Department of Physiology at the College of Medical Evangelists, Loma Linda, California, in 1955. Dr. M.H.F. Friedman (Figure 5-9), was designated Acting Chairman until 1957, when he formally succeeded J. Earl Thomas to the Chair. Dr. Thomas died in California on February 2, 1972, at the age of 81. His portrait, presented by the Class of 1948, hangs in Jefferson Alumni Hall.

On assuming the Chair, Friedman abolished both Saturday classes, divided student laboratories into smaller units, and added to the faculty Drs. Louis A. Kazal, as Assistant Professor, and Domenic A. DeBias as Instructor. Kazal, a 1940 graduate of Rutgers University (Ph.D., Biochemistry), was a research biochemist with the Merck, Sharp & Dohme Pharmaceutical Corporation (Director, Biological Development; Manager, Technical Information; and Technical Assistant to the Medical Director) before accepting a joint appointment in physiology and medicine (Cardeza Foundation for Hematological Research) at Jefferson in 1957. His research involved the chemistry and biophysics of blood coagulation and erythropoiesis. Kazal served Jefferson for the remainder of his professional

career. In the Department of Physiology he presented lectures on the physiology of coagulation, developed laboratory exercises in coagulation, and engaged in and supervised graduate student research in coagulation and erythropoiesis. At the Cardeza Foundation, Kazal headed the Plasma Fractionation Unit from the time of his arrival, and served as Associate Director of the Cardeza Foundation from 1960 until his retirement in 1978.

Domenic DeBias received his Ph.D. degree in Physiology from Jefferson in 1956. He was the first graduate student of the Department to assume a staff position at Jefferson; his thesis research had been under the supervision of Karl Paschkis. DeBias' investigative studies involved adrenal and

thyroid function stress. Later work involved hormonal factors associated with endurance to high altitude and the evaluation of sequelae to myocardial infarction with exposure to environmental pollutants (e.g., carbon monoxide).

In the early 1970s Jefferson's curriculum embraced a concept the roots of which dated back to its earliest days: integrated teaching. After establishing a course, cell and tissue biology, that integrated biochemistry with elements of histology and genetics, anatomy and physiology were brought into an integrated course, structure and function. Dr. DeBias was selected as coordinator of this ambitious undertaking and served in this capacity until 1975, when he was named Chairman of the Department of Physiology at the Philadelphia College of Osteopathic Medicine.

■ The Basic Sciences Mature

Friedman responded to the increasing importance of cellular physiology and biophysics by the appointment in 1958 of Dr. June N. Barker as Instructor and in 1960 by Dr. Daniel L. Gilbert as Assistant Professor. Trained at the University of Rochester (B.S., 1952) and at Duke University (M.A., 1954, Ph.D., Physiology, 1956), Barker came to Jefferson after serving a year as Instructor in Physiology at Duke University. She was the first woman to receive a faculty appointment in physiology at Jefferson. A conservative institution, slow to change, Jefferson at the time of Barker's appointment was still three years away from admitting its first woman medical student (1961). A specialist in water and electrolyte metabolism, Barker conducted research in fetal physiology (intrauterine fluid balance, cerebral and pulmonary circulation, and metabolism). She pioneered in the development of ultramicrotechniques in fluid and tissue analysis. In 1964 Barker left Jefferson for a research career in physiology and rehabilitation medicine at the School of Medicine of New York University.

A graduate of Drew University (A.B., 1948), University of Iowa (M.S., 1950) and the University of Rochester (Ph.D. in Physiology, 1955), Daniel Gilbert held faculty appointments in physiology at the School of Medicine and Dentistry of the University of Rochester (1955–1956) and at Albany Medical College (1956–1960) before coming to Jefferson. His work in biophysics involved membrane permeability, ion distribution and equilibria, radiobiology/radiation toxicity, and the



FIG. 5-9. M.H.F. Friedman, Ph.D., Sixth Chairman (1955–1974).

biophysics of evolution. Gilbert left Jefferson in 1963 to head the Section on Cellular Biophysics of the National Institute of Neurological Diseases and Stroke.

Friedman further strengthened the traditionally strong gastrointestinal base of the Department with the appointment in 1961 of Dr. Donald B. Doemling as Instructor. A graduate of St. Benedict's College (B.S., 1952) and the University of Illinois (M.S., 1954, and Ph.D. in Physiology, 1958), Doemling held academic appointments in physiology at the University of Illinois (1952–1957) and physiology and pharmacology at the Dental School of Northwestern University (1957–1960) before coming to Philadelphia. A dedicated teacher and skillful experimental surgeon, he took charge of and reorganized the student laboratories, in addition to his teaching responsibilities in intestinal absorption and renal physiology. His interests in intestinal absorption, inflammation, and lymph formation and flow led to the development of a surgical technique for chronic implantation of a thoracic duct cannula, allowing uninterrupted lymph collections over periods of months. Doemling returned to Chicago in 1968 to assume the Chair in Physiology and Pharmacology at the Loyola University School of Dentistry.

In recognition of the need for better understanding of smooth muscle function, Dr. Marion J. Siegman was appointed Instructor in 1967. A graduate of Tulane University (B.A., 1954) and the State University of New York (Ph.D. in Pharmacology, 1966), Dr. Siegman brought valuable laboratory experience in the study of the mechanical properties of smooth muscle. Her research interests included the energetics of contraction, excitation-contraction coupling, and cation transport and metabolism. A strong proponent of meaningful interaction among researchers, Siegman was one of the founding members of the Philadelphia Muscle Institute, an interdisciplinary areawide federally funded research center for the study of muscle, headquartered at the University of Pennsylvania. A member of the National Science Foundation Review Committee on Cell Biology and of the National Institutes of Health Physiology Study Section, in 1977 she became the first woman to be named Professor of Physiology at Jefferson.

Until 1964 Domenic DeBias had taught both the respiratory and endocrine sections of the physiology course. In that year Friedman brought in Dr. Sheldon F. Gottlieb as Assistant Professor. The era of organ system specialization was at hand. Following graduation from Brooklyn

College and the University of Texas (Ph.D. in Physiology, 1959), Gottlieb joined the research laboratories of the Linde Division of Union Carbide Corporation as a research physiologist (1959–1964), investigating physiological and biochemical effects of hyperbaric gaseous environments on living systems. At Jefferson, in addition to his responsibilities in respiratory physiology, Gottlieb pursued his research interests both within the Department and through a joint appointment in the Department of Anesthesiology. In 1968 he left Jefferson to serve as Professor in the Department of Biological Sciences, Purdue University, until being named Dean of the Graduate School and Director of Research at the University of South Alabama in 1981.

Friedman continued to build up his Department through the 1960s. Departmental responsibilities were expanding, as was the degree of specialization of the staff. After bringing in Barker from Duke, Gilbert from Rochester, Doemling from Chicago, Siegman from New York, and Gottlieb from industry, Friedman added a number of Jefferson's own trainees to the faculty. Dr. Leonard M. Rosenfeld (A.B., University of Pennsylvania, 1959; Ph.D. in Physiology, Jefferson, 1964) (see Figure 5-10) was appointed Instructor in 1964. He assumed June Barker's teaching responsibilities in water and electrolyte metabolism as well as part (all, after 1974) of the gastrointestinal block. In 1975 Rosenfeld was named to replace Domenic DeBias as physiology teaching coordinator, both within the Department and within the integrated anatomy-physiology structure-and-function framework. His research included intestinal metabolism, cell population dynamics, electrolyte metabolism, and splanchnic blood flow/ischemia as well as studies on nutrition, air pollution, and myocardial infarction (diagnostic enzymology).

Dr. Eugene J. Zawoiski (Ph.D. in Physiology, Jefferson, 1963) was appointed Instructor in 1965. From 1951 to 1965, Dr. Zawoiski engaged in pathological, toxicological, physiological, pharmacological, and teratological research at Merck, Sharp & Dohme, and subsequently at the Merck Institute for Therapeutic Research. At

Jefferson, Zawoiski taught renal physiology and had extensive involvement in the teaching of physiology to student nurses in the diploma program, serving as course coordinator (1975–1980). He pursued his teratological research as well as studies on central nervous system involvement in gastrointestinal function.

In 1968, Dr. Chandra M. Banerjee was named Assistant Professor to replace Sheldon Gottlieb. Born in Calcutta, India, Banerjee received his medical education at the University of Calcutta and his physiology training at the Medical College of Virginia (Ph.D. in Physiology, 1967). After several clinical assignments in India (1955–1958) and in New York (1959–1960), Banerjee served as staff scientist in respiratory physiology at Hazelton Laboratories in Virginia (1967–1968). At Jefferson, he followed Gottlieb in holding joint appointments in physiology and anesthesiology. His research interests centered on the pulmonary effect of air pollutants, pulmonary edema, and the respiratory consequences of myocardial infarction. In 1974, Banerjee left Jefferson to take up the position of Professor of Physiology at the Southern Illinois University School of Medicine.

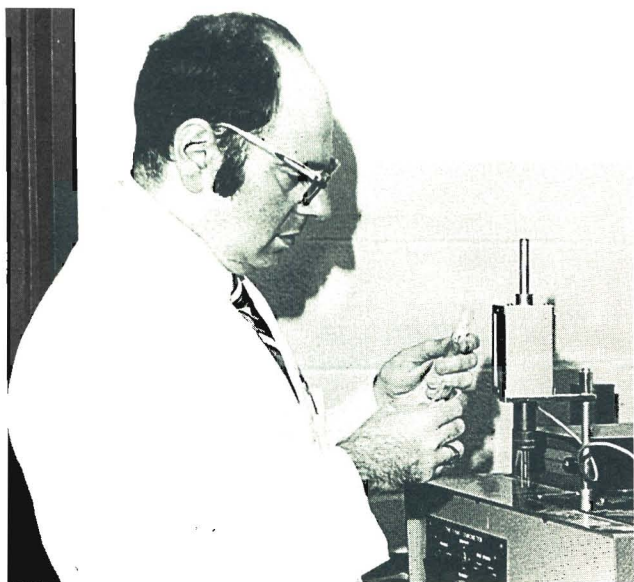


FIG. 5-10. Leonard M. Rosenfeld, Ph.D., Assistant Professor of Physiology, with main interest in the gastrointestinal system.

To fill the void created by Doemling's departure, Banerjee recommended a former colleague from Virginia to Friedman. Dr. Robert E. Thurber (University of Kansas, Ph.D. in Physiology, 1965) had served as a research associate in radiation biology at the Brookhaven National Laboratories (1956–1961) and at the Medical College of Virginia (1961–1969) before assuming an Associate Professorship at Jefferson (1969–1970). His research interests included the transfer and distribution of electrolytes, renal transport, and radiation biology. At the end of the year, Thurber was named to the Chair of Physiology at the newly established School of Medicine of East Carolina University, in Greenville, North Carolina.

Jefferson had always been one of the largest medical schools in the nation. As the class size rose from 160 to 223, concerns were raised as to how to maximize student–faculty personal contact. A system of literature clubs was inaugurated. Each faculty member was assigned 25 students. Reading assignments were established on a weekly basis. Assignment refinement led to a one-on-one interaction between staff and student, plus the obvious benefit of introducing the student to the medical and basic science literature.

Graduate education matured. Whereas from initiation of graduate training at Jefferson in 1949 until 1959 the Department of Physiology had 10 graduates (6 Ph.D., 4 M.S.), during the period of 1960–1970, 47 students received graduate degrees in physiology (24 Ph.D., 23 M.S.). As one graduate remembered the period, “Perhaps the most valuable memory I have of the time spent at Jefferson . . . [is] the spirit of collegiality among faculty and graduate students . . . I always felt a part of the department and took away with me a real sense of pride in my accomplishments.”

Dr. M.H. Friedman retired from Jefferson on June 30, 1974. He was named Emeritus Professor and then joined Domenic DeBias' Department at the Philadelphia College of Osteopathic Medicine. His portrait was presented to the College by the Class of 1974.

Allen M. Lefer, Ph.D., Seventh Chairman (1974–)

On July 1, 1974, Dr. Allan M. Lefer (Figure 5-11) became the seventh Chairman of the Department, the tenth individual to be responsible for physiology since the start of the school in 1824.

There was repeated history in this appointment. Robley Dunglison was the first occupant of the Chair (1836); he had come from the University of Virginia, the institution established by Thomas Jefferson (with an intervening Professorship at the University of Maryland, 1833–1836). Now, 138 years later, Allan Lefer, of the same University of Virginia, was following in Dunglison's footsteps as he also came to Philadelphia to occupy the Chair in Physiology.

A native New Yorker, Lefer was educated at Adelphi University (B.A., 1957), Western Reserve University (M.A., 1959), and the University of Illinois (Ph.D. in Physiology, 1962). Following an initial appointment as Instructor in Physiology at Western Reserve University (1962–1964), Lefer relocated to the University of Virginia School of Medicine at Charlottesville, rising through the academic ranks from Assistant Professor to Professor (1964–1972). He spent the year 1971–1972 as a Visiting Professor and United States Public Health Service Senior Fellow at the Hadassah Medical School, Hebrew University, Jerusalem, Israel. Allan Lefer's assumption of the Chair ended almost one-half century of special departmental emphasis on gastrointestinal function (1927–1974, through the Chairmanships of J. Earl Thomas and



FIG. 5-11. Allen M. Lefer, Ph.D., Seventh Chairman (1974–).

M.H.F. Friedman). The new departmental emphasis was to be decidedly cardiovascular. Lefer's varied cardiovascular interests, experience, and involvement included the humoral regulation of myocardial contractility, experimental myocardial infarction, and the pathogenesis of circulatory shock. His goals for the department were to "continue to promote growth and development of the quality aspects of the department" while moving aggressively to enhance capabilities and productivity in departmental research. Coincident with his appointment, Lefer recruited a previous trainee, Dr. Michael J. Rovetto, and a fellow-Virginian, Dr. James A. Spath, Jr. as Assistant Professors.

Dr. Michael Rovetto received his Ph.D. in Physiology under Lefer at the University of Virginia (1970). On leaving Virginia, Rovetto served as Research Associate in Physiology at Hershey Medical Center, Pennsylvania State University (1971–1974). At Jefferson he continued his studies on myocardial metabolism and the regulation of cardiovascular function. Advanced to Associate Professorship in 1977, Rovetto resigned to accept a similar position at the University of Missouri School of Medicine (1980).

Dr. James A. Spath, Jr., trained at the University of Oklahoma Medical Center (Ph.D. in Physiology, 1966). From 1966 to 1974 he served as Assistant Professor of Physiology, Virginia Commonwealth University, Medical College of Virginia, Richmond. His research involved cardiac enzyme activity in pericardial tamponade, pharmacological limitation of ischemic heart injury, circulatory regulation in shock, and postmyocardial ischemia development of pulmonary edema.

From the start Lefer established international relationships that resulted in a continuing series of visits to the Department, for periods ranging from days up to two years, of both junior and mature scientists. The first such visitor was Dr. Minoru Okuda, an academic clinician from Japan, who served as Visiting Associate Professor and Research Associate (1974–1976), investigating glucocorticoids and the ischemic myocardium. The

visit was considered extraordinarily productive, and Dr. Okuda returned to the Defense Medical College (Saitama Prefecture, Japan) better equipped to integrate basic science and clinical medicine. Other Japanese fellows that followed were Dr. Haruo Araki from Kumamoto University and Dr. Shuichi Okamatsu from Kyushu University. In addition, the research capabilities of the department were enhanced by the presence of at least one postdoctoral fellow annually. Support for such positions was made possible through enhanced extramural funding. The number of departmental research technicians similarly increased. The Department had long supported a departmental machine shop. It was this facility that had aided Thomas in the design and construction of his innovative devices. Lefer now added two additional departmental support facilities, an electronic laboratory (for design and maintenance) and a photographic laboratory for assistance in presentations and publications.

Active recruitment activities throughout 1974–1975 resulted in the appointment of Drs. Marlys H. Gee and Anatole Besarab as Assistant Professors. Marlys Gee received her graduate training at the University of Colorado School of Medicine (Ph.D. in Physiology, 1972). A three-year research fellowship (1972–1975) at the Cardiovascular Research Institute of the School of Medicine, University of California, San Francisco, preceded her 1975 arrival in Philadelphia to assume Chandra Banerjee's responsibilities in respiratory physiology. Her research interests were in the pathophysiology of pulmonary edema, pulmonary epithelial and interstitial protein transport, and postmyocardial ischemia development of lung vascular injury. This latter project involved significant collaboration with James Spath. In 1980 Dr. Gee was awarded a National Institutes of Health Career Development Research Award.

Dr. Anatole Besarab came to Philadelphia following a fellowship at Boston's Beth Israel Hospital and an Instructorship in Medicine at Harvard Medical School (1973–1975). At Jefferson, Besarab was given joint appointments in physiology and in medicine, with medicine as the

primary appointment. In the department he lectured on renal physiology and acid-base balance. His research interests involved ionic modulation of parathyroid hormone action on the kidney utilizing the isolated perfused kidney.

During 1976–1977 a fourth major departmental support facility was developed, an electron microscopy suite. A departmental surgical area was converted to house a Zeiss EM-95 electron microscope, a preparation laboratory, and a photographic darkroom, along with a departmental technician to operate the facility.

Continued recruitment activity resulted in the 1976 appointment of Drs. Thomas M. Butler, John T. Flynn, and Joseph R. Sherwin as Assistant Professors. Thomas Butler received his graduate training at the University of Pennsylvania (Ph.D. in Molecular Biology, 1974) followed by a postdoctoral fellowship in the laboratory of Professor Robert E. Davis, Pennsylvania Muscle Institute at the University of Pennsylvania (1974–1976). Here Butler engaged in investigative studies of the energetics and regulation of muscle contraction. A number of these studies were collaborative among Butler, Davies, and Siegman. This cooperation continued and deepened with Butler's relocation to Jefferson. Dr. Butler received a National Institutes of Health Career Development Award in 1981.

Dr. John T. Flynn, a graduate of the Hahnemann Medical College and Hospital (Ph.D. in Physiology, 1974), came to Jefferson as Research Associate for additional postdoctoral training in cardiovascular physiology in Lefer's laboratory (1974–1976). Flynn became deeply involved in the chemistry and physiology of prostaglandins, their synthesis, and analytical methodology. He studied the development of circulatory shock and of toxemias. Several studies involved the isolated perfused liver, while others were collaborative with Lefer, Spath, or Gee.

Dr. Joseph R. Sherwin received his graduate training at the University of Pittsburgh (Ph.D. in Physiology, 1973). He remained at Pittsburgh on Research Associateship (1973–1976) until his arrival at Jefferson in 1976 to assume teaching and research in endocrine physiology. His research activities focused on the regulation of thyroid gland function, especially iodide transport and glandular blood flow. In 1980, Sherwin was named coordinator of the first-year course in medical physiology.

As Aserinsky's departure in May 1976 had left the department without a trained

neurophysiologist, further recruitment resulted in the 1977 appointment of Dr. Paul S. Blum as Assistant Professor. Blum received his Ph.D. in Physiology from the University of Vermont (1973). The year 1973–1974 was spent at Duke University as a National Institute of Mental Health postdoctoral trainee in sciences related to the nervous system. Subsequently Blum served as Research Associate in Neurology at the College of Physicians and Surgeons, Columbia University (1974–1977). At Jefferson he continued his investigations pertaining to the physiological regulation of the central nervous system, with special emphasis on the function of the raphe nucleus and of the role of reticulospinal pathways in the regulation of blood pressure and the processing of sensory information.

■ Interdepartmental Programs

A growing research interest developed in metabolic, hemodynamic, and pathophysiological aspects of myocardial ischemias and circulatory shock. The main focus of these activities interrelated with the Departments of Pharmacology, Medicine, and Surgery. Out of this interaction was established in the fall of 1977 the Ischemia-Shock Research Center, with Allan Lefer as Director and Michael Rovetto, Marlys Gee, and Marion Siegman as the Center's Advisory Council. Monthly meetings were held to enhance scientific dialogue among the members. In addition, prominent scholars in the field were invited to give guest lectures. On April 23, 1980, the Center sponsored a minisymposium on shock. Funding for the Center was derived from donations of private industry and grants from the W. W. Smith Foundation and the Ralph and Marion Falk Foundation.

The departmental commitment to quality graduate education remained strong. The number of departmental trainees, however, dropped from its peak in the 1960s. This reflected the fact that each student received financial support and, thus, the number of incoming students was limited by the fiscal resources of the department, supplemented by institutional funds.

In 1979, the Jefferson Chapter of Sigma Xi, the scientific research society, established a separate graduate student competition as part of its annual Student Research Day. A Physiology graduate student was awarded first prize for the most

outstanding poster presentation for four consecutive years (1979–1982). Edward F. Smith III, a 1981 graduate, received the first achievement award for excellence by the Alumni Association of the College of Graduate Studies. He was awarded a prestigious Alexander von Humboldt Foundation Postdoctoral Fellowship for additional study in Cologne, Germany. Further, Dr. Smith's thesis concerning pathophysiological actions of thromboxane A₂ in coronary artery disease (his thesis advisor was A.M. Lefer) was accepted into the Council of Graduate Schools' competition for their 1981 Dissertation Award. It remained in competition until the finals and was judged one of the top 12 theses of 1981.

To partially replace the loss of cardiovascular expertise experienced by Michael Rovetto's relocation to Missouri, Dr. Stuart K. Williams II was appointed Assistant Professor in 1981. Educated at the University of Delaware (Ph.D. in Cell Biology, 1979), Williams served as a postdoctoral fellow in the Department of Pathology of the Yale University School of Medicine (1979–1981). His research interests were in microcirculation and the role of micropinocytosis in capillary endothelium.

The record of 160 years of Physiology at Jefferson (1824–1984) has been impressive. It has seen the Department evolve from a basic one-man operation into a sophisticated modern system, the establishment of professional physiology, the introduction of practical application into medical education (museum, demonstrations, student laboratory, student research), meaningful clinical interaction in training and investigation, and the advancement of knowledge in varied fields of study. The challenge is to extend this record and to advance the frontiers of education and of investigation even further.

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